# Older People's Needs in Urban Disaster Response: A Systematic Literature Review

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# Older People's Needs in Urban Disaster Response: A Systematic Literature Review

**Abstract**

Against the backdrop of rapid population ageing and widespread urbanisation, this review explores older people's needs in urban disaster response. We conducted a systematic review of 120 publications across several related fields – disaster management, gerontology, and urban governance. We identified five needs of older people in disaster response: health, socioeconomic, evacuation and settlement, information and communication, and cultural needs. We find that older adults' needs were insufficiently met for four main reasons. First, a lack of understanding of the relationships between different needs poses challenges to coordinating disaster response, particularly when relief aid targets different needs in an uncoordinated fashion. Second, standard disaster response often provides unsuitable aid to older people, leaving them feeling uncomfortable, unequal, and undignified. Third, there is a discrepancy between policy expectations and actual disaster response, resulting in inadequate incorporation of older people's needs into disaster response at local, national, and international levels. Fourth, there is a relative lack of advocacy that directly gives voice to older people rather than indirectly reflecting their needs through carers and disaster responders. To address research and knowledge gaps, we propose five directions for future research: (1) a need for conceptually informed, contextually salient, and transparent working definitions of older people, (2) a need for nuanced intersectional understandings of older people's needs, (3) a holistic understanding of the disaster ecology of older people's different needs, (4) a focus on secondary disasters arising from primary disasters, and (5) a need for more theoretically informed and empirically rigorous research.

**Keywords:** Disaster response, need, older people, systematic review, urban

**Article type:** Systematic Literature Review

## 1. Introduction

Our world is becoming increasingly urbanised, with more than 66% of the world's population expected to live in cities by 2030 (United Nations Development Programme, 2020). Urbanisation and rapid population growth often lead to more people living in unsafe areas and dwellings, such as exposed residential locations and unsafe buildings, where death tolls and injuries can be enormous in disasters. For instance, a recent earthquake in Afghanistan killed at least 920 people and injured 600 (as of 22 June 2022), demonstrating the deadly consequences of living in poorly built homes (Sands and Cursino, 2022). Furthermore, the expansion of infrastructure and residential areas in north-eastern India was one of the primary causes of the worst floods in over 120 years in India in June 2022, where at least 130 people reportedly died in the first four days following the disaster (Wallen, 2022).

Although there is no consensus on the definition of "urban" (Ritchie and Roser, 2018), it is clear that urbanisation poses great challenges to disaster response, especially for vulnerable groups such as older adults. While older people are sometimes defined as those aged 65 years or over (Astill and Miller, 2018; Becquart et al., 2019; United Nations Department of Economic and Social Affairs, 2019), inconsistent age cut-off points are often used. Older people are widely recognised as one of the most vulnerable or at-risk populations (Engelman et al., 2022; Whitton, 2018). They are more likely to suffer from higher rates of deaths and injuries linked to natural disasters than other population segments (Engelman et al., 2022; Pekovic et al., 2007; Zhu and Sun, 2018). For example, among the 1,330 residents along the Gulf Coast killed by Hurricane Katrina, more than 70% were aged 60 years or over, of whom almost half were older than 75, and at least 68 lived in nursing homes (McCann, 2011). A study by Zhu and Sun (2018) reported a considerably higher mortality rate among people aged over 75 in the 2008 Wenchuan Earthquake and the 1995 Kobe Earthquake.

Despite their heightened risks, older people have received insufficient dedicated attention in disaster response and recovery efforts (Engelman et al., 2022). Although older adults often require special attention from disaster planners and professionals who operationalise disaster response (Pinkowski, 2008), the special needs of older people have often been overlooked in strategies and responses designed to reduce disaster risks (United Nations Economic Commission for Europe, 2020). Under a one-size-fits-all approach, older adults' physical, psychological, social, and economic susceptibilities are largely overlooked (Pinkowski, 2008). Several recent government and international organisation reports have identified a lack of attention to older people's needs in disaster response in urban areas (e.g., Centers for Disease Control and Prevention, 2012; Gibson and Hayunga, 2006; HelpAge International, 2000). Understanding older people's needs will enable disaster responders and first aid providers to provide them with appropriate services (Cloyd and Dyer, 2010). However, what older people's needs are in disaster response and how they can be met remain under-researched.

When discussing older adults' needs in disasters, existing literature tends to focus on pre-disaster preparedness and long-term disaster recovery. There is a relative lack of attention to the response phase during disasters, which is arguably the most critical phase of disaster management. Researchers and practitioners have grown increasingly aware of older adults' special needs. However, some age-related misconceptions, such as stereotypes that older

people are not responsive, not easy to empower, and tend to be socially and economically inactive (Bodstein, 2014), often exclude older people from disaster planning and policymaking. Consequently, older adults are often overlooked in disaster planning and response (Bodstein, 2014). There is an exigent imperative to investigate older people's needs in the disaster response phase and how such needs can be met.

Against the above backdrop, this article presents a systematic and critical literature review covering three interrelated areas of research on older people in the context of urban disasters: gerontology, disaster management, and urban governance. These areas cover key dimensions for exploring older people's needs in disaster response, particularly in the context of new challenges posed to disaster management by rapid urbanisation, as an increasing number of older adults reside in urban areas (He et al., 2016; Liang et al., 2017). Our review aims to answer the following questions:

1. What are older people's needs in urban areas in a natural disaster?
2. How are the needs of older people met or left unmet, and why?
3. What is needed in research and practice to better meet older people's needs in urban disaster response?

The remainder of this review is organised as follows. Section 2 explains our literature search methods and process. Section 3 begins by discussing disaster risks and their three core components – hazard, vulnerability and exposure – as defined by the United Nations Office for Disaster Risk Reduction (2022a) and particularly how these key components relate to older adults. Sections 4 and 5 synthesise and critique existing literature in response to our questions. Finally, we discuss the limitations of existing literature and identify key future research directions in Section 6. In doing so, this article contributes to an emerging but highly limited scholarship by identifying and addressing the needs of older people residing in urban areas during the response phase of natural disasters. Furthermore, it helps inform future research on disaster and risk reduction against the global backdrop of rapid population ageing and urbanisation.

## 2. Literature search, selection and review procedures

Due to the interdisciplinary nature of our review, the Web of Science portal, the most common database of publications in English, was chosen as the primary database for our literature search. An additional search was performed on Google Scholar. To ensure the comprehensive coverage of our review, we developed a list of distinct derivations and combinations of keywords as our search terms, as detailed in Table 1. Our keyword combinations both included and excluded the term "urban(isation)", to ensure that we did not miss relevant articles that may not have explicitly mentioned "urban(isation)". As we found very few articles when including "urban" in our keywords, we expanded our search to include research on older adults in disasters generally, and filtered out articles that did not touch upon the urban context through manual reading. For example, a systematic literature review by Bayraktar and Yilmaz (2018) used "older adults", "elderly" and "disasters" as their keywords. While Bayraktar and Yilmaz's (2018) review focused mainly on older people in

disaster events generally, our review focuses on urban-residing older adults in the context of natural disasters.

**Table 1.** Key search terms and the number of resultant publications

| **Key search terms** | **Number of publications returned** |
|---|---|
| "senior citizen*" + "natural disaster*" | 3 |
| "senior*" + "natural disaster*" | 47 |
| "elder*" + "natural disaster*" | 176 |
| "old people" + "natural disaster*" | 2 |
| "old adult*" + "natural disaster*" | 3 |
| "old population*" + "natural disaster*" | – |
| "old person*" + "natural disaster*" | 1 |
| "older people" + "natural disaster*" | 44 |
| "older adult*" + "natural disaster*" | 171 |
| "older population*" + "natural disaster*" | 14 |
| "older person*" + "natural disaster*" | 20 |
| "senior citizen*" + "urban disaster*" | – |
| "senior*" + "urban disaster*" | 1 |
| "elder*" + "urban disaster*" | 3 |
| "old people" + "urban disaster*" | – |
| "old adult*" + "urban disaster*" | – |
| "old population*" + "urban disaster*" | – |
| "old person*" + "urban disaster*" | – |
| "older people" + "urban disaster*" | – |
| "older adult*" + "urban disaster*" | 1 |
| "older population*" + "urban disaster*" | – |
| "older person*" + "urban disaster*" | – |
| "senior citizen*" + "urban*" + "natural disaster*" | – |
| "senior*" + "urban*" + "natural disaster*" | 3 |
| "elder*" + "urban*" + "natural disaster*" | 10 |
| "old people" + "urban*" + "natural disaster*" | – |
| "old adult*" + "urban*" + "natural disaster*" | – |
| "old population*" + "urban*" + "natural disaster*" | – |
| "old person*" + "urban*" + "natural disaster*" | – |
| "older people" + "urban*" + "natural disaster*" | – |
| "older adult*" + "urban*" + "natural disaster*" | 4 |
| "older population*" + "urban*" + "natural disaster*" | – |
| "older person*" + "urban*" + "natural disaster*" | – |
| **Total** | **503** |

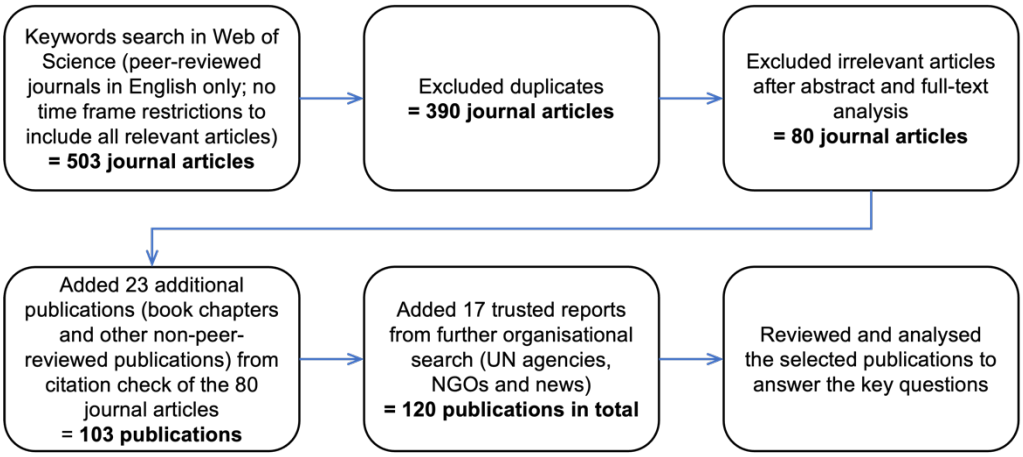


**Figure 1.** Literature search, selection and review procedures

Figure 1 describes our literature search and selection procedure. We initially identified 503 articles. Each article identified during the initial search was evaluated for its relevance. To ensure that we did not miss any relevant articles, we also checked the reference lists of every single article. Our search also covered relevant white papers and organisational reports. We read each article carefully and manually selected the relevant articles according to our inclusion criteria. To ensure that we did not miss any publications that implicitly focus on an urban context, publications that discussed older adults in natural disasters were included in our initial pool, even if the term "urban" is not apparent in the articles.

Departing from the initial pool, we read each article carefully and selected relevant articles based on our inclusion criteria detailed in Table 2. Publications were excluded if they only studied older people or disasters but not older people in disasters. Given our focus on natural disasters, publications that focus solely on man-made accidents (e.g., nuclear leakage) or long-term disaster recovery were excluded. Given our focus on disaster emergency response, we excluded long-term, slowly developed disasters such as droughts. Moreover, we excluded publications that only mentioned older adults in disaster management in passing, as they do not contribute to addressing our substantive questions. After excluding publications unrelated to older people in natural disasters, we obtained 120 publications, including journal articles, book chapters and white papers, published between 1979 and 2022 (see the Appendix for a detailed list).

**Table 2.** Publication inclusion and exclusion criteria

| **Selection criteria** | **Included** | **Excluded** |
|---|---|---|
| Older people only (unrelated to natural disasters) | | √ |
| Older people in rural areas only | | √ |
| Disasters only (unrelated to older people) | | √ |
| Long-term effects of disasters (unrelated to the disaster response phase) | | √ |
| Older people as the focus but include other age groups or vulnerable groups | √ | |
| Mixed age groups or vulnerable groups without a focus on older people | | √ |
| Natural disasters and man-made accidents | √ | |
| Man-made emergencies or accidents only | | √ |
| Short-lived but violent natural disasters, e.g., hurricanes | √ | |
| Slowly developed but long-lived natural disasters, e.g., droughts | | √ |

### 2.1 An overview of the reviewed publications

Among the journal articles included in this review, the most studied country is the United States (US) ($n$ = 24), followed by Australia ($n$ = 9) and China ($n$ = 6). A large number of articles ($n$ = 9) were published in the *International Journal of Disaster Risk Reduction*. Other journals contributing four or more articles include *Disaster Medicine and Public Health Preparedness* ($n$ = 4) and *International Journal of Environmental Research and Public Health* ($n$ = 4), as shown in Table 3.

**Table 3.** Distribution of journals contributing to two or more articles

| Journal | Number of articles |
|---|---|
| *International Journal of Disaster Risk Reduction* | 9 |
| *Disaster Medicine and Public Health Preparedness* | 4 |
| *International Journal of Environmental Research and Public Health* | 4 |
| *BMC Public Health* | 3 |
| *Natural Hazards* | 2 |
| *Ageing & Society* | 2 |
| *Disasters* | 2 |
| *Health Care for Women International* | 2 |
| *Prehospital and Disaster Medicine* | 2 |
| *Public Health Nursing* | 2 |
| *Southern Medical Journal* | 2 |

As shown in Table 4, five of the reviewed journal articles are literature reviews concerning the health needs of older people (Ahmadi et al., 2018b; Massey et al., 2017), the impact of disasters on older people (Benevolenza and DeRigne, 2019), and the heightened vulnerability of older adults in disasters (Bayraktar and Yilmaz, 2018). Massey et al. (2017) focused on older people in low- and middle-income countries but covered both natural disasters and armed conflicts. Gutman and Yon's (2014) article reviewed publications focusing on the abuse and neglect of older people in disasters. While four of the five previous reviews employed a systematic literature review approach, Bayraktar and Yilmaz (2018) performed a narrative literature review. However, urbanisation and urban areas are not featured as a focus in these five literature reviews, which covered a much smaller number of publications than we do in this review.

**Table 4.** Previous literature reviews

| Reference | # of articles reviewed | Focus |
|---|---|---|
| Ahmadi et al. (2018b) | 27 | Health needs of older adults aged 60 and over |
| Benevolenza and DeRigne (2019) | 13 (empirical studies on US populations) | Impact of three hurricanes from 2005 to 2017 in the United States on vulnerable populations (e.g., elderly, disabled, children, prisoners, and substance abusers) |
| Bayraktar and Yilmaz (2018) | 29 | Vulnerability of older populations during disasters |
| Gutman and Yon (2014) | 19 | Elder abuse and neglect in disasters |
| Massey et al. (2017) | 36 (white papers included) | Health needs of older populations in both armed conflicts and natural disasters in low- and middle-income nations |

### 2.2 The use of methods and theories in existing literature

Table 5 showcases the methods used in existing literature to study older people's needs in urban disaster response. Most of the reviewed publications are empirical, with a mixture of qualitative and quantitative research. Most qualitative research employs a case study approach focusing on one or a few disasters. For example, Rey et al. (2017) analysed the effects of the 2015 Cyclone Pam in Vanuatu, whereas Cheery et al. (2010) examined the mental health consequences of Hurricanes Katrina and Rita in Louisiana. These qualitative studies utilised interviews and/or focus group discussions (Kilijanek and Drabek, 1979) as primary data collection methods. Their data analysis mainly relies on an inductive logic (e.g., Engelman et al., 2022), with a few studies utilising abductive reasoning or combining both inductive and deductive approaches (e.g., Bell et al., 2021). Quantitative research mainly draws on panel data analysis and quasi-experimental design using surveys as a primary data collection method (Lam et al., 2017). A main issue remains that the participants in existing empirical research are often heterogeneous in terms of both age (young and old) and involvement (e.g., victims and aid workers), without a specific focus on older people. There is a need to focus directly on older people to more accurately understand their needs in disasters.

Despite some methodological diversity in existing research, it is worth noting that a review conducted by Massey et al. (2017), which included 36 articles, identified significant weaknesses in the quality of empirical studies on the health needs of older people in low- and middle-income countries. The common issue among quantitative research was a lack of sophisticated statistical analysis, as only descriptive analysis was conducted in a considerable proportion of the studies. For qualitative studies, Massey et al. (2017) identified a lack of in-depth engagement between researchers and participants as a common weakness.

**Table 5.** The use of methods in existing literature

| Method | Example |
|---|---|
| Case study | Kwan (2020), Rey et al. (2017), Safitri et al. (2020), Wang (2018) |
| Interview | Daddoust et al. (2018), Engelman et al. (2022) |
| Focus group | Bell et al. (2021), Howard et al. (2017a) |
| Interview and focus group | Ahsan and Tullio-Pow (2015), Jagnoor et al. (2019) |
| Survey | Bonnan-White (2017), Cooper et al. (2022) |
| Systematic literature review | Ahmadi et al. (2018b), Benevolenza and DeRigne (2019), Gutman and Yon (2014), Massey et al. (2017) |
| Review | Bayraktar and Yilmaz (2018), Silverman et al. (1995) |
| Other (e.g., conceptual synthesis, etc.) | Jarzebski et al. (2021), Knodel et al. (2015) |

Although there is a plethora of empirical studies, such studies exhibit a notable lack of theoretical engagement. Of the journal articles retrieved from the Web of Science, only 10 explicitly utilised a theoretical framework, as shown in Table 6. For example, Bonnan-White (2017) used a human security and vulnerability theoretical framework, and Pang et al. (2020) employed the theory of information worlds to investigate older adults' information seeking and sharing during disasters. Furthermore, social capital theory was mentioned in several articles (e.g., Kim et al., 2022; Kim and Zakour, 2017) but not explicitly discussed. Similarly, Cooper et al. (2022) briefly mentioned the risk homeostasis theory in the discussion section

of their article. It is evident that most publications are largely practice-focused, and there is a general lack of in-depth theoretical engagement in this field. Original theoretical development is also scarce, as most studies draw on theories from disciplines such as mobility studies, public health and information systems. There is still a need to employ and develop appropriate theories in studying older people in natural disasters, although Durant (2011) had highlighted this need more than a decade ago.

**Table 6.** The use of theories in existing literature

| Reference | Theories employed |
|---|---|
| Ahsan and Tullio-Pow (2015) | FEA (functional, expressive and aesthetic) consumer needs model |
| Bell et al. (2021) | The social-ecological model of disaster resilience (SEMDR); Schramm's SEMDR communication process model |
| Bonnan-White (2017) | Human security and vulnerability |
| Cherry et al. (2021) | Inoculation and stress sensitisation |
| Cherry et al. (2010) | The inoculation and burden hypotheses |
| Durant (2011) | Social capital theory (only discussed in passing) |
| Kim et al. (2022) | Health-related quality of life (HRQOL) conceptual model |
| Kleier et al. (2018) | Model of hurricane preparation decision process |
| Malak et al. (2020) | Vulnerability theory |
| Pang et al. (2020) | Theory of information worlds |

In summary, through a systematic literature search and selection process, 120 carefully selected publications were included in our review. We report the results from synthesising and analysing the selected literature in the following sections.

## 3. Key concepts in existing literature

### 3.1 Disaster risk and older people

A disaster is an event that disrupts the normal conditions of existence and causes a level of suffering that exceeds the adjustment capacity of the affected community (World Health Organization Department of Emergency and Humanitarian Action, 2002). Disaster risk arises from the interplay between three components: hazard, exposure and vulnerability (disaster risk = hazard × exposure × vulnerability) – i.e., without exposure, there is no risk (United Nations Office for Disaster Risk Reduction, 2022a). In other words, disaster risk only arises when hazard meets vulnerability. For example, the vulnerability of older people living in urban areas is heightened by rapid and poorly planned urbanisation that often overlaps with high-risk exposure areas (United Nations Office for Disaster Risk Reduction, 2022b).

Hazards disrupt people's normal living conditions and daily activities (World Health Organization Department of Emergency and Humanitarian Action, 2002). There are at least two types of hazards: natural and man-made (World Health Organization Department of Emergency and Humanitarian Action, 2002). This review focuses on natural hazards at the intersection of climate (change) and rapid urbanisation. Natural hazards can be short-lived but violent (e.g., hurricanes) or slowly developed but long-lived (e.g., droughts). This review focuses on the former, where emergency responses are most relevant. Furthermore, multiple hazards can occur simultaneously or in rapid sequence (World Meteorological Organization, 2022). With climate change, natural hazards such as hurricanes, tornadoes and flash floods

are occurring globally at an increasing frequency (Thompson et al., 2017). Heatwaves, for example, have become more intense, with more than 13,000 older people deaths in the 2003 heatwave in France (Langer, 2004). Natural hazards become natural disasters only when there is an impact on a population (e.g., lives and property) (Wisner et al., 2004).

Apart from causing deaths, injuries and economic damages, natural disasters can also affect individuals' emotional and psychological wellbeing (Bayraktar and Yilmaz, 2018), particularly among vulnerable populations such as older people. The impact of disasters depends on the degree of exposure and the level of vulnerability of a given population. The level of vulnerability determines the extent of risk (United Nations Office for Disaster Risk Reduction, 2022a). It is thus critical to reduce vulnerability in order to reduce disaster risks (Pekovic et al., 2007). Vulnerability varies across countries, populations and individuals (Hasan et al., 2019). The more vulnerable a country, population or individual, the higher the risk level (Pekovic et al., 2007). In general, it can be argued that low- and middle-income countries are particularly susceptible to disasters (Tyler and Moench, 2012). For example, many countries in Asia are sites of recurring natural hazards (Engelman et al., 2022). Vulnerability can be exacerbated by resource constraints, especially in low- and middle-income countries (Engelman et al., 2022), where residents are overall disadvantaged in terms of education, income and wealth (Pinkowski, 2008). At an individual level, vulnerability is characterised by individuals' intersectional characteristics, such as gender, race, age, socioeconomic status, and pre-existing health conditions.

Despite varying definitions of vulnerable and at-risk populations in disaster operations, older people are consistently categorised as vulnerable and at-risk across most definitions. For example, Hasan et al. (2019) defined vulnerable groups as children, pregnant women, older people, and people with disabilities and health issues. Thompson et al. (2017) identified five vulnerable groups comprising older adults, the linguistically diverse, families with young children, physically frail people, and people with disabilities and mental health issues. Howard et al. (2018) defined five similar vulnerable populations – older people, people with disabilities, families with children under five, low-income households, and culturally and linguistically diverse people.

In 2019, there were 1 billion older people aged 65 or over worldwide, which is projected to double by 2050 (World Health Organization, 2022). By 2030, more than 66% of the world's population are projected to live in cities (United Nations Development Programme, 2020). Moreover, more than 80% of the world's older people will reside in low- and middle-income countries, where disasters are more likely to occur with relatively more severe impacts compared with high- and upper-income countries (HelpAge International, 2012). The booming older populations pose unprecedented challenges to disaster and humanitarian response (HelpAge International, 2012).

Older people's vulnerability can vary with various factors, including their physical, mental, social and economic conditions (Banks, 2013; Maltz, 2019; Morrow, 1999). People's sensory (e.g., vision and hearing), cognitive, physical and mental abilities tend to decline as they age (Maltz, 2019). It is not unusual for older people to have health conditions and rely on health care and assistance (Maltz, 2019). Thus, older people often need extra support in disasters (Whitton, 2018). These conditions can be exacerbated by socioeconomic constraints (Oriol, 1999). For example, a lack of resources, such as financial insecurities and dependency

on others, are also key factors contributing to vulnerability (Malak et al., 2020). In addition, the probability of living alone increases with age (Sakauye et al., 2009), particularly in urban areas (Klinenberg, 2001), which can be further compounded by demographic and fertility decline (i.e., increasing childlessness) and a lack of state welfare provision in low- and middle-income countries (Bongaarts, 2015). The absence of family members and familiar neighbours who can provide support or assistance in disaster situations increases older people's vulnerability (Sakauye et al., 2009).

Existing research often considers vulnerable people as a homogenous group. However, older people are highly diverse in terms of their needs, vulnerabilities and capabilities (HelpAge International, 2012). The perspective of intersectionality suggests that they can belong to more than one vulnerable group (Cooper et al., 2022; Howard et al., 2017a), as their age intersects with gender, class, race, disability and so on. It is, therefore, imperative to account for diverse subgroups of older people and recognise their intersectional vulnerabilities when conducting research. For example, Wang and Yarnal (2012) argued that wealthy older adults prefer to reside in certain places (e.g., coastal areas) that are more physically susceptible to disaster (e.g., hurricanes). However, they can still be less vulnerable socially due to their economic affluence. These observations highlight the heterogeneities of older people.

Older people can be categorised in various ways in disaster response. Categorisations that are often used include fit vs. frail, healthy vs. unhealthy (with chronic diseases), living on their own, in assisted living facilities vs. in nursing homes, living alone vs. living with families and relatives, and being dependent on medications/treatments vs. independent (Banks, 2013; Zoraster et al., 2007). These categories are, nonetheless, often compounded (Morrow, 1999). Furthermore, older people can be particularly vulnerable to changes in their living environment, resulting in dehydration, hypothermia and hyperthermia, falling, and high or low blood pressure (Fernandez et al., 2002). Their conditions, especially medical ones, can often be worsened by disasters (Engelman et al., 2022; Pekovic et al., 2007).

### 3.2 Urbanisation and older people

Mass urbanisation is accompanied by rapid population ageing (Jarzebski et al., 2021; United Nations Office for Disaster Risk Reduction, 2015a). Improvements in health care and modern medicine increase life expectancy and the size of the older population (Morrow, 1999). By 2050, older adults aged 65 or over will make up around 30% of the population in as many as 64 countries worldwide (Bodstein, 2014). The pace of population ageing in low- and middle-income countries is considerably faster than in high-income ones (Bodstein, 2014).

Urban development in low- and middle-income countries is often characterised by unequal access to infrastructure and services (United Nations Office for Disaster Risk Reduction, 2015a). Older people living in rented accommodation are particularly susceptible to disasters because landlords often fail to adapt the dwelling to accommodate their needs in disasters. Rapid but poorly planned urban development can heighten urban residents' and especially older adults' vulnerability and disaster risks (United Nations Office for Disaster Risk Reduction, 2022b). Many older adults, often with limited capacity to care for themselves, live in their own homes in line with policies that encourage "ageing in place" (Forsyth et al., 2019; Pinkowski, 2008). In Australia, for example, government-subsidised *in*

*situ* care resulted in older people remaining in exposed urban areas, relying on support from government agencies for daily activities and during disasters (Astill, 2017).

With rapid urbanisation, there has been an increase in climate-related meteorological, geological and hydrological hazards (United Nations Development Programme, 2020; United Nations Office for Disaster Risk Reduction, 2015a). For example, Rey et al. (2017) found that living in urban areas increases exposure to meteorological and natural hazards. Urban expansion also increases exposure to natural disasters, as low-income families often live in hazard-prone areas such as coastlines or flood plains (United Nations Office for Disaster Risk Reduction, 2015a; 2022a). In China, for example, while the population in the most seismically hazardous areas (MSHAs) increased by 33.6% or 32.53 million with rapid urbanisation between 1990 to 2010, the older population in these areas increased by 81.4% during the same period (He et al., 2016). Using geographic information system census data, Liang et al. (2017) found that between 1990 and 2010, the Chinese population living in rainstorm hazard areas increased by 14.6% or 110 million, while the corresponding size of the older population increased by 86.4% or 38 million. Similarly, a 31% increase in older adults aged 85 years and above was observed in Florida between 2010 and 2015 (Kocatepe et al., 2018).

Urban disaster research tends to focus more on disaster preparedness than response (United Nations Office for Disaster Risk Reduction, 2015b). Numerous studies focused on factors influencing the level of preparedness for urban disasters (e.g., Kim and Zakour, 2017; Kleier et al., 2018). For example, Lam et al. (2017) examined community disaster preparedness in Hong Kong, including preferred means of accessing information and evacuation kits. They found that while 40% of general residents had evacuation kits, such kits were less accessible to households with older people (Lam et al., 2017). However, the authors did not attempt to explain this age disparity further. Similarly, Loke et al. (2012) found that most (77.4%) older residents in Hong Kong were unprepared for disasters. Such a lack of preparedness is particularly noted in the psychological dimension, as older people are often less resilient to changes or disruptions to their everyday environment and life routines (Durant, 2011). By contrast, far less attention has been paid to older people in urban disaster response. Nevertheless, the importance of attending to older people in urban disasters is well documented. For example, in assessing urban resilience to floods in Indonesia, Thoban and Hizbaron (2020) identified the prevalence of older people as a main factor that decreases social resilience that affects the overall urban disaster resilience.

## 4. Understanding older people's needs in urban natural disasters

Following Ahmadi et al. (2018b, p. 2), our review defines older people's needs as "all needs felt or expressed by older people and professionals". However, it is clear from our review that the needs are identified primarily from the perspectives of professionals and stakeholders rather than older adults themselves. On the presumption of age-related deterioration, professionals and stakeholders often assume the major responsibility for identifying older people's needs in disasters. Table 7 summarises five key needs of older adults from our reviewed articles: health, socioeconomic, evacuation and settlement-related, information and communication, and cultural needs. We order the five needs by their relative frequency of

appearance in the literature, where health needs are most extensively discussed while cultural needs are often overlooked.

## 4.1 Five major needs of older adults in urban natural disasters

### *4.1.1 Health needs*

Table 7 demonstrates that existing research focuses predominantly on the impact of disasters on older people's health (e.g., Becquart et al., 2019; Cherry et al., 2010; Kriebel-Gasparro, 2022). In their systematic literature review, Ahmadi et al. (2018b) identified six health-related needs of older adults, including medical needs (ongoing needs and needs caused by disasters), psycho-social support (mental, emotional and social needs), ADL (activities of daily living that are essential in sustaining an independent life), resources, information and protection. In their systematic review, Massey et al. (2017) identified four main health needs: mental, physical, functioning and nutrition. Becquart et al. (2019) investigated the impact of the 2005 Hurricane Katrina on cardiovascular disease (CVD) among older people, showing a rapid increase in hospitalisation rates following the disaster. Researchers have also documented a significant increase in emergency department visits by older adults, especially those aged 85 years and older, in the three weeks following Hurricane Sandy (Malik et al., 2018).

Mental health of vulnerable populations can be undermined by natural disasters, as well as a lack of action in response to the disasters (Benevolenza and DeRigne, 2019). Begum et al. (2022) found a significant increase in mental health issues among older people immediately and in the long term after Hurricane Sandy. Apart from a handful of exceptions, most studies tend to focus on the medium- (Sakauye et al., 2009) and long-term effects of disasters on mental health (Sakauye et al., 2009), especially post-traumatic stress disorder (PTSD). In the aftermath of disasters, older people appeared to suffer greater psychological distress (Toyabe et al., 2006) and are more likely to develop PTSD and exhibit psychiatric symptoms (Jia et al., 2010), compared with younger populations. Nonetheless, older people who survived the first year after the disaster coped with the long-term mental effects better than younger people (Adams et al., 2011), which highlights a need to focus on older people's mental health needs in the immediate disaster response phase.

Some older people require help with their activities of daily living (ADLs), such as dressing, toileting and shopping (Fernandez et al., 2002). Apart from physical and mental health-related needs, older people also have unique needs pertaining to nutrient intake. Food supplies need to cater for this need to reduce the risk of malnutrition (Fatmah et al., 2021), which may lead to progressive declines in health, reduced cognitive and physical functioning, and heightened mortality (Evans, 2005). A few studies have emphasised the importance of nutrition. For example, Magkos et al. (2004) assessed the nutritional status of victims of the 1999 earthquake in Athens, which left 70,000 people homeless.

**Table 7.** Older people's needs in urban natural disasters

| Source | Health needs | | | | | | | Socioeconomic needs | | | | Evacuation and settlement-related needs | | | | | Information and communication needs | | | | Cultural needs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthcare (in general) | Physical care | Mental care | Daily activity (BADLs[1]; IADLs[2]) | Medication/equipment | Nutrition | Admission/emergency department visit | Physical/emotional support | Social/community support | Financial support | Security | Shelter (access/ equipment) | Shelter (pet-friendly) | Transportation/assistance | Trust/credibility of source | Temporary housing (special structure) | Information/awareness | Communication | Informality | Proximity/face-to-face engagement | Dignity/respect | Religiosity | Culturally sensitive response | [Not discussed] |
| Ahmadi et al. (2018a) | | | | | | | | | | | √ | | | | | | | | | | √ | √ | | |
| Ahmadi et al. (2018b) | √ | | | | | | | | | | | | | | | | | | | | | | | |
| Ardalan et al. (2010) | | | | | √ | | | √ | | | √ | | | | | | | | | | | | √ | |
| Astill (2017) | √ | | | √ | | | | | | | | | | | | | | | | | | | | |
| Fernandez et al. (2002) | | | √ | | | | | √ | √ | √ | | | | | | | | | | | | | | |
| Astill and Miller (2018) | | | | | | | | | | | | | | | | | | | | | | | | √ |
| Banks (2013) | √ | | | | | | | | √ | √ | | | | | | | | | | | | | | |
| Becquart et al. (2019) | | | | | | | √ | | | | | | | | | | | | | | | | | |
| Begum et al. (2022) | | | | | | | √ | | | | | | | | | | | | | | | | | |
| Bell et al. (2021) | √ | | | | | | | | √ | | | | | | | | | | | | | | | |
| Benevolenza and DeRigne (2019) | | √ | √ | | | | | | | | | | | | | | | | | | | | | |
| Bhalla et al. (2015) | | | | √ | √ | | | | | | | | | | | | | | | | | | | |
| Bonnan-White (2017) | | | | | | | | | | | √ | | | | √ | | | | | | | | | |
| Brown et al. (2010) | √ | | | | | | | | √ | | | | | | | | | | | | | √ | | |

[1] Basic Activities of Daily Living e.g., dressing
[2] Instrumental Activities of Daily Living e.g., transportation

| Source | Health needs | | | | | | | Socioeconomic needs | | | | Evacuation and settlement-related needs | | | | | Information and communication needs | | | | Cultural needs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthcare (in general) | Physical care | Mental care | Daily activity (BADLs[1]; IADLs[2]) | Medication/equipment | Nutrition | Admission/emergency department visit | Physical/emotional support | Social/community support | Financial support | Security | Shelter (access/ equipment) | Shelter (pet-friendly) | Transportation/assistance | Trust/credibility of source | Temporary housing (special structure) | Information/awareness | Communication | Informality | Proximity/face-to-face engagement | Dignity/respect | Religiosity | Culturally sensitive response | [Not discussed] |
| Cherry et al. (2021) | | | √ | | | | | | | | | | | | | | | | | | | | | |
| Cherry et al. (2010) | | | √ | | | | | | | | | | | | | | | | | | | | | |
| Cooper et al. (2022) | | | | | | | | | | | | | | | | | √ | | | | | | | |
| Cox and Kim (2018) | | | | | | | | | | √ | | | | | | | | | | | | | | |
| Daddoust et al. (2018) | | | | | | | | | √ | | | | | | | | | | | | | | | |
| Dostal (2015) | | | | | | | | | | | | √ | | | | | | | | | | | | |
| Douglas et al. (2019) | | | | | | | | | | | | | √ | | | | | | | | | | | |
| Durant (2011) | | | | | | | | | | | | | | | | | | | | | | | | √ |
| Efendi et al. (2022) | | | √ | | | | | | | | | | | | | | | | | | | | | |
| Engelman et al. (2022) | √ | | | | | | | | | | | | | | | | | | | | | | | |
| Fatmah et al. (2021) | | | | | | | | | | | | | | | | | | | | | | | | |
| Fountain et al. (2019) | | | | | | | | | | | | | | | | | | | | | | | | √ |
| Fugate-Whitlock (2007) | | | | | | | | | | | | | | | √ | | | | | | | | | |
| Gutman and Yon (2014) | | | | | | | | | | | √ | | | | | | | | | | | | | |
| Hasan et al. (2019) | | | | | | | | | | | | | | | | | | | | | | | | √ |
| He et al. (2016) | | | | | | | | | | | | | | | | | | | | | | | | √ |
| Heid et al. (2017) | | | | | | | | √ | | | | | | | | | | | | | | | | |
| Howard et al. (2018) | | | | | | | | | | | √ | | | | | | | | | | | | | |
| Howard et al. (2017a) | | | | | | | | | | | | | | | | | | √ | | | | | | |

| Source | Health needs | | | | | | | Socioeconomic needs | | | | Evacuation and settlement-related needs | | | | | Information and communication needs | | | | Cultural needs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthcare (in general) | Physical care | Mental care | Daily activity (BADLs[1]; IADLs[2]) | Medication/equipment | Nutrition | Admission/emergency department visit | Physical/emotional support | Social/community support | Financial support | Security | Shelter (access/ equipment) | Shelter (pet-friendly) | Transportation/assistance | Trust/credibility of source | Temporary housing (special structure) | Information/awareness | Communication | Informality | Proximity/face-to-face engagement | Dignity/respect | Religiosity | Culturally sensitive response | [Not discussed] |
| Howard et al. (2017b) | | | | | | | | | √ | | | | | | | | | | | | | | | |
| Jagnoor et al. (2019) | | | | | | | | | | √ | | | | | | | | | | | | | √ | |
| Jia et al. (2010) | | | √ | | | | | | | | | | | | | | | | | | | | | |
| Kim and Zakour (2017) | | | | | | | | | √ | √ | | | | | | | | | | | | | | |
| Kim et al. (2022) | √ | | | | | | | | | | | | | | | | | | | | | | | |
| Kleier et al. (2018) | | | | | | | | √ | √ | √ | | | | | | | | | | | | | | |
| Kocatepe et al. (2018) | | | | | | | | | | | | √ | √ | | | | | | | | | | | |
| Krongthaeo et al. (2021) | √ | | | | | | | | | | | √ | | | | | | | | | | | | |
| Kwan (2020) | √ | | | | | | | | √ | √ | √ | | | | | | | | | | √ | √ | | |
| Lam et al. (2017) | | | | | | | | | | | | | | | | | √ | √ | | | | | | |
| Langer (2004) | | | | | | | | | √ | | | | | | | | | | | | | | | |
| Loke et al. (2012) | | | | | | | | | | | | | | | | | √ | | | | | | | |
| Liang et al. (2017) | | | | | | | | | | | | | | | | | | | | | | | | √ |
| Magkos et al. (2004) | | | | | | √ | | | | | | | | | | | | | | | | | | |
| Malak et al. (2020) | √ | | | | | | | | √ | | | | | | | | | | | | | | | |
| Malik et al. (2018) | | | | | | | √ | | | | | | | | | | | | | | | | | |
| Maltais (2019) | | √ | √ | | | | | | | | | | | | | | | √ | | | | | | |
| Massey et al. (2017) | | √ | √ | √ | | √ | | | | | | | | | | | | | | | | | | |
| McGuire et al. (2007) | | | | | | | | | | | | √ | | √ | | | | | | | | | | |

| Source | Health needs | | | | | | | Socioeconomic needs | | | | Evacuation and settlement-related needs | | | | | Information and communication needs | | | | Cultural needs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthcare (in general) | Physical care | Mental care | Daily activity (BADLs[1]; IADLs[2]) | Medication/equipment | Nutrition | Admission/emergency department visit | Physical/emotional support | Social/community support | Financial support | Security | Shelter (access/ equipment) | Shelter (pet-friendly) | Transportation/assistance | Trust/credibility of source | Temporary housing (special structure) | Information/awareness | Communication | Informality | Proximity/face-to-face engagement | Dignity/respect | Religiosity | Culturally sensitive response | [Not discussed] |
| McCann (2011) | √ | | | | | | | | | | | | | | | √ | | | | | | | | |
| Mecocci et al. (2000) | | | | | | | | | | | | | | | | √ | | | | | | | | |
| Pang et al. (2020) | | | | | | | | | | | | | | | | | √ | √ | √ | √ | | | | |
| Pekovic et al. (2007) | | √ | √ | | | | | | | | | | | √ | | | | | | | | | | |
| Rey et al. (2017) | | | | | | | | | | √ | | | | | | | | | | | | | | |
| Rosenkoetter et al. (2007) | √ | | | | | | | | | | | | | √ | √ | | | | | | | | | |
| Roth (2018) | | | | | | | | | | | | √ | | | | | | √ | | | | | | |
| Sakauye et al. (2009) | | | √ | | | | | | √ | √ | | | | | | | | | | | | | | |
| Shenk et al. (2010) | | | | | | | | | √ | | | | | | | | | | | | | | | |
| Silverman et al. (1995) | √ | | | | | | | | | | | | | | | | | | | | | | | |
| Toyabe et al. (2006) | | | √ | | | | | | | | | | | | | √ | | | | | | | | |
| Wang (2018) | | | | | | | | | | √ | | | | | | | √ | | | | | | | |
| Wang and Yarnal (2012) | √ | | | | | | | | √ | √ | | | | | | | | | | | | | | |
| Whitton (2018) | | | | | | | | | √ | √ | | | | | | | | √ | | √ | | | | |
| Yoshida et al. (2022) | √ | | | | | | | | | | | | | | | | | | | | | | | |
| Zhu and Sun (2018) | | | | | | | | | | | | | | | | | | | | | √ | | | |
| Zoraster et al. (2007) | √ | | | | | | | | | | | | | | | | | | | | | | | |

### *4.1.2 Socioeconomic needs*

Disasters not only undermine older people's health but also their socioeconomic wellbeing (Roth, 2018). Compared with younger people, older people are more likely to consider the loss or damage of property and exterior items in disasters significant (Kilijanek and Drabek, 1979). Bayraktar and Yilmaz (2018) underlined a need to consider the socioeconomic impact of disasters on older people as a major psychological stressor. It is therefore not surprising that economic support from family, friends, neighbours and community networks not only helps improve older people's material conditions in disasters but also helps alleviate their mental distress (Heid et al., 2017; Malak et al., 2020).

It is worth noting that although there are several studies on older people's socioeconomic needs in disasters, most of them focus on a very limited range of similar issues. Only a few exceptional studies explored issues such as economic abuse and negligence. In their systematic review, Gutman and Yon (2014) highlighted the financial abuse (i.e., theft and contractor fraud) faced by older people in disasters, in addition to physical abuse (domestic violence) and abandonment. Therefore, relief workers must be trained to identify, prevent and mitigate economic abuse and neglect of older people in disasters (Gutman and Yon, 2014; HelpAge, 2000).

### *4.1.3 Evacuation and settlement-related needs*

In order to evacuate older people in disasters, there is a need to meet their special requirements regarding evacuation assistance and shelter provision. Evacuation is particularly challenging for many older adults, especially those with disabilities (McGuire et al., 2007). The American Association of Retired Persons (2006) discovered that half of US older adults stated that they would need assistance to evacuate in disasters (Gibson and Hayunga, 2006). More time and resources are required to evacuate older adults than younger people. While Rosenkoetter et al. (2007) found that over 70% of older people were willing to evacuate, Dostal (2015) found that urban homebound older adults were unable or unwilling to evacuate, particularly due to difficulties in physical mobility.

It is thus important to recognise older people's distinctive characteristics and develop emergency strategies tailored to their special needs (Engelman et al., 2022; Loke et al., 2012), including special assistance for evacuating and sheltering (Kocatepe et al., 2018). For example, to evacuate, older adults with disabilities may need canes, walkers, wheelchairs and other equipment, and additional assistance (McGuire et al., 2007). Moreover, special transportation equipment and shelter arrangements may be required to accommodate older people (McGuire et al., 2007; Rosenkoetter et al., 2007). For example, in relocating urban-older residents to shelters, their medical needs can be as complex as older people living in nursing homes (Dostal, 2015).

Furthermore, there is a need for age-friendly temporary housing suitable for older adults. Living in unsuitable housing may worsen depression resulting from forced relocation due to disasters (Mecocci et al., 2000). Compared with younger people, older people may be harder hit by the loss of property (Kilijanek and Drabek, 1979). Research also shows that older people living in institutionalised group quarters are generally more vulnerable than those residing in private households, thus often requiring additional support for daily activities (Wang and Yarnal, 2012).

In addition to physical and material support that facilitates evacuation, it is essential to account for older people's emotional needs. Their emotional attachments to belongings and, in some cases, pets can significantly affect their willingness to be evacuated. The literature has identified a need to evacuate not just older people but also their valued pets and belongings (Douglas et al., 2019; Kocatepe et al., 2018; Thompson et al., 2017). For example, Douglas et al. (2019) found that about one-third of older people in the Miami-Dade area have pets, and pets strongly influence older people's evacuation preferences and decisions. Thus, disaster shelters need to accommodate not just humans but also pets (Kocatepe et al., 2018). Furthermore, emotional distress can arise from relocating and rebuilding a new home (Maltais, 2019). For example, in the backlash of disasters, Italian older adults housed in temporary accommodations were more likely to suffer from mental distress, compared with those who could remain in their own homes (Mecocci et al., 2000).

Older people's evacuation willingness can be influenced by factors other than emotions, including one's past disaster experiences (Fugate-Whitlock, 2007), evacuation drill practice (Lee et al., 2018), and trust in government officials (Fugate-Whitlock, 2007; Rosenkoetter et al., 2007). Among these factors, trust in officials is particularly important. For example, Bonnan-White (2017) examined the evacuation willingness of older people residing in independent living centres and found that their willingness to follow officials' evacuation orders is strongly related to their trust in the officials.

#### *4.1.4 Information and communication needs*

Information, knowing what to expect and what to do, is crucial for individuals to navigate heightened uncertainties and disruptions in disasters. Lam et al. (2017) underscored a need to tailor information provision according to age groups, with an additional emphasis on older adults' primary carers. As different vulnerable groups require different information access options, older people will unlikely receive the correct and necessary information if it is not provided via an appropriate medium (Cooper et al., 2022; Howard et al., 2017a). While new technologies, such as social networking sites, are important in spreading disaster information to young digital natives, older people often prefer television, radio, and landline phone calls (Howard et al., 2017a; Kleier et al., 2018; Lam et al., 2017). Cooper et al. (2022) found a low level of social media use in how older people receive and share information during disasters.

Apart from broadcast media, older people prefer receiving information through informal interactions with trusted contacts in the local community (Pang et al., 2020). Informal networks and relationships serve as vital sources of information and support for older people. It is suggested that natural community gatekeepers, such as neighbours, mail carriers and metre readers, should be mobilised to reach older adults who live alone or are isolated (Langer, 2004). Therefore, it is important to integrate the needs of older adults in disaster information dissemination by using their preferred modes and media of communication (Pang et al., 2020). The design of warning systems also needs to account for potential visual, hearing and cognitive impairments among older people (Fernandez et al., 2002).

#### *4.1.5 Cultural needs*

Older people's cultural needs are severely under-researched. Cultural needs are often only implicitly or briefly mentioned in relation to the above needs. For instance, dignity and respect were only briefly mentioned in a few studies (Ahmadi et al., 2018a; Kwan, 2020; Zhu and Sun, 2018). As a rare exception, Ardalan et al. (2010) showed that older Iranians felt undignified and offended by disaster relief operations when they were delivered food that was not appropriate for their religious and cultural traditions. At the same time, older people tend not to complain due to dignity concerns (Ardalan et al., 2010), which renders their cultural needs invisible in the literature.

Moreover, some research focused on religion as an often-overlooked but crucial resource that helps enhance older people's disaster resilience (Ahmadi et al., 2018a; Kwan, 2020). However, considerable gender differences are noted. For example, following Hurricanes Katrina and Rita, older female survivors were more likely to rely on religion than their male counterparts (Brown et al., 2010). In the Philippines, older women relied on prayers as a crucial form of spiritual support in disasters (Kwan, 2020).

Culturally sensitive plans and responses are essential to meeting older people's needs in disasters (Ahmadi et al., 2018a; Ardalan et al., 2010). Cultural traditions tend to hold greater salience among older than younger people. One of the barriers to disaster response and resilience concerns culturally embedded gender sensitivity (Jagnoor et al., 2019). For example, older women, especially in non-Western cultures (e.g., Asia), are likely to adhere to traditional dress codes and require traditional clothing, including saris and face veils (HelpAge, 2000). However, although clothing is one of the most basic provisions in disaster response to maintain victims' dignity (Sphere Project, 2011), researchers are yet to pay due attention to issues of cultural respect, sensitivity and dignity in disaster response.

### 4.2 Critical reflections on older people's needs in urban disasters

In this section, we present four critical reflections on older people's needs in urban natural disaster response. First, most existing studies on disasters and disaster response have yet to engage specifically with the sweeping trends of urbanisation and population ageing. In the limited range of research focusing on urban areas, there is a lack of consensus regarding how the "urban" is defined. Table 8 further illustrates the variegated definitions of "the urban". While local population size has been taken as a key indicator of urbanisation, the threshold of urban population size varies considerably from a minimum of 200 in Sweden to 50,000 in Japan (Ritchie and Roser, 2018). As existing definitions of urban units closely inform what constitutes "target areas" and resource allocation in disaster response, the diverse definitions of the urban means that urban disaster responses across the world operate on very different scales and are coordinated at distinct administrative levels (e.g., local community level in Sweden vs. the national level in Singapore). As many countries rely on economic indicators such as occupational composition and the level of industrialisation to define the urban, such definitions insufficiently account for the features of urban design that configure older people's vulnerability and risks in disasters. In order to come up with a thorough understanding of the implications of urbanisation for disaster response, future efforts are needed to more systematically tease out the characterising features of the urban and urbanisation in relation to older people's needs in disasters.

**Table 8.** Distinct definitions of "urban" across different countries (Ritchie and Roser, 2018)

| **Country** | **National definition of "urban"** |
|---|---|
| Argentina | Localities with 2,000 inhabitants or more. |
| Sweden | Built-up areas with 200 inhabitants or more, where houses are at most 200 metres apart. |
| Japan | Cities are known as *shi*. In general, *shi* refers to a municipality that satisfies the following criteria: (1) 50,000 inhabitants or more; (2) 60% or more of the houses are in the main built-up areas; (3) 60% or more of the population (including dependents) work in manufacturing, trade or other types of urban business. |
| India | Statutory places with a municipality, corporation or cantonment board or notified town area committee, satisfying all of the following three criteria: (1) 5,000 inhabitants or more; (2) at least 75% of the male working population are engaged in non-agricultural work; and (3) at least 400 inhabitants per square kilometre. |
| Zimbabwe | Places officially designated as urban, with 2,500 or more inhabitants residing in a compact settlement pattern and with more than 50% of the employed population working in non-agricultural occupations. |
| Singapore | Entire population. |
| Uruguay | Cities officially designated an "urban" status. |

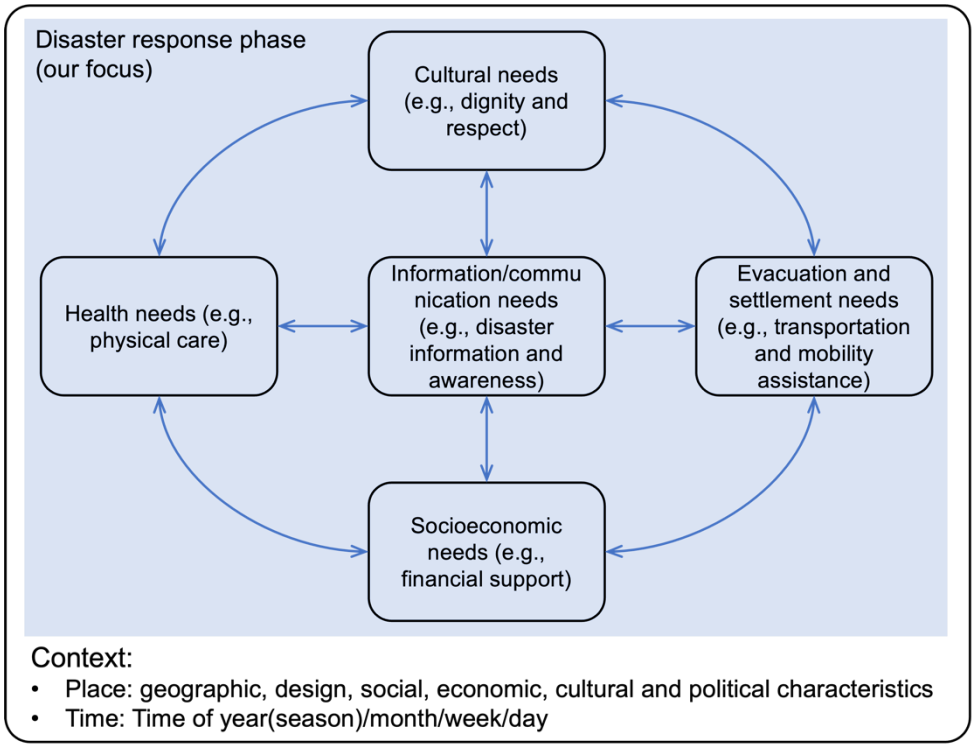


**Figure 2.** A holistic ecology of older people's interdependent needs in urban disaster response

Second, as Figure 2 shows, older people's different needs are not isolated but are interlinked across different domains. For instance, unmet cultural needs can lead to increased mental health distress and needs during and after disasters. Health needs are further linked to socioeconomic needs (e.g., material support and economic recovery), cultural needs (e.g., appropriate clothing and housing) and evacuation needs (e.g., transportation and assistance). Particularly, information and communication needs are inextricably linked to the other four needs. Disaster information communication is not limited to disaster preparedness, awareness

and situation updates during disaster evacuations and settlement; it also concerns how crucial information on older people's health, cultural and socioeconomic needs are effectively communicated. While existing literature has largely overlooked the relationships between the different needs, particular attention is needed to fully theorise and empirically assess the interdependence between older people's needs across different domains.

Third, older people's needs in disasters are not only linked across different domains, but also interconnected throughout the disaster preparation, response and recovery phases. For example, unmet nutrition needs during disasters can give rise to long-term health issues after disasters, which is evidenced by a sharp increase in emergency visits and hospital admissions a few months after the disaster events (Becquart et al., 2019; Begum et al., 2022; Malik et al., 2018). However, our review shows that demarcating the different phases is not always straightforward, due to highly inconsistent definitions and categorisations of disaster (management) cycles. Key players such as the United Nations and major international non-governmental organisations typically refer to disaster (management) cycles in two ways. The first divides disaster cycles into four main phases: prevention/mitigation, preparedness, response/relief, and recovery (World Health Organization Department of Emergency and Humanitarian Action, 2002). The other divides disaster cycles broadly into pre-disaster and post-disaster phases (World Health Organization Department of Emergency and Humanitarian Action, 2002). The two definitions are inconsistently adopted in the literature. We also found that many articles do not explicitly specify the phase of disaster (management), but use vague terms such as before, during and after disasters. Table 9 provides some examples of the variegated ways in which the reviewed articles refer to disaster phases. The inconsistent definitions of disaster phases in our reviewed literature make it difficult to identify and compare older people's needs across disaster phases.

**Table 9.** Examples of the reviewed publications focusing on distinct disaster phases

| **Phases of disaster** | **Examples of articles** |
|---|---|
| Pre-disaster, post-disaster | Kwan (2020), Rey et al. (2017) |
| Preparedness, response and recovery | Howard et al. (2017b), Jagnoor et al. (2019), Kim and Zakour (2017), Krongthaeo et al. (2021), Wang (2018) |
| Before, during and after | Ahmadi et al. (2018b), Banks (2013), Begum et al. (2022), Bell et al. (2021), Pang et al. (2020) |

Finally, it is crucial to situate and understand older people's disaster needs in specific contexts, in terms of place and time. On the one hand, existing research has paid some attention to how older people's needs in urban disasters vary across geographical regions and types of landscapes. Different urban places are susceptible to distinct disasters to different degrees. For example, in China, scholars noted a significant increase in the number of older people living in areas prone to rainstorms and seismic hazards (He et al., 2016; Liang et al., 2017). Research shows that older people who live in hurricane-prone areas such as south Florida (Kleier et al., 2018; Wang 2018), in regions prone to flooding and cyclones such as coastal Australia (Astill and Miller (2018), and in socially isolated communities are generally more vulnerable (Cooper et al., 2022; Durant, 2011). Some geographical regions are simultaneously vulnerable to multiple hazards. The Republic of Vanuatu as a Small Island Developing State (SIDS) is highly susceptible to a wide range of disasters due to its closeness

to active tectonic phenomena, including volcanoes, earthquakes, landslides, and tsunamis (Rey et al., 2017). In Indonesia, the hazard of volcano eruptions is compounded by typhoons and cyclones (Pang et al., 2020). In these regions, the presence of multiple disaster hazards compounds older people's vulnerability and complicates their needs at the junction of multiple disaster risks. Adding to the complexity, older people's vulnerability and disaster needs across different regions are characterised by not only geographical features of the regions but also socioeconomic ones, such as long-term poverty and economic deprivation (Jagnoor et al., 2019; Wang and Yarnal, 2012).

On the other hand, the temporal context of older people's needs in disasters has received very limited attention beyond the seasonality of disasters. For instance, along the Atlantic coast and Mexican Gulf, the time period between June and November is often referred to as the "hurricane season" (Kocatepe et al., 2018). In South Korea, disasters such as typhoons, landslides, and flooding often occur in July and August (Lee et al., 2018a). Moreover, other temporal dimensions, such as the day(s) of the week and time(s) of the day, pertaining to the outbreak of and response to disasters have received little attention in research on older people's needs. For example, compared to daytime, older people tend to be more vulnerable in the darkness of the night, which may also make disaster response more challenging. Disaster risk and response research, therefore, should systematically investigate and theorise the temporal configurations of older people's disaster needs.

## 5. Meeting older people's needs in urban natural disasters

Table 10 summarises insights from existing research on how older people's needs are met in urban natural disasters. The organisation of the table builds on the distinct types of needs identified in the preceding sections as well as different combinations of the needs (as shown in the first column). The table also details the specific nature of a disaster under scrutiny, the place in which it occurred, target population studied, and interventions implemented. Instead of providing a high-level summary of different types of intervention, we retain detailed information in this table because interventions applied to meet older people's needs in disasters are closely contextualised and configured by the specificities of disasters and target populations.

As Table 10 shows, to meet the distinctive needs of older people, disaster governance has predominantly emphasised disaster preparedness, which covers an extensive range of pre-emptive measures and interventions. By contrast, it is clear from our reviewed publications that support for older people is far from adequate, systematic and comprehensive, particularly in the disaster response phase. Kilijanek and Drabek (1979, p. 559) referred to such inadequacy as a "pattern of neglect" in which older people receive aids far less than, for example, their younger counterparts; and the "pattern of neglect" remains four decades after the critique advanced by Kilijanek and Drabek.

**Table 10.** Interventions in and recommendations for meeting older people's needs in existing literature

| Older people's needs in disaster response | Interventions/recommendations | Disaster | Country/place | Population studied | Source |
|---|---|---|---|---|---|
| **Health needs** – healthcare (in general) | Emergency preparedness and response (EPR); disability-inclusive provisions for older people | Hurricane (Maria) | Puerto Rico | Key informants at Community-Based Organisations (n = 22) | Engelman et al. (2022) |
| | Enhance community resilience, social support, and disaster preparedness to increase health-related quality of life | Earthquake (Pohang 2017) | South Korea | Older people ≥ 65 (n = 312) | Kim et al. (2022) |
| | Disaster preparedness plan must take into account the special needs of older people, especially those who are frail | Hurricane (Andrew) | US | First-hand experience of trained observers | Silverman et al. (1995) |
| | Local governments and care providers should prepare for future floods and other emergencies by considering the increased costs and utilisation of care facilities | Flood | Japan | All long-term care service users focusing on older adults ≥ 65 | Yoshida et al. (2022) |
| | Older people, especially those with chronic diseases, should be included in disaster planning at the federal, state, and local levels | Hurricane | US | Frail elders | McCann (2011) |
| **Health needs** – mental care | National and regional policymakers need to pay attention to older people's mental health in post-disaster recovery | [Unspecified] | Indonesia | Policymakers | Efendi et al. (2022) |
| | [Not discussed] | Hurricane (Katrina and Rita) | US | Middle-aged 45–64, older 65–89, and oldest-old ≥ 90 (n = 66) | Cherry et al. (2010) |
| | A need for more mental health services for older people and other at-risk groups | Earthquake (Sichuan 2008) | China | 327 survivors of the earthquake (152 elders, 175 younger adults) | Jia et al. (2010) |
| **Health needs ─** nutrition | Provision of Broccoli-Soybean-Mangrove food bar to increase macronutrients intakes | Flood | Indonesia | Older people ≥ 60 (n = 33) | Fatmah et al. (2021) |
| | [Not discussed] | Earthquake | Greece | 225 adolescents and 20 older adults | Magkos et al. 2004 |
| **Health needs ─** admission/emergency department visit | A need to address inequities in resource allocation and access | Hurricane (Katrina) | US | Older patients ≥65 | Becquart et al. (2019) |
| | Hospitals and public health efforts should dedicate more resources to older adults for long-term treatment and follow-up | Hurricane (Sandy) | US | Older patients ≥ 64 | Begum et al. (2022) |
| | A need for dedicated resources and planning for older adults following a natural disaster | Hurricane (Sandy) | US | Older adults aged 65–74, 75–84, and ≥ 85 | Malik et al. (2018) |

| Older people's needs in disaster response | Interventions/recommendations | Disaster | Country/place | Population studied | Source |
|---|---|---|---|---|---|
| **Socioeconomic needs ─** physical/emotional support | A need to develop social support networks (i.e., family, friends and communities) | Hurricane (Sandy) | US | Community-dwelling older adults aged 50–74 (n = 20) | Heid et al. (2017) |
| **Socioeconomic needs ─** financial support | Social workers could pre-emptively identify the differences between vulnerable sub-populations to offer tailored programmes, distribution methods, and messaging to improve disaster preparedness | [Unspecified] | US | Older adults ≥ 51 (n = 1711) | Cox and Kim (2018) |
| **Socioeconomic needs ─** social/community support | Locate older people through neighbourhood gatekeepers, peer and group services | Heatwave | France | Urban older people | Langer (2004) |
| | Design a vulnerability assessment tool for older people | Earthquake (2012), Flood (2015) | Iran | Older adults ≥ 60 (n = 22) and experts (n = 2) | Daddoust et al. (2018) |
| | A need to actively involve older people in disaster preparedness, response and recovery | [Unspecified] | Australia | Older people aged 65–74 (n = 41) | Howard et al. (2017b) |
| | A need for effective policies and intervention programmes to improve disaster preparedness among the older people | [Unspecified] | US | Adults ≥ 55 (n = 719) | Kim and Zakour (2017) |
| | Preparedness is a key issue but has to be viewed within the larger challenges of socioeconomic and cultural variability, as well as gender and age | Earthquake | Peru | 24 older adults aged 60–90 | Shenk et al. (2010) |
| **Socioeconomic needs ─** security | Training and awareness programmes for first responders are needed to better recognise older people's needs and prevent abuse | [Unspecified] | [Unspecified] | [Unspecified] | Gutman and Yon (2014) |
| | Emergency and human services need to consider social isolation as a key risk factor in disaster preparedness, response, and recovery work | [Unspecified] | Australia | 111 participants from 5 "at-risk" populations, including older adults aged 65–74 and ≥ 75) | Howard et al. (2018) |
| **Socioeconomic needs** – dignity/respect | [Not discussed] | Wenchuan Earthquake, Kobe Earthquake | China Japan | Older adults aged over 75 and the rate of mortality | Zhu and Sun (2018) |
| **Evacuation needs** – shelter (access/medication/equipment) | [Not discussed] | [Unspecified] | US | Urban homebound older adults aged 64–105 (n = 36); surrogate decision-makers (n = 20) | Dostal (2015) |
| **Evacuation needs** – shelter (pet-friendly) | [Not discussed] | [Unspecified] | [unspecified] | [unspecified] | Douglas et al. (2019) |
| **Evacuation needs** – trust/credibility of source | [Not discussed] | Hurricane | US | Older adults | Fugate-Whitlock (2007) |

| Older people's needs in disaster response | Interventions/recommendations | Disaster | Country/place | Population studied | Source |
|---|---|---|---|---|---|
| **Information and communication needs ─** information/awareness | [Not discussed] | [Unspecified] | Australia | Vulnerable people, including elders ≥ 60 (over half aged 22–39) (n = 215) | Cooper et al. (2022) |
| | [Not discussed] | [Unspecified] | China (Hong Kong) | 1137 older adults aged 60 and over | Loke et al. (2012) |
| **Information and communication needs** – communication | Information should be provided via a preferred medium used by different social groups | [Unspecified] | Australia | 111 participants from 5 "at-risk" populations, including older adults aged 65–74 and ≥ 75) | Howard et al. (2017a) |
| **Basic needs** – temporary housing (special structure) | Following natural disasters, emergency programmes should be adapted to older people's needs, which are often different from those of young people | Earthquake (1997) | Italy | 332 older people aged ≥ 64 | Mecocci et al. (2000) |
| **Combination of needs** – social and financial support | A need for effective policies and intervention programmes to improve disaster preparedness among older people | [Unspecified] | US | Adults ≥ 55 (n = 719) | Kim and Zakour (2017) |
| **Combination of needs** – social support, financial support, mental care | Establish security, stability, and safety; reunify families; and provide psychiatric services to those most severely affected | Hurricane (Katrina) | US | Older adults | Sakauye et al. (2009) |
| **Combination of needs** – physical support, social support, financial support | Provide guidance for public health staff to co-develop and co-delivery intervention with other stakeholders, such as living facilities administrators; promote education regarding health and emergency preparedness | Hurricane | US | Older adults aged ≥ 55 (n=188) | Kleier et al. (2018) |
| **Combination of needs** – mental care, physical/emotional support, social support, financial support | Emergency management must recognise the needs of frail older people and develop targeted strategies to meet their needs | [Unspecified] | [Unspecified] | [Unspecified] | Fernandez et al. (2002) |
| **Combination of needs** – financial support, culturally sensitive response | Develop policy-based community approaches to disaster preparedness; increase investment in systems-level responses that empower communities and promote resilience | Water-related natural disasters (e.g., flood and cyclone) | Bangladesh | Adult ≥ 18 | Jagnoor et al. (2019) |
| **Combination of needs** – financial support, information/awareness | More practical and age-specific interventions are needed to promote older adults' disaster preparedness | Hurricane | US | 30 older adults 60–90 years old | Wang (2018) |
| **Combination of needs** – mental care; religiosity | Religiosity and perceived social support are important potential resilience resources | Flood | US | Predominately middle-aged and older adults 18–88 (n = 223) | Cherry et al. (2021) |

| Older people's needs in disaster response | Interventions/recommendations | Disaster | Country/place | Population studied | Source |
|---|---|---|---|---|---|
| **Combination of needs** – healthcare, social support, religiosity | Disaster preparedness programmes should focus on relaying critical information ahead of time; local cultural practices should be taken into account | Hurricane (Katrina and Rita) | US | Middle-aged and older adults 47–93 (n = 59), 31 females and 28 males | Brown et al. (2010) |
| **Combination of needs** – security/protection, dignity and respect | Policymakers and service providers should identify traits that lead to vulnerability and cultural sensitivities | Earthquake | Iran | Older adults ≥ 60 (n = 18) key informants (n = 11) | Ahmadi et al. (2018a) |
| **Combination of needs** – healthcare, daily activity (BADLS, IADLS) | Need to identify negative/unintended implications of policies | Cyclone (Larry and Yasi) | Australia | Independent-living older adults ≥ 65 (n = 36) key informants (n = 21) | Astill (2017) |
| **Combination of needs** – social support, healthcare | [Not discussed] | Hurricane (Irma and Harvey) | US | Home-based care providers (n = 25) | Bell et al. (2021) |
| | To increase older people's adaptability to cyclone disasters, all levels of society need to pay them special attention | Cyclone | Bangladesh | 24 older adults aged 60 and over, 8 key informants – NGO officials, social workers | Malak et al. (2020) |
| **Combination of needs** – physical care, mental care | Foster strong social capital is a way to combat stressors | Hurricane (2005-2017) | US | Vulnerable populations | Benevolenza and DeRigne (2019) |
| **Combination of needs** – mental care, special structure temporary housing | [Not discussed] | Earthquake (Niigata-Chuetsu) | Japan | 2,083 lived in temporary housing (mixed age group) | Toyabe et al. (2006) |
| **Combination of needs** – physical care, mental care, daily activity (BADLS, IADLS), nutrition | Humanitarian agencies should consider ways to strengthen their work and capacity to better understand and address older people's health needs | [Unspecified] | Low- and middle-income countries | [Unspecified] | Massey et al. (2017) |
| **Combination of needs** – physical care, mental care, communication | [Not discussed] | [Unspecified] | [Unspecified] | Older people with disabilities | Maltais (2019) |
| **Combination of needs** – medication/equipment, activity (BADLS, IADLS) | [Not discussed] | [Unspecified] | US | 100 community-residing ED patients and visitors aged 65 years and older | Bhalla et al. (2015) |
| **Combination of needs** – shelter (access/medication/equipment/ pet-friendly) | [Not discussed] | Hurricane | US | The oldest-old ≥ 85 | Kocatepe et al. (2018) |
| **Combination of needs** – shelter (access/medication/equipment), transportation/assistance | For geographical areas that are at risk of a natural disaster, having baseline data on the number of community-dwelling older people with a disability and/or those who require the use of special | [Unspecified] | US | 529 Community residing elders aged 65 and older with a disability and requiring special equipment | McGuire et al. (2007) |

| Older people's needs in disaster response | Interventions/recommendations | Disaster | Country/place | Population studied | Source |
|---|---|---|---|---|---|
| | equipment should assist planners in preparing for potential evacuation and sheltering | | | | |
| **Combination of needs** – physical care, mental care, transportation/assistance | Planning must be accompanied by (1) coordination among ageing services providers and non-ageing services providers, and (2) a clarification of the roles of different agencies | Hurricanes, tornadoes, ice storms, heat waves, influenza, wildfires, floods, and earthquakes | [Unspecified] | Older adults | Pekovic et al. (2007) |
| **Combination of needs** – healthcare, transportation/ assistance, trust/credibility of source | Individuals should have an emergency plan that includes a kit of essential medical supplies and information, important contact information, and relocation sites | [Unspecified] | US | 139 older residents at six congregate meal sites (mostly ≥ 60) | Rosenkoetter et al. (2007) |
| **Combination of needs** – healthcare, shelter (access/medication/equipment) | A need for community-based flood preparedness for slow-onset flood | Flood | Thailand | 15 family caregivers; 8 administrative and public health officers | Krongthaeo et al. (2021) |
| **Combination of needs** – shelter (access/medication/equipment), communication | A need to account for inclusivity and accessibility, such as the accessibility of accommodations | [Unspecified] | [Unspecified] | Vulnerable populations, specifically people with disabilities | Roth (2018) |
| **Combination of needs** – security, trust/credibility of source | [Not discussed] | [Unspecified] | US | Older adults living in independent living centres ≥ 65 (n = 45) | Bonnan-White (2017) |
| **Combination of needs** – security, financial support, social support, religiosity, healthcare, dignity/respect | Resilience-building interventions require a holistic practice model | Typhoon (Haiyan) | Philippines | 4 older women (68–81) | Kwan (2020) |
| **Combination of needs** – security, emotional support, culturally sensitive response, dignity and respect, equipment | Relief agencies need to be trained to be age-sensitive and should mainstream older people's rights in the planning and implementation of disaster response | Earthquake (Bam) | Iran | 56 people aged 65–88 | Ardalan et al. (2010) |
| **Combination of needs** – financial support, social support, healthcare | Effective vulnerability reduction measures should account for the differences between the elderly populations. | Hurricane | US | The young old (aged 65–74) and the old–old (aged 75 and older) | Wang and Yarnal (2012) |
| | Healthcare providers and systems can improve health outcomes for older adults following disasters via specific pre-disaster-planning that engages with not only older people but also their communities | [Unspecified] | [Unspecified] | [Unspecified] | Banks (2013) |

| Older people's needs in disaster response | Interventions/recommendations | Disaster | Country/place | Population studied | Source |
|---|---|---|---|---|---|
| **Combination of needs** – information, communication | Community resilience-building programmes should tailor information provision to different age groups with a focus on older people's care providers | [Unspecified] | China (Hong Kong) | 1,023 residents aged ≥ 18 | Lam et al. (2017) |
| **Combination of needs** – social support, financial support, face-to-face communication | [Not discussed] | [Unspecified] | Australia | Feedback from government and non-government agencies | Whitton (2018) |
| **Combination of needs** – information, communication, informality, proximity | Institutional actors should be present in various disaster sites where more informal interactions and sharing of information can be encouraged | Volcano Eruptions; Typhoons/ Cyclones | Indonesia | 42 older persons ≥ 60 | Pang et al. (2020) |
| **[Not discussed]** | [Not discussed] | [Unspecified] | Australia | Independent-living older adults ≥ 65 (n = 36) key informants (n = 21) | Astill and Miller (2018) |
| | [Not discussed] | Hurricane (Katrina) | US | [Unspecified] | Durant (2011) |
| | [Not discussed] | Earthquake | China | Older adults ≥ 65 | He et al. (2016) |
| | [Not discussed] | Rainstorm | China | Older adults ≥ 65 | Liang et al. (2017) |

Older people's needs in natural disasters are not adequately met for four major reasons. First, cross-domain interdependence and coordination pose challenges for disaster relief workers with different expertise and backgrounds. For example, healthcare professionals understand health-related needs but may not understand and cater for older people's evacuation needs, while first aid providers may not fully understand older people's health needs (Ardalan et al., 2010; Maltz, 2019). Older people often require special attention (Maltz, 2019), but basic subsistence such as food is often provided collectively rather than tailored to the needs of specific population segments such as older people (Ardalan et al., 2010; Wisner et al., 2012). Similarly, relief packages typically include standard items for the general population without focusing on older people's needs (Taghavifard and Yousefzadeh, 2020).

Second, older people in disasters often lack equal and adequate access to aid and support (HelpAge, 2000). According to Becquart et al. (2019), disaster relief resources are often unequally allocated to and accessible by older people, compared with other age groups (Kilijanek and Drabek, 1979). Similarly, Jagnoor et al. (2019) found that support is inadequate for vulnerable populations, including older people, in community-based disaster response, such as a lack of warning systems tailored to older people's needs. Older adults are also often at risk of being excluded from formal social and healthcare services in disasters (Langer, 2004). Such risks arise from barriers such as a lack of awareness of service availability and different languages used by non-local and international aid teams (Langer, 2004). As Table 11 shows, older people are often subsumed under the umbrella category of "vulnerable populations", which often means that their distinctive needs are not distinguished from those of the other vulnerable groups. As a result, one-size-fits-all disaster responses, even when targeted at vulnerable groups, often fail to meet older people's needs.

**Table 11.** Summary of definitions of vulnerable populations

| **Vulnerable populations** | **Source** |
|---|---|
| Children, pregnant women, the elderly and the disabled | Bodstein (2014) |
| Older people (65 and over), people living with disability, parents with young children (under five years of age), culturally and linguistically diverse (CALD) people, low-income households | Howard et al. (2018) |
| The poor, the elderly, women-headed households and recent residents | Morrow (1999) |
| People living in rented accommodations, the elderly, and female-headed households | Rey et al. (2017) |
| Linguistically diverse, older adults, families with young children, physically frail, self-identifying disabled, and individuals with mental health considerations | Thompson et al. (2017) |

Third, older people and their caregivers often experience a discrepancy between policy expectations regarding age-friendly disaster response and their actual lived experiences of such response (Astill and Miller, 2018). A report by the American Association for Geriatric Psychiatry highlighted the role of multiple failures in addressing older people's needs after Hurricane Katrina in New Orleans in causing mental health problems and subsequent suicide among elder victims (Sakauye et al., 2009). Such failures include a lack of consistent provision of financial aid, social and community support for promoting security and safety, and access to local health services for treatments and follow-up (Sakauye et al., 2009). The report further suggested that successfully implementing disaster governance and response requires governmental mandates that place older people at the centre of actual

disaster response operations, not just in theory or on paper. The needs of older people should be incorporated into emergency response at all levels – international, national and local (Gibson and Hayunga, 2006). Particularly, international and national disaster aid and response teams need to work with local teams within the context of local community networks, infrastructures and services (Bodstein, 2014).

Finally, while representation matters, there is a relative lack of advocacy for older people's needs and wellbeing in disasters (Bhalla et al., 2015; Maltz, 2019). For example, children's interests are represented by international advocacy such as the United Nations International Children's Emergency Fund (UNICEF) and those of women are heralded by UN Women, but there is a lack of large-scale international representation and advocacy for older people (Zhu and Sun, 2018). For example, Engelman et al. (2022) investigated the disaster preparation and response role of Community-Based Organizations (CBOs) in addressing the needs of disabled and older people by interviewing 22 key informants in NGOs in Puerto Rico. While the organisational representatives clearly identified an imperative to incorporate older people's needs into the Emergency Operations Plan, they also noted an equally important need to gauge their needs not just from a responder's perspective but also from older people themselves. Therefore, advocacy by governments and international organisations should not only represent and speak for older people, it is also crucial to solicit direct inputs and engagement from older people to speak for themselves about their own needs (Maltz, 2019; Phillips and Morrow, 2007).

## 6. Older people and urban disaster response: Research gaps and future directions

Older people are a diverse and under-served population in disaster response (Becquart et al., 2019). There is an overall lack of research focusing on older adults' distinctive needs in disasters (Fountain et al., 2019). According to the International Federation of Red Cross and Red Crescent Societies (2005), aid supplies are primarily based on popular media portrayals and donors' perceptions of older people's needs instead of the needs expressed by older people themselves.

Rapid urbanisation and increasing concentration of older people in urban areas further complicate our understanding of the needs of older people when disasters strike. Urban areas differ from non-urban areas in terms of population density (e.g., residents and houses), diversity (e.g., ethnic, religious, linguistic) and dynamics of movement (Sphere Association, 2018). The ongoing and intertwined trends of population ageing and urbanisation increase the importance of understanding the vulnerability of urban-older residents who are frequently and severely affected by natural disasters (Fountain et al., 2019). Older people living in rural areas who need help are typically known by other local residents since people often know one another well in close-knit rural communities. By contrast, in large urban areas, many older adults live alone (McGuire et al., 2007) and are "hidden" within the general population (Langer, 2004, p. 278).

Older people have received limited attention in urbanisation and urban resilience (Jarzebski et al., 2021). Although older people have been the focus of some disaster management research (Durant, 2011), they are yet to be featured centrally in urban disaster

management. There is a need to understand and address the distinctive needs of older people in urban disasters (Bodstein, 2014), particularly in low- and middle-income countries where urbanisation and natural disasters are increasing hand in hand (Tyler and Moench, 2012)

As summarised in Table 12, in this review, we have provided a comprehensive synthesis of the literature, its theoretical and methodological underpinnings, practical implications and major gaps in terms of (1) what has been well-researched, (2) what remains less researched, and (3) what remains unknown. Building on the summary in Table 12, we further discuss how the gaps in existing research inform future research directions in this concluding section.

**Table 12.** The current state of the field

| | |
|---|---|
| What has already been well-researched? | • The short-term and long-term impact of disasters on older people's physical and mental health.<br>• Older people in developed countries, mainly the United States and Australia. |
| What remains less researched? | • Existing literature has focused primarily on factors contributing to older people's vulnerability in disasters, emphasising their weaknesses instead of their actual needs.<br>• While most studies focused on advanced economies (Fountain et al., 2019), particularly the United States, less research has investigated natural disasters in low- and middle-income countries.<br>• Basic but culturally sensitive needs (e.g., clothing) are particularly under-researched. Aid has often been delivered as standard one-size-fits-all provisions. Only a few studies have investigated older people's basic but essential needs such as food and clothing.<br>• Most research has been conducted post-disaster, focusing on experiences rather than pre-disaster needs and responses during disasters (Fountain et al., 2019). |
| What remains unknown? | • Existing literature has largely overlooked older people's intersectional vulnerabilities, such as disability, race and ethnicity, gender and sexuality.<br>• Although it is evident from the literature that disaster response has largely ignored the special needs of older people (HelpAge International, 2008), it remains unknown whether older people's needs have been addressed satisfactorily by disaster response.<br>• It is imperative to understand older people's needs directly from older people. Most research either assumes older people's needs or learns about these needs indirectly from other stakeholders. |

### 6.1 Defining older people and assessing their multidimensional needs

There is a need to review and reconsider the variegated definitions of older people. The definitions in existing literature in terms of age are inconsistent – mainly 65 years and older (Astill and Miller, 2018; Maltais, 2019), but often 60 years and older (Kwan, 2020; Pang et al., 2020) or 55 years and older (Gibson and Hayunga, 2006; Kim and Zakour, 2017). Some studies did not specify an age range at all, e.g., Bonnan-White (2017) and Durant (2011). Some studies defined older people ambiguously or broadly as 60–90 years old (Maltais, 2019; Yoshida et al., 2022), although people within this age group differ in many aspects. At advanced ages, they typically experience frailty and thus are more vulnerable, compared with, for example, those aged 60 to 65 years old. Only a few studies define older people in a precise and conceptually informed manner. For instance, Lee et al. (2018) divided Korean elders into youngest–old (65–74 years old), middle-old (75–84 years old), and oldest-old (85 years and older). Cherry et al. (2010) proposed three subgroups, namely, middle-aged (45–64 years), older (65–89 years), and oldest-old (90 years and over). Malik et al. (2018) presented three subgroups: 65–74 years, 75–84 years, and 85 years and older. While Kocatepe et al. (2018) defined the "oldest-old" as people aged 85 years and older, HelpAge International

(2012) defined 80 years or older as the "older-old". Some organisations also argued that the definition of older people as 50 years and older may be more suitable in developing countries, where many people live in hardship with health-related conditions typically present at earlier ages (HelpAge International, 2012).

By no means do we suggest the need for a single definition of older people. For example, older people differ in their health status, ranging from independently ambulatory to frail or bed-ridden (Silverman et al., 1995). While some are fit and healthy irrespective of age, others have particular health conditions and needs (Wang and Yarnal, 2012). Thus, age should not be the only indicator used to assess older people's vulnerability (Daddoust et al., 2018). Furthermore, as Bodstein et al. (2014, p. 179) noted, "old age as a symbolic concept, is interpreted by societies in accordance with their different cultural, historic and economic contexts". Therefore, we urge scholars and policymakers to develop conceptually informed definitions of older people and justify why particular age cut-off points are substantively salient in a given research, policy and practical context.

To fully understand how to meaningfully define "older people" and meet their needs in disasters, we need to develop and implement multidimensional assessments building on the ecology of older adults' interdependent needs identified in our review (cf. Figure 2). In addition to age, existing disaster vulnerability and need assessments have quite extensively captured people's physical and mental health status using, for example, the General Health Questionnaire (GHQ), Post-Traumatic Disorder Checklist – Civilian Version (PCL-C) and Cumulative Illness Rating Scale (CIRS), among others (Brown et al., 2010; Jia et al., 2010; Mecocci et al., 2000). A smaller body of research also focused on assessing older people's socioeconomic backgrounds such as education (Ardalan et al., 2010; Langer, 2004). Only a very limited number of exceptional studies assessed older people's past disaster experiences (Kantamaneni et al., 2022) and their attitudes toward evacuation (Rosenkoetter et al., 2007). By contrast, older people's information and communication needs and cultural needs are largely left unassessed, which should be key areas for improvement in future disaster response research and practice.

### 6.2 Intersectional understanding of older people's disaster experiences and needs

Researchers need to account for multiple intersectional social categories and vulnerabilities among older people. Intersectionality can be used as a useful theoretical underpinning to think about how to nuance our understanding of older people and their needs in disaster response (Cho et al., 2013; Collins, 2002; Crenshaw, 1991). The concept of intersectionality highlights how multiple social identities cut across and compound one another to shape older people's experiences and needs in disaster response besides age, including gender, sexuality, race, ethnicity, class and so on. Recognising older people's intersectional and diverse positions allows us to identify their multiple vulnerabilities in disasters. Only a few studies have attempted to recognise older people's intersectional needs: Cox and Kim (2018) examined the intersection between race, ethnicity and income, and Maltis (2019) considered older people with different types of disabilities. Future research must account for the diversity and complexity within older populations (Fountain et al., 2019).

As an example, gender is often an important dimension that underpins older people's intersectional needs. Gender intersects with age in shaping how older women and men are differently affected by disasters (HelpAge International, 2012). However, gender has been

largely overlooked in research on older people in disasters. Disasters can impact men and women differently (Jagnoor et al., 2019; Kantamaneni et al., 2022). For instance, health and care needs differ by gender (United Nations Economic Commission for Europe, 2020). Women often experience higher levels of depression-related symptoms than men in the aftermath of disasters (Seplaki et al., 2006). Gender differences were also observed in women's greater reliance on religious beliefs and coping during disasters (Brown et al., 2010).

In addition, race and income status can affect the vulnerabilities of older people. In the United States, for example, lower-income and older Hispanic people tend to be less prepared and resilient in disasters, compared with their higher-income and white counterparts (Cox and Kim, 2018). Adding to the complexity, race and income can often intersect with further social categories, such as gender (Howard et al., 2017a). Women, especially in low- and middle-income countries, tend to have a lower socioeconomic status than men (Lee et al., 2022). Compared with men, women tend to be more economically deprived due to their widespread exclusion from the labour market (Ahmadi et al., 2018b). For example, in the Philippines, older widowed women living in poverty identified employment or livelihoods as a key factor in building disaster resilience (Kwan, 2020).

### 6.3 Understanding the holistic disaster ecology of older people's needs

As we have identified in our review (cf. Sections 4.1 and 4.2), older people often have multiple interdependent needs in disasters. With a predominant focus on health-related matters, prior research has insufficiently responded to older people's other needs that can be equally important to their safety and wellbeing in disasters (Banks, 2013; Bayraktar and Yilmaz, 2018). Given that older people's different needs are closely interlinked, a preoccupation with health needs alone can undermine how older people's health needs are met in turn (Bayraktar and Yilmaz, 2018).

In this context, we underline the importance of understanding the holistic ecology of older people's needs in disasters. This means future research needs to go beyond a predominant focus on health needs and recognise the other needs discussed in Section 4.1, namely, socioeconomic, evacuation and settlement, information and communication, and cultural needs. Among these additional four major needs, we contend that cultural and information and communication needs require particular attention due to their apparent under-representation in existing literature.

Meanwhile, future research needs to examine the relationships between different types of needs in order to better understand how disaster responders can coordinate between the different needs, which will help achieve something greater than the sum of its different parts. It is clear from Section 4.2 that the five major needs are not isolated but interlinked. One need can reinforce another, and the failure to meet one can impede the meeting of another. Thus, we encourage disaster scholars, responders, governments and organisations to systematically and holistically consider different types of needs. Importantly, we highlight the need to consider the contextual embeddedness (i.e., place and temporality) of the needs.

### 6.4 Examining interlinked secondary disasters

Existing research tends to focus on a given natural disaster as an isolated event, paying insufficient attention to interlinked secondary disasters. When a natural disaster occurs, it can be accompanied by or trigger other disasters, which can further undermine older people's well-being. For example, a hurricane often entails flooding (McCann, 2011). Following Hurricane Sandy, power failures due to flood affected a number of nursing homes and care facilities (Malik et al., 2018). Earthquakes are often followed by numerous aftershocks (Toyabe et al., 2006), which can cause further damage to infrastructures and pose continuing risks to older adults. Although these few exceptional studies briefly mentioned the secondary disasters that followed the primary ones (Malik et al., 2018; McCann, 2011; Toyabe et al., 2006), none of the studies included in our systematic review explicitly discussed older people's needs in secondary disasters, and the interrelation between primary and secondary disasters is particularly overlooked.

Secondary disasters often strike in the aftermath of primary disasters that have made already-susceptible populations, such as older people, more vulnerable. In this context, disaster response efforts and future research should go beyond treating natural disasters as independent events and pay close attention to interrelated secondary disasters. A holistic multi-hazard approach to disaster response is urgently needed. Specifically, researchers need to examine and better understand the interconnections between multiple path-dependent natural and man-made disasters. In examining and responding to secondary disasters, researchers and disaster responders need to account for not only older people's pre-existing vulnerabilities that are heightened by the primary disasters but also new vulnerabilities and needs that may arise in the aftermath of the primary disasters among older adults. Only in so doing can we properly account for and mitigate the impact of disasters on older people and more fully meet their needs in disaster response.

### 6.5 Theoretically informed and empirically robust research

Future research needs to be more theoretically informed and empirically robust. Durant (2011) has highlighted the significance of employing an appropriate theoretical framework. As discussed in Section 2.2, however, only a few studies on older people in the context of disaster response explicitly use or develop theoretical frameworks. The underdeveloped state of theorising is also evident, as many studies passing through our initial search ($n$ = 503) adopted a grounded theory approach where no theoretical framework is employed or developed.

Meanwhile, while there are a number of empirical investigations drawing on diverse qualitative, quantitative and mixed methods, empirical studies that focus specifically on older people remain underdeveloped. Most studies draw on samples composed of a mix of multiple vulnerable populations (Cooper et al., 2022) or mixed-age groups (Brown et al., 2010; Lam et al., 2017; Magkos et al., 2004). Many studies that supposedly studied older people in disasters only indirectly investigated key informants such as caregivers, nurses, nursing home staff, aid workers and emergency management, but not older people themselves (Engelman et al., 2022; Fountain et al., 2019; Krongthaeo et al., 2021; Lee et al., 2022). Many studies that mention older people only did so to note their vulnerability rather than engage them as research participants.

There are also concerns regarding methodological rigour and quality. Previous quantitative studies mainly utilised descriptive statistics (Massey et al., 2017). In qualitative studies, superficial engagement between researchers and participants was a common weakness (Massey et al., 2017). In addition, many studies in this area used emergency department visits or hospital admissions to determine the impact of natural disasters on older people. This means older populations who did not have a need or may not have the means to visit the hospital are excluded from the impact analysis. Future research should develop more systematic and sophisticated methods to assess older people's disaster needs. Giving voice to older people themselves is a clear research and methodological priority.

In conclusion, to make significant advancements in research on disaster risk reduction, we need to bring to the fore a research agenda that attends to older people's needs in disaster response, particularly in rapidly expanding urban areas. To do so, we propose that future research needs (1) a conceptually informed, contextually salient and transparent working definition of older people, (2) an intersectional and nuanced understanding of older people's needs, (3) a holistic and longitudinal understanding of the disaster ecology of older people's needs, (4) a focus on secondary disasters arising from the focal natural disasters, and (5) more theoretically informed and empirically robust research that places the voice of older people at the centre of both theoretical thinking and research design. While we focus on the disaster response phase, future research could expand the scope to the disaster recovery phase to investigate older people's needs in the aftermath of a disaster, for example, in terms of the removal of disaster wastes, the restoration of memorabilia, and the rebuilding of homes.

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# Appendix A. 80 selected journal articles from Web of Science search

| # | Author(s) | Title | Journal |
|---|---|---|---|
| 1 | Ahmadi et al., 2018a | How did older adults respond to challenges after an earthquake? Results from a qualitative study in Iran | Archives of Gerontology and Geriatrics |
| 2 | Ahmadi et al., 2018b | Health needs of older adults after natural disasters: A systematic literature review | Trauma Monthly |
| 3 | Astill 2017 | Ageing in remote and cyclone-prone communities: Geography, policy, and disaster relief | Geographical Research |
| 4 | Astill and Miller 2018 | "We expect senior citizens to be able to prepare and recover from a cyclone as well as younger members of this community": Emergency management's expectations of older adults residing in aging, remote hamlets on Australia's cyclone-prone coastline | Disaster Medicine and Public Health Preparedness |
| 5 | Becquart et al., 2019 | Cardiovascular disease hospitalizations in Louisiana parishes' elderly before, during and after Hurricane Katrina | International Journal of Environmental Research and Public Health |
| 6 | Begum et al., 2022 | Assessing short-term and long-term mental health effects among older adults after Hurricane Sandy | Science of the Total Environment |
| 7 | Bell et al., 2021 | "Helping fill that gap:" A qualitative study of aging in place after disaster through the lens of home-based care providers | BMC Geriatrics |
| 8 | Benevolenza and DeRigne 2019 | The impact of climate change and natural disasters on vulnerable populations: A systematic review of literature | Journal of Human Behavior in the Social Environment |
| 9 | Bonnan-White 2017 | Independent-living senior communities in disaster: Self-Efficacy and trust in responding agencies | Journal of Homeland Security and Emergency Management |
| 10 | Brown et al., 2010 | After Hurricanes Katrina and Rita: Gender differences in health and religiosity in middle-aged and older adults | Health Care for Women International |
| 11 | Cherry et al., 2021 | Disaster stressors and psychological well-being in older adults after a flood | Psychology and Aging |
| 12 | Cherry et al., 2010 | Cognitive and psychosocial consequences of Hurricanes Katrina and Rita among middle-aged, older, and oldest-old adults in the Louisiana Healthy Aging Study (LHAS) | Journal of Applied Social Psychology |
| 13 | Cloyd and Dyer 2010 | Catastrophic events and older adults | Critical Care Nursing Clinics of North America |
| 14 | Cooper et al., 2022 | Building social resilience and inclusion in disasters: A survey of vulnerable persons' social media use | Australasian Journal of Information Systems |
| 15 | Cox and Kim 2018 | Race and income disparities in disaster preparedness in old age | Journal of Gerontological Social Work |
| 16 | Daddoust et al., 2018 | The vulnerability of the Iranian elderly in disasters: Qualitative content analysis | Iranian Journal of Nursing and Midwifery Research |
| 17 | Dostal 2015 | Vulnerability of urban homebound older adults in disasters: A survey of evacuation preparedness | Disaster Medicine and Public Health Preparedness |
| 18 | Durant 2011 | The utility of vulnerability and social capital theories in studying the impact of Hurricane Katrina on the elderly | Journal of Family Issues |
| 19 | Engelman et al., 2022 | Assessing the emergency response role of community-based organizations (CBOs) serving people with disabilities and older adults in Puerto Rico post-Hurricane Maria and during the COVID-19 pandemic | International Journal of Environmental Research and Public Health |
| 20 | Fatmah et al., 2021 | Broccoli-soybean-mangrove food bar as an emergency food for older people during natural disaster | International Journal of Environmental Research and Public Health |
| 21 | Fountain et al., 2019 | Older adults in disaster and emergency management: What are the priority research areas in Australia? | International Journal of Disaster Risk Reduction |

| # | Author(s) | Title | Journal |
|---|---|---|---|
| 22 | Fugate-Whitlock 2007 | Disaster evacuation: An exploratory study of older men and women in Georgia and North Carolina | Journal of Gerontological Nursing |
| 23 | Gutman and Yon 2014 | Elder abuse and neglect in disasters: Types, prevalence and research gaps | International Journal of Disaster Risk Reduction |
| 24 | Hasan et al., 2019 | Gender-inclusive disaster management policy in Bangladesh: A content analysis of national and international regulatory frameworks | International Journal Of Disaster Risk Reduction |
| 25 | He et al., 2016 | The population in China's earthquake-prone areas has increased by over 32 million along with rapid urbanization | Environmental Research Letters |
| 26 | Heid et al., 2017 | Challenges faced and support received: Older adults' perceptions of Hurricane Sandy | Disaster Medicine and Public Health Preparedness |
| 27 | Howard et al., 2018 | How social isolation affects disaster preparedness and response in Australia: Implications for social work | Australian Social Work |
| 28 | Howard et al., 2017a | "They'll tell us when to evacuate": The experiences and expectations of disaster-related communication in vulnerable groups | International Journal of Disaster Risk Reduction |
| 29 | Howard et al., 2017b | Older people as assets in disaster preparedness, response and recovery: Lessons from regional Australia | Ageing & Society |
| 30 | Jagnoor et al., 2019 | Exploring the impact, response and preparedness to water-related natural disasters in the Barisal division of Bangladesh: A mixed methods study | BMJ Open |
| 31 | Jia et al., 2010 | Are the elderly more vulnerable to psychological impact of natural disaster? A population-based survey of adult survivors of the 2008 Sichuan earthquake | BMC Public Health |
| 32 | Kilijanek and Drabek 1979 | Assessing long-term impacts of a natural disaster - focus on the elderly | Gerontologist |
| 33 | Kim and Zakour 2017 | Disaster preparedness among older adults: Social support, community participation, and demographic characteristics | Health And Quality Of Life Outcomes |
| 34 | Kim et al., 2022 | Health-related quality of life among older adults who experienced the Pohang earthquake in South Korea: A cross-sectional survey | Journal of Social Service Research |
| 35 | Kleier et al., 2018 | Hurricane preparedness among elderly residents in South Florida | Public Health Nursing |
| 36 | Kocatepe et al., 2018 | Pet- and special needs-friendly shelter planning in South Florida: A spatial capacitated p-median-based approach | International Journal of Disaster Risk Reduction |
| 37 | Krongthaeo et al., 2021 | Community-based flood preparedness for Thai dependent older adults | International Journal of Disaster Risk Reduction |
| 38 | Kwan 2020 | Factors and processes in the pre-disaster context that shape the resilience of older women in poverty | International Journal of Disaster Risk Reduction |
| 39 | Lam et al., 2017 | Urban disaster preparedness of Hong Kong residents: A territory-wide survey | International Journal of Disaster Risk Reduction |
| 40 | Langer 2004 | Natural disasters that reveal cracks in our social foundation | Educational Gerontology |
| 41 | Liang et al., 2017 | Increase of elderly population in the rainstorm hazard areas of China | International Journal of Environmental Research and Public Health |
| 42 | Malak et al., 2020 | "We are feeling older than our age": Vulnerability and adaptive strategies of aging people to cyclones in coastal Bangladesh | International Journal of Disaster Risk Reduction |
| 43 | Malik et al., 2018 | Vulnerability of older adults in disasters: Emergency department utilization by geriatric patients after Hurricane Sandy | Disaster Medicine and Public Health Preparedness |
| 44 | Massey et al., 2017 | Health needs of older populations affected by humanitarian crises in low- and middle-income countries: A systematic review | Conflict and Health |

| # | Author(s) | Title | Journal |
|---|---|---|---|
| 45 | McGuire et al., 2007 | Natural disasters and older US adults with disabilities: Implications for evacuation | Disasters |
| 46 | Mecocci et al., 2000 | Impact of the earthquake of September 26, 1997 in Umbria, Italy on the socioenvironmental and psychophysical conditions of an elderly population | Aging-Clinical and Experimental Research |
| 47 | Pang et al., 2020 | Exploring the information worlds of older persons during disasters | Journal of The Association for Information Science and Technology |
| 48 | Pekovic et al., 2007 | Planning for and responding to special needs of elders in natural disasters | Generations |
| 49 | Rosenkoetter et al., 2007 | Perceptions of older adults regarding evacuation in the event of a natural disaster | Public Health Nursing |
| 50 | Roth 2018 | A resilient community is one that includes and protects everyone | Bulletin of the Atomic Scientists |
| 51 | Sakauye et al., 2009 | AAGP position statement: Disaster preparedness for older Americans: Critical issues for the preservation of mental health | American Journal of Geriatric Psychiatry |
| 52 | Shenk et al., 2010 | Understanding the disaster experience of older adults by gender: The experience of survivors of the 2007 earthquake in Peru | Health Care For Women International |
| 53 | Silverman et al., 1995 | Lessons learned from Hurricane Andrew: Recommendations for care of the elderly in long-term care facilities | South Med Journal |
| 54 | Taghavifard and Yousefzadeh 2020 | A localized procedural model for cash-based assistance to livelihood and health of natural disasters' victims based on information technology | Iranian Red Crescent Medical Journal |
| 55 | Thompson et al., 2017 | Animal ownership among vulnerable populations in regional South Australia: Implications for natural disaster preparedness and resilience | Journal of Public Health Management and Practice |
| 56 | Toyabe et al., 2006 | Impaired psychological recovery in the elderly after the Niigata-Chuetsu earthquake in Japan: A population-based study | BMC Public Health |
| 57 | Wang 2018 | Bracing for hurricanes: A qualitative analysis of the extent and level of preparedness among older adults | Gerontologist |
| 58 | Wang and Yarnal 2012 | The vulnerability of the elderly to hurricane hazards in Sarasota, Florida | Natural Hazards |
| 59 | Yoshida et al., 2022 | Effects of the 2018 Japan floods on long-term care insurance costs in Japan: Retrospective cohort study | BMC Public Health |
| 60 | Ardalan et al., 2010 | Older people's needs following major disasters: A qualitative study of Iranian elders' experiences of the Bam earthquake | Ageing & Society |
| 61 | Banks, 2013 | Caring for elderly adults during disasters: Improving health outcomes and recovery | Southern Medical Journal |
| 62 | Bhalla et al., 2015 | Geriatric disaster preparedness | Prehospital and Disaster Medicine |
| 63 | Bodstein, 2014 | The vulnerability of the elderly in disasters: The need for an effective resilience policy | Ambiente & Sociedade |
| 64 | Douglas et al., 2019 | Evacuating people and their pets: Older Floridians' need for and proximity to pet-friendly shelters | The Journals of Gerontology: Series B |
| 65 | Efendi et al., 2022 | Policymakers' perspectives on responding to the elderly's mental health needs in post-disaster situations | Journal of Public Health Research |
| 66 | Fernandez et al., 2002 | Frail elderly as disaster victims: Emergency management strategies | Prehospital and Disaster Medicine |
| 67 | Lee et al., 2018a | Factors contributing to disaster evacuation: The case of South Korea | Sustainability |

| # | Author(s) | Title | Journal |
|---|---|---|---|
| 68 | Lee et al., 2018b | Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department | Clinical and Experimental Emergency Medicine |
| 69 | Loke et al., 2012 | At-home disaster preparedness of elderly people in Hong Kong | Geriatrics & Gerontology International |
| 70 | Magkos et al., 2004 | Nutritional risk following a major disaster in a previously well-nourished population: Who is vulnerable? | Public Health. |
| 71 | Maltais, 2019 | Elderly people with disabilities and natural disasters: Vulnerability of senior citizens and post trauma | Gerontology & Geriatric Medicine |
| 72 | McCann, 2011 | A review of hurricane disaster planning for the elderly | World Medical & Health Policy |
| 73 | Morrow, 1999 | Identifying and mapping community vulnerability | Disasters |
| 74 | Phillips and Morrow, 2007 | Social science research needs: Focus on vulnerable populations, forecasting, and warnings | Natural Hazards Review |
| 75 | Rey et al., 2017 | An integrative approach to understand vulnerability and resilience post-disaster: The 2015 Cyclone Pam in urban Vanuatu as case study | Disaster Prevention and Management |
| 76 | Thoban and Hizbaron, 2020 | Urban resilience to floods in parts of Makassar, Indonesia | E3S Web of Conferences |
| 77 | Tyler and Moench, 2012 | A framework for urban climate resilience | Climate and Development |
| 78 | Whitton, 2018 | Social recovery for the elderly: Learnings from South-West Queensland | Australian Journal of Emergency Management |
| 79 | Zhu and Sun, 2018 | Recognising and promoting the unique capacities of the elderly | International Journal of Emergency Management |
| 80 | Zoraster et al., 2007 | Disaster management of chronic dialysis patients | American Journal of Disaster Medicine |

## Appendix B. 23 selected publications from additional citation check

| # | Author(s) | Title | Journal |
|---|---|---|---|
| 1 | Adams et al., 2011 | Aging disaster: Mortality, vulnerability, and long-term recovery among Katrina survivors | Medical Anthropology |
| 2 | Bayraktar and Yilmaz, 2018 | Vulnerability of elderly people in disasters: A systematic review | Turkish Journal of Geriatrics |
| 3 | Bongaarts, 2015 | Global fertility and population trends | Seminars in reproductive medicine |
| 4 | Cho et al., 2013 | Toward a field of intersectionality studies: Theory, applications, and praxis | Sign: Journal of Women in Culture and Society |
| 5 | Collins, 2002 | Black feminist thought: Knowledge, consciousness, and the politics of empowerment | |
| 6 | Crenshaw, 1991 | Mapping the margins: Intersectionality, identity politics, and violence against women of color | Stanford Law Review |
| 7 | Evans, 2005 | Malnutrition in the elderly: A multifactorial failure to thrive | The Permanente Journal |
| 8 | Forsyth et al., 2019 | Improving housing and neighborhoods for the vulnerable: Older people, small households, urban design, and planning | Urban Design International |
| 9 | Wisner et al., 2012 | Handbook of hazards and disaster risk reduction | Book |
| 10 | Jarzebski et al., 2021 | Ageing and population shrinking: Implications for sustainability in the urban century | NPJ Urban Sustainability |
| 11 | Kantamaneni, 2022 | Impact of coastal disasters on women in urban slums: A new index | Sustainability |
| 12 | Klinenberg, 2001 | Dying alone: The social production of urban isolation | Ethnography |
| 13 | Kriebel-Gasparro, 2022 | Climate change: Effects on the older adult | The Journal for Nurse Practitioners |
| 14 | Knodel et al., 2015 | The situation of Thailand's older population: An update based on the 2014 Survey of Older Persons in Thailand | Research Collection School of Social Sciences |
| 15 | Maltz, 2019 | Caught in the eye of the storm: The disproportionate impact of natural disasters on the elderly population in the United States | Elder Law Journal |
| 16 | Gibson and Hayunga, 2006 | We can do better: Lessons learned for protecting older persons in disasters | AARP Public Policy Institute |
| 17 | Lee et al., 2022 | Gender matters: The role of women in community-based disaster risk management in Taiwan | International Journal of Disaster Risk Reduction |
| 18 | Oriol, 1999 | Psychosocial issues for older adults in disasters | Center for Mental Health Service |
| 19 | Pinkowski, 2008 | Disaster management handbook | Book Chapter (CRC Press) |
| 20 | Safitri et al., 2020 | Analysis of hydro climatological disaster management for resilient city in Surabaya | EasyChair Preprint |
| 21 | Seplaki et al., 2006 | Before and after the 1999 Chi-Chi earthquake: Traumatic events and depressive symptoms in an older population | Social science & Medicine |
| 22 | Wisner et al., 2004 | At risk: Natural hazards, people's vulnerability and disasters | Book |
| 23 | Willets et al., 2004 | Longevity in the 21st century | British Actuarial Journal |

## Appendix C. Additional publications from citation check (17 organisational reports)

| # | Source | Title | Web link |
|---|---|---|---|
| 1 | HelpAge International, 2000 | Older people in disasters and humanitarian crises: Guidelines for best practice | https://www.helpage.org/silo/files/older-people-in-disasters-and-humanitairan-crises-guidelines-for-best-practice.pdf. |
| 2 | HelpAge International, 2012 | Ensuring inclusion of older people in initial emergency needs assessments | https://www.humanitarianlibrary.org/sites/default/files/2019/10/Needs%20assessment%20-FINAL.pdf. |
| 3 | Ritchie and Roser, 2018 | Urbanization. Our world in data | https://ourworldindata.org/urbanization |
| 4 | Sands and Cursino, 2022 | Afghan earthquake: Hundreds killed and scores wounded, says state media BBC News | https://www.bbc.com/news/world-asia-61890804 |
| 5 | Sphere Association, 2018 | Sphere handbook: Humanitarian charter and minimum standards in humanitarian response | https://spherestandards.org/wp-content/uploads/Sphere-Handbook-2018-EN.pdf |
| 6 | Sphere Project, 2011 | Humanitarian charter and minimum standards in humanitarian response | https://www.unhcr.org/50b491b09.pdf |
| 7 | International Federation of Red Cross and Red Crescent Societies, 2005 | World disasters report 2005: Focus on information in disasters | https://www.alnap.org/help-library/world-disasters-report-2005-focus-on-information-in-disasters |
| 8 | United Nations Development Programme, 2020 | Urban climate resilience | https://www.undp.org/publications/undp-issues-brief-urban-climate-resilience. |
| 9 | United Nations Office for Disaster Risk Reduction, 2022a | Understanding disaster risk | https://www.preventionweb.net/understanding-disaster-risk/component-risk/exposure. |
| 10 | United Nations Office for Disaster Risk Reduction, 2022b | Poorly planned urban development | https://www.preventionweb.net/understanding-disaster-risk/risk-drivers/poorly-planned-urban-development |
| 11 | United Nations Economic Commission for Europe, 2020 | UNECE policy brief on ageing No. 25 | https://unece.org/fileadmin/DAM/pau/age/Policy_briefs/ECE_WG1_36_PB25.pdf. |
| 12 | United Nations Office for Disaster Risk Reduction, 2015a | Global assessment report on disaster risk reduction (GAR) 2015 | https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2015. |
| 13 | United Nations Office for Disaster Risk Reduction, 2015b | Sendai framework for disaster risk reduction 2015-2030 | https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030. |
| 14 | Wallen, 2022 | At least 130 dead as floods swamp Bangladesh and India. The Telegraph | https://www.telegraph.co.uk/global-health/climate-and-people/least-130-dead-floods-swamp-bangladesh-india/. |
| 15 | World Health Organization,2022 | Ageing | https://apps.who.int/disasters/repo/7656.pdf. |
| 16 | World Health Organization Department of Emergency and Humanitarian Action, 2002 | Disasters & emergencies definitions | https://www.who.int/health-topics/ageing. |
| 17 | World Meteorological Organization, 2022 | Natural hazards and disaster risk reduction | https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction#:~:text=Natural%20hazards%20are%20severe%20and,lives%20and%20livelihoods%20are%20destroyed |