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#### REVIEW ARTICLE

## VULNERABILITY OF ELDERLY PEOPLE IN DISASTERS: A SYSTEMATIC REVIEW

### ABSTRACT

**Introduction:** Disasters significantly affect the physical, emotional, and psychological health of individuals and result in high numbers of deaths, injuries, and economic losses. Elderly people are among the groups most vulnerable to the negative impacts of disasters. In this direction, this systematic review aims to provide an overview of relevant studies on the vulnerability of elderly populations during disasters.

**Materials and Method:** A literature search was conducted from 2000 to 2017 using MEDLINE, Pub Med, Science direct, and Scopus and Cochrane libraries. This review was conducted in September 2017, and the keywords included "older adults", "elderly", "disasters", "vulnerable groups." In total, 29 research articles composed the main sample of the study.

**Results:** Several studies have found that older adults are vulnerable in disasters. The results of these studies were examined and are presented according to the physical effects, psychosocial effects, relocation trauma, and ethical aspects as the main themes.x

**Conclusion:** In countries with rapidly aging populations, a large number of vulnerable elderly people require assistance in the event of a disaster. Many studies have reported that the health of these vulnerable populations is frequently worsened by disasters, to the point of a higher incident of fatal consequences. Therefore, disaster planning needs to include strategies for attending to care-giving needs, unique psychosocial needs, relocation trauma, medications, and medical needs of this population.

**Keywords:** Aged; Disasters; Vulnerable populations; Disaster planning

#### DERLEME MAKALE

## AFETLERDE YAŞLILARIN İNCİNEBİLİRLİĞİ: SİSTEMATİK DERLEME

### Öz

**Giriş:** Afetler, bireylerin fiziksel, duygusal ve psikolojik sağlıkları üzerinde önemli etkilere sahiptir ve ölüm, yaralanma ve ekonomik kayıpların artmasına neden olur. Afetlerin olumsuz etkilerine karşı en incinebilir gruplardan biri yaşlılardır. Bu sistematik derlemenin amacı, yaşlı nüfusun afetlerde incinebilirliğine ilişkin ilgili çalışmalara genel bir bakış sunmaktır.

**Gereç ve Yöntem:** MEDLINE, Pub Med, Science direct, Scopus ve Cochrane kütüphaneleri kullanılarak 2000'den 2017 yılına kadar literatür araştırması yapıldı. Bu inceleme Eylül 2017'de gerçekleştirildi ve anahtar sözcükler "yaşlılar", "afetler", "incinebilir gruplar" idi. Toplam 29 araştırma makalesi, çalışmanın ana örneklemini oluşturdu.

**Bulgular:** Birçok çalışma afetlerde yaşlı bireylerin incinebilir olduğunu belirlemiştir. Bu çalışmaların sonuçları fiziksel etkilere, psikososyal etkilere, yer değiştirme travmasına ve etik konulara ilişkin ana temalara göre sunulmuştur.

**Sonuç:** Hızla yaşlanan nüfusa sahip ülkelerde, çok sayıda incinebilir yaşlı afet durumunda yardıma ihtiyaç duymaktadır. Birçok çalışma, bu incinebilir nüfusun sağlığının, afetler sonucunda sıklıkla ölümcül sonuçlara varabilecek şekilde kötüleştiğini rapor etmiştir. Afet planlaması, bu nüfusun bakım gereksinimlerine, bireysel psikososyal ihtiyaçlarına, yer değiştirme travmasına, ilaçlarına ve tıbbi gereksinimlerine yönelik stratejiler içermelidir.

**Anahtar Sözcükler:** Yaşlı; Afetler; İncinebilir gruplar; Afet planlaması

## INTRODUCTION

Disasters are extraordinary and catastrophic events that affect thousands of people and occur somewhere in the world every day despite several economic, social, and scientific developments. Disasters have significant effects on the physical, emotional, and psychological health of individuals and result in high numbers of deaths, injuries, and economic losses (1-3).

The World Disasters Report noted a 60% increase in disasters in the last decade. According to the World Disasters Report in 2013, proposed by the International Federation of Red Cross and Red Crescent Societies, during the period 2003–2012, 6699 disasters occurred, causing 1.1 million deaths and 2,167.4 million injuries. Earthquakes and tsunamis occurred in Indonesia and neighboring countries in 2004 and in Japan in 2011. An earthquake in Asia occurred in 2004 and left at least 266,000 dead (1). Over the past 30 years, natural disasters have affected over 16 million Australians, causing almost AU\$40 billion dollars' worth of damage and killing thousands of people (3).

During any disaster, there are some demographic groups of people who are more vulnerable than others. Elderly people are among the groups most vulnerable to the negative impacts of disasters (4-6). The World Health Organization has identified older adults as a vulnerable population that is more likely to be at a greater risk in a disaster. The worldwide population of people aged 65 years or older is predicted to increase from 550 million to 973 million between 2000 and 2030. Globally, the population of older people will exceed the number of children for the first time in 2045, and by 2050, the proportion of older people will rise to 22%. Therefore, the number of older adults who will be negatively impacted by disasters will continue to rise as this demographic group increases over time (6).

Disaster statistics frequently report higher mortality and morbidity rates for older adults compared to the rest of the population. In the 2011

Japanese Tsunami, 77% of the people who died were aged 65 or older (5). In the great Hanshin Earthquake, more than half of the fatalities were among people over 60 years of age. The same patterns were observed in the Guatemalan and Armenia earthquakes, in which higher death rates were observed among elderly populations (7). Among the fatalities from the Aceh (Indonesia) Tsunami in 2004, the highest death rate was recorded for those over 60 years old. When Hurricane Katrina hit New Orleans in 2005, 71% of the people killed were aged 60 years and above (3).

In regions with rapidly aging populations, vulnerable elderly people need assistance in the event of a disaster. Along this line, this systematic review aimed to show the known vulnerability of elderly people in disaster situations. The study provides a general overview of relevant studies on the vulnerability of elderly populations during disasters and identifies research gaps. Results of this review may be useful in establishing appropriate disaster-management plans.

## MATERIALS AND METHOD

### Data sources

For the instant study, a literature search was conducted from 2000 to 2017 using MEDLINE, Pub Med, Science direct, and the Scopus and Cochrane libraries. This review was conducted in September 2017, and the keywords included "older adults", "elderly", "disasters", "vulnerable populations".

### Inclusion criteria

Research articles from 2000 to 2017 that focused on topics relevant to the research question were included in this review. Because the present review was intended to provide a general overview of studies on the vulnerability of elderly populations during disasters, there was no limitation on the study type, and all types of full-text research articles were included. The articles reviewed included ecological, descriptive, retrospective cohort, prospective



cohort, quasi-experimental, methodological, and qualitative and systematic reviews, published in academic journals.

### Exclusion criteria

The study excluded articles published before 2000, non-English articles, not full-text access articles, those published in non-academic journals, those that did not focus on the vulnerability of elderly people during disasters. Fig. 1 gives a quick review of the search and selection of papers in the present study process.

### Risk of bias assessment

The risk of bias assessment was performed by two researchers by using the Cochrane risk of bias tool. The assessment included selection bias (random sequence generation and allocation concealment), performance bias, detection bias, attrition bias, reporting bias, and "other" bias. Biases were rated as "low," "unclear," or "high" risk. The researchers independently performed bias assessment, and disagreements were resolved through discussion. The potential for bias in all the reviewed studies was estimated as "low".

## RESULTS

Ninety-five articles were accessed in the first search, of which 60 were related to the vulnerability of the elderly in disasters. From these articles, eight articles were not accessed as full-text, and 23 articles did not directly focus on the research question. Finally, 29 articles focusing on the research question composed the main sample of the present systematic review (2,3,5,7-32) (Table 1). The results of these studies were examined and are presented according to the physical effects, psychosocial effects, relocation trauma, and ethical aspects as main themes (Table 2).

### Physical effects:

Older adults have less physiologic reserves when their body is stressed. Physiologic changes including decreased bone mass, diminished fat stores, loss of

subcutaneous tissues, and muscle atrophy leave an elderly body prone to more severe injuries (7, 17). Having chronic illnesses that need specific treatment interventions, slower reaction times, and difficulties in seeking assistance may increase their susceptibility to the impact of disasters (17).

Zhang et al. determined that during the Wenchuan earthquake, elderly victims who experienced being crushed by heavy debris more frequently developed acute kidney injury (AKI). Elderly patients with AKI requiring dialysis were at a relatively higher risk of mortality and had a greater incidence of pneumonia than younger patients. Sepsis was independently associated with mortality in the elderly (7).

In a study from Greece on the nutritional status of vulnerable groups who had experienced an earthquake, it was shown that dietary energy and protein intake in elderly were inadequate due to multiple physiological and psychological factors (8).

Furthermore, Brilleman et al. indicated in their article that exposure to a disaster could worsen disability by disrupting the adapted environment that individuals had crafted around themselves to mitigate physical risks for disability. Disasters may disrupt ongoing medical care for therapies ranging from daily insulin availability to longitudinal chemotherapy courses (14). Tomata et al. performed an ecological study to determine whether the disability prevalence among the elderly population increased after the Great East Japan earthquake. This analysis showed that disability prevalence in disaster-stricken areas increased more markedly over three years after the Great East Japan Earthquake (13). Wu et al. (2015) investigated the health status and health-related quality of life (HRQoL) of the elderly in the city of Bazhong after a major flood in 2011. The results indicated a marked decline in the health status among the elderly (27). Additionally, results of Zhu and Sun's study showed that in the 2008 Wenchuan earthquake and the 1995 Kobe earthquake, mortality rates were higher than that of children (17).

### **Psychosocial effects**

Many survivors of disasters experience psychosocial problems in their adjustment to the loss of resources (e.g., housing and belongings) or loved ones. Post-traumatic stress disorder (PTSD) is the most frequently reported psychiatric morbidity among disaster victims. Numerous studies have documented the estimated rate of probable PTSD or PTSD symptoms among elderly people after disasters (10, 30-32). In a population-based sample of the 33,340 flood victims in China, Liu et al. reported that the risk of PTSD increased in older victims (31). Symptoms of PTSD, such as re-experiencing, emotional numbing and avoidance, and heightened arousal, are among the most commonly reported and examined mental health outcomes (10, 32). A longitudinal prospective quantitative study of 274 older Australians found that those who were affected by a flood reported significantly higher PTSD symptoms, with one in six reporting PTSD symptoms that might require clinical attention (32). Tanji et al. (2017) demonstrated that psychological distress was associated with an increased risk of functional disability among elderly survivors of a natural disaster (12).

There were several studies on the social vulnerability of the elderly in disasters (1,2,29). In Tuohy et al.'s study, social vulnerability was linked to three themes including personal protection, practical preparedness, and social preparedness (1). Cherry et al. found that perceived social support had a protective effect for all mental health outcomes, which also held for symptoms of depression and generalized anxiety disorder in multivariate models (2). Fatemi et al.'s systematic review highlights the indicators of social vulnerability in disasters. Elderly people living alone are dependent on others and are likely to require protection, financial support, transportation, medical care, access to medication, and assistance with ordinary daily activities during disasters (29).

In contrast to the above research, some research suggests that elderly disaster survivors are relatively resilient and tend to report fewer negative emotional effects and those prior experiences of disasters reduce adverse psychological effects (15, 26). Chronological age, life experience, and prior experience of coping with disasters may lead to many older adults having more coping resources and increased resilience. Rafiey et al. (2016) showed a higher level of positive mental health among elderly earthquake survivors compared to their younger counterparts in the wake of natural disasters, which suggests that advanced age per se does not contribute to increased vulnerability (26). Behavioral examples of older adults displaying resilience during disasters include providing support to family, friends, and the local community; assisting in disaster recovery; engaging with social networks to provide emotional support for other victims; and using the event as a source of spiritual growth or personal learning (15).

### **Relocation trauma**

Studies have reported that the relocation of elderly inpatients increases their mortality risk (9,11). After the accident at the Fukushima Daiichi nuclear power plant, which followed the Great East Japan Earthquake, analysis showed excess mortality due to evacuation, which reflected increased vulnerability of institutionalized elderly to change and their need for special attention and care in disaster evacuations. Pneumonia was the most common cause of death, indicating the influence of poor living conditions during relocation (9).

### **Ethical aspects**

A systematic review by Gutman and Yon highlights the ethical aspect of elderly vulnerability in disasters. They have reported that the elderly as a vulnerable group may be at the risk of exposure to ethical problems. Ethical problems include financial abuse, most commonly theft in shelters and contractor fraud, neglect (primarily abandonment), and actual physical abuse (domestic violence) (19).



Table 1. Studies of disaster vulnerability of the elderly.

Author/ publication date	Place	Design	Aim	Study period	Sample/ Specificities of population	Key findings
Magkos et al. (2004) (8)	Greece: Athens	Descriptive study	To assess the nutritional status of the homeless and identify the groups at risk of under-nutrition following the earthquake.	1999–2000	225 homeless and temporarily housed after the earthquake: 80 men, 145 women, Two major camps in the area: Aetos camp (tents, 47 men and 76 women) Kaputa camp (prefabricated houses, 33 men and 69 women).	Inadequate dietary energy and protein intake during Greece Earthquake.
Liu et al. (2006) (31)	China: Hunan	Descriptive study	To estimate the occurrence and to assess the determinants of post-traumatic stress disorder (PTSD) in flood victims.	2000	33,340 flood victims: A total of eight counties, 40 towns, 310 villages, 13,450 households, and 38,760 individuals aged seven years or older.	The risk of PTSD increased in older victims.
Spitzer et al. (2008) (30)	Germany	Descriptive study	To determine the risk of trauma exposure and subsequent PTSD in an elderly community sample.	2002–2006	3170 adults living in a German community within three age groups: young (44 years and younger; N = 997), middle-aged (45–64 years; N = 1322), and elderly (65 years and older; N = 851).	Higher rates of trauma exposure in older adults compared to younger and middle-aged adults. PTSD is not rare in the elderly and some may have a lifetime diagnosis of PTSD, which is associated with symptoms of depression and anxiety.
Zhang et al. (2012) (7)	China: Sichuan province	Descriptive study	To compare epidemiological and clinical features of crush-related acute kidney injury (AKI) between elderly and younger adults in the Wenchuan earthquake.	2008	17 reference hospitals: 228 patients, 211 adult patients aged between 15 and 96 years. 45(19.7%) old adults aged 65 years or older. 118(55.9%) men.	More frequent AKI and dialysis associated with relatively high risk of mortality. Greater incidence of pneumonia than younger patients. Sepsis associated with mortality.

Tuohy and Stephens (2012) (22)	New Zealand: Kaitiata	Narrative interviews	To analyze stories told by older adults about their experiences of a flood disaster from a life-course perspective.	No information	Nine older adults: four participants lived in a rest home (two were male and two were female aged between their late 70s and late 80s); and five participants lived alone (two were male and three were female aged between their late 60s and late 70s).	Disasters became a reference point for previous challenging experiences, which created biographical continuity, coherence, and order over time.
Kun et al. (2013) (10)	China: Wenchuan	Descriptive study	To estimate the prevalence of PTSD and assess determinants related to PTSD symptoms among adult earthquake survivors.	2008	2004 respondents from households (91% participation rate). The median age of participants was 35.2 years, and the mean age was 36.1 years (range 15–80 years).	Older age was an independent risk factor for PTSD symptoms in heavily damaged areas.
Yasumura et al. (2013) (9)	Japan: Fukushima	Descriptive study	To report data on excess mortality among relocated institutionalized elderly after the nuclear disaster.	2011	1,770 institutionalized elderly at 34 community facilities: Seventy percent (207/295) of the deaths after the disaster occurred among women, and 93% (244/262) of deaths occurred in individuals aged ≤75 years.	Excess mortality reflecting the vulnerability of institutionalized elderly to disaster evacuation. Pneumonia was the most common cause of death.
Claver et al. (2013) (5)	US: New Orleans, Gulfport, Biloxi, Houston	Qualitative case study	To provide information about the evacuation experiences and characteristics of vulnerable nursing home residents.	2007	Thirteen nursing home administrative and clinical staff and medical center administrators: Eight of whom held primarily administrative roles at the time of the hurricanes, two of whom had a clinical role, and three of whom characterized their role as both administrative and clinical.	Physical harm, psychological distress, cognitive decline, and increased social isolation were areas deserving special attention for this vulnerable population.
Beiet al. (2013) (32)	Australia: Victoria, New South Wales	Longitudinal prospective study	To examine the impact of floods on the mental and physical health of older adults and explored risk and protective factors.	2010	274 older adults: Mean age of 71.69; most were married or in de facto relationships (80.9%); over half (64.8%) were retired.	Those who were affected by a flood (21%) reported significantly higher PTSD symptoms, with one in six reporting PTSD symptoms that might require clinical attention.



Gutman and Yon (2014) (19)	An electronic search of the databases.	Systematic review	To provide an overview of what is known about elder mistreatment in disaster situations, identify research gaps, and discuss possible policy interventions.	2012	A total of 19 articles, chapters, reports, and one dissertation that mentioned elder mistreatment during or in the aftermath of a disaster.	The types of abuse most commonly occurring included financial (theft in shelters and contractor fraud), neglect (primarily abandonment), and physical abuse (domestic violence).  Three central themes were identified: personal protection, practical preparedness, and social preparedness. The findings provide future practical direction for age specific preparedness planning during non-disaster times, which will also assist with improving outcomes for independent older adults during and after a disaster.
Tuohyet al.(2014) (18)	New Zealand: Canterbury	Qualitative study	To understand the meanings of preparedness from a sample of older adults who experienced the Canterbury earthquakes.	2012	10 older adults aged between 66 and 90 years (median age 80 years)	A marked decline in health status among elderly.
Wu et al. (2015) (27)	China: Bazhong	Cross-sectional survey	To provide assessment of post-disaster health-related quality of life (HRQoL) and the underlying associated factors among the elderly in the flood-affected Southwest China.	No information	1,183 elderly: The mean age was 68.9±7.8 years (range 60–99 years); male-to-female ratio was 1.4:1. Most of the participants received primary education (73.8%) or below.	
Tomata et al. (2015) (13)	East Japan	Ecological study	To examine the increase in the rate of disability prevalence among the older population during the three years after the Great East Japan Earthquake.	2010–2014	1,570 municipalities: Mean number of insured elderly persons aged 65 years was 19,346 in the coastal disaster areas, 9787 in the inland disaster areas, and 18,969 in the non-disaster areas.	The mean rate of increase in disability prevalence in coastal and inland disaster areas was higher than that in non-disaster prone areas.

Miller and Brockie (2015) (15)	Australia: Queensland	Qualitative study	To explore the individual experiences of older adults during the Queensland floods.	2013	10 older adults: Aged over 65 years, lived independently in their homes and had been evacuated in both the 2011 and 2013 Queensland floods.	Poems highlight the different social resources older people have to draw on in their lives, especially during a crisis, and how they are supported.
Cherry et al. (2015) (2)	US: Louisiana	Descriptive study	To examine long-term psychological outcomes in older adults after disaster.	No information	219 older residents of disaster-affected communities in south Louisiana.	Non-organizational religiosity was a significant predictor PTSD. Low income was a significant predictor of depression symptoms. Perceived social support had a protective effect for all mental health outcomes.
Al-rousan et al. (2015) (28)	US	Cohort study	To determine natural disaster preparedness levels among older US adults and assess factors that may adversely affect health and safety during such incidents.	2010	1,304 older adults; the average age was 70.2 years. Most had an educational attainment beyond a high-school diploma (79.0%), and 25.7% lived alone.	Preparedness scores indicated that increasing age, physical disability, lower educational attainment, and income were independently and significantly associated with poorer overall preparedness.
Rafey et al. (2016) (26)	Iran: East Azerbaijan	Cross-sectional survey	To examine the post-disaster mental health differences between elderly and younger adult survivors after an earthquake in Iran.	2015	324 earthquake survivors: The elderly group comprised 56 elderly persons aged $\geq 60$ years. The young group (aged 18–30 years) included 268 respondents.	A higher level of positive mental health among elderly earthquake survivors compared to their younger counterparts in natural disasters.
Nomura et al. (2016) (11)	Japan: Fukushima	Descriptive study	To assess associations between evacuation and mortality after the Fukushima nuclear incident.	2013	1,215 residents admitted to seven elderly care facilities: 409 elderly are female. 262 elderly are at the ages of 80–89 years	Initial evacuation from the original facility associated with 3.37 times higher mortality risk than non-evacuation.





Kwok and Ku (2016) (16)	China: Hong Kong	Cohort study	To challenge the dominant biomedical discourse on aging, neglecting the integrative and cultural perspectives that provide a meaningful understanding of human aging.	No information	Eight older adults between the ages of 75 and 93.	The study participants had struggled for survival through unprecedented political disasters and social turmoil in their youth.
Annear et al. (2016) (20)	Japan: Kansai, Okinawa and Tohoku	Descriptive study, Constitution of a scale	To explore perceptions of vulnerability to disasters in the context of population aging. To test the reliability and validity of the Perceptions of Ageing and Disaster Vulnerability Scale (PADVS)	2016	172 health students and professional; over 75% of the cohort were undergraduate nursing students, and the majority were women.	The PADVS provides a reliable and valid measure. Results of PADVS completion showed clear respondent concerns about social isolation, lack of support networks, and poor functional capacity among older adult populations.
Sugano (2016) (23)	East Japan	Quasi-experimental	To explore the wellbeing of elderly survivors after natural disasters	No information	4,619 survivors of the 2009 wave, 3,572 survivors of the 2011 wave and earthquakes	The results by difference-in-difference estimation show that there was a significant impact on expenditure and employment, but little significant impact on subjective well-being or health.
Tsukasaki et al. (2016) (25)	Eastern and Western Japan	Semi-structured survey	To clarify preparedness measures and the support necessary to protect the health of community-dwelling vulnerable elderly people in natural disasters by analyzing their status and the challenges they face.	2013	Centers managed or contracted by municipalities and are operated by three types of professionals: care managers, social workers, and nurses; 304 centers responded (response rate, 20.5%).	The disaster preparedness of elderly users requiring support was insufficient in 150 (51.9%) centers.

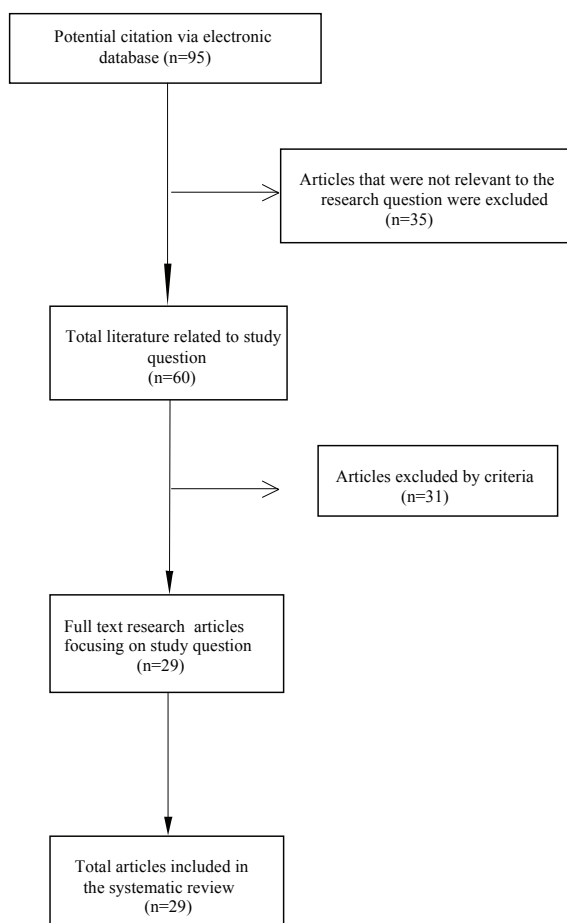
Tanji et al. (2017) (12)	East Japan	Prospective cohort	To examine whether psychological distress would have increased the incident risk of functional disability among elderly survivors after the Great East Japan Earthquake.	2011–2014	1,037 older residents: Mean age was 73.8; 45.8% elderly were men.	Psychological distress was associated with an increased risk of functional disability among elderly survivors of a natural disaster.
Brockie and Miller (2017) (3)	Australia: Queensland	Qualitative study	To explore older residents' experiences of floods.	2013	10 older residents: Six women and four men who were evacuated from their homes during both the 2011 and 2013 Queensland floods. Average age of 73 years (ranging from 67 to 83 years).	Many older people had lived through multiple floods and were just beginning to acknowledge how aging, specifically their increasing frailty, was changing and impacting their ability to prepare, respond to, and recover from a severe weather event.
Brilleman et al. (2017) (14)	US Federal Emergency Management Agency	Longitudinal and time to event (Joint modeling approach)	To determine associations between community-level disaster exposure and individual-level changes in disability and death risk for older Americans.	2000–2010	18,102 American individuals aged 50–89 years, who were participating in the national longitudinal Health and Retirement Study.	There was no evidence of an association between community-level disaster exposure and individual-level changes in disability of risk of death.
Zhu and Sun (2017) (17)	China: Wenchuan Japan: Kobe	Descriptive study	To evaluate whether age has an impact on mortality rate, explores age groups with the greatest vulnerabilities of the earthquake.	2008–2010	Age groups from the 2008 Wenchuan and 1995 Kobe Earthquakes	There was greater significance in the relationship between people over 75 years of age and the mean mortality rate than that of children.
Howard et al. (2017) (21)	Australia: New South Wales	Qualitative study	To report experiences and expectations of vulnerable groups including older people.	2014	111 community members in 17 focus groups: Female (70%); male (30%); people over the age of 65 years (37%), people with disabilities (31%).	Three core themes emerged: trust, hope, and source credibility; preferred communicative technologies; and clarity and confusion during a crisis.



Astill (2017) (24)	Australia: Queensland	Exploratory, mixed methodologies, phenomenological approaches	Focusing on the experience of more vulnerable older residents, the aim of this research was to explore how regional Australian coastal communities have coped with repeated natural disasters.	2014–2015	Senior respondents aged 65 years or older (N = 36, 17 men and 19 women); Emergency services officers (N = 10); community healthcarers (N = 7); local government disaster managers (N = 4).	Post-disaster political decisions have had a negative long-term impact on local economies, causing out-migration by those seeking employment and resulting in many elderly residents facing a future without family support.
Fatemi et al. (2017) (29)	Bibliographies, citation databases, and other available records	Systematic review	To review the social vulnerability indices and their validity in disasters within the period 1985–2015 and to develop a suitable classification to make sense of social vulnerability indices in the Iranian context.	2015	43 peer-reviewed English and Persian language journals. Excluding snowball material, all other sources of written material were obtained using the same search strategy.	The study highlights the indicators of social vulnerability in disasters. People aged 65 years and above are also likely to be more vulnerable to disasters and require special treatment by disaster response planners and operational officers.

**Table 2.** Features and factors associated with disaster vulnerability of elderly people.

Features/factors associated with disaster vulnerability of the elderly
<p><b>Physical aspects</b></p> <ul style="list-style-type: none"> <li>✓ Physiologic changes leave an elderly body prone to more severe injuries. Older adults have less physiologic reserves when their body is stressed (7).</li> <li>✓ Elderly victims who experienced disaster more frequently developed acute kidney injury and pneumonia than younger patients did (7).</li> <li>✓ Elderly are at higher risk of nutritional deficiencies due to multiple physiological and psychological factors (8).</li> <li>✓ There is marked decline in the health status among the elderly after disasters (27).</li> <li>✓ The elderly has higher risk of mortality in disasters (7,17).</li> <li>✓ Exposure to a disaster might worsen the disabilities among the elderly (13).</li> <li>✓ Disasters may disrupt ongoing medical care for therapies (14).</li> </ul>
<p><b>Psychosocial aspects</b></p> <ul style="list-style-type: none"> <li>✓ Many survivors of natural disasters experience psychosocial problems in their adjustment to the loss of resources or loved ones (10).</li> <li>✓ Post-traumatic stress disorder is the most frequently reported psychiatric morbidity among victims of disasters (10,30-32).</li> <li>✓ Psychological distress was associated with an increased risk of functional disability among elderly survivors of a natural disaster (12).</li> <li>✓ Some research suggests that elderly disaster survivors are relatively resilient and tend to report fewer negative emotional effects and those prior experiences of disasters reduce adverse psychological effects (15,26).</li> <li>✓ Older adults emphasized social preparedness, which highlighted the importance of social relationships and social support as important for maintaining wellbeing during the ongoing earthquake sequence (1).</li> <li>✓ Perceived social support had a protective effect for all mental health outcomes, which also held for symptoms of depression and generalized anxiety disorder in multivariate models (2).</li> <li>✓ Elderly people living alone depend on others and are likely to require protection, financial support, transportation, medical care, access to medication, and assistance with ordinary daily activities during disasters (29).</li> </ul>
<ul style="list-style-type: none"> <li>✓ <b>Relocation trauma</b></li> <li>✓ Relocation of elderly inpatients increases their morbidity and mortality risk (9,11).</li> <li>✓ Pneumonia was the most common cause of death, indicating the influence of poor living conditions (low temperature and poor nutrition) during relocation (9).</li> </ul>
<p><b>Ethical aspects</b></p> <ul style="list-style-type: none"> <li>✓ The elderly may be exposed to more ethical problems as vulnerable populations during and after disasters (19).</li> <li>✓ Ethical problems include financial abuse, most commonly theft in shelters and contractor fraud, neglect (primarily abandonment), and actual physical abuse (domestic violence) (19).</li> </ul>



**Figure 1.** Flow diagram of the search and selection of papers.

## DISCUSSION

The literature review revealed a number of researches concerning the vulnerability of elderly people in disasters. The older age group is more vulnerable to the negative impacts of disasters due to the biological, psychological, and social changes associated with aging. The present review encompasses studies focusing on the physical and psychosocial effects of disasters on the elderly; however, a study gap appears with regard to the ethical aspects of elderly vulnerability (2,3,5,7-32).

Physical factors such as having chronic illnesses that need specific treatment interventions, changes

in organ functions, weakened physical health, decreased sensory awareness, mobility issues, slower reaction times, nutritional deficiencies, and disability are the main contributing factors of vulnerability of elderly in disasters (7,8,13,14,27). Therefore, frequent assessment is needed by healthcare providers who can identify decompensating factors in older adults. Disaster plans should address nutritional, medical/medication, and care-giving needs of elderly people (8,27).

Elderly people experience psychological problems including PTSD and social problems regarding personal protection, practical preparedness, and social preparedness in disasters (10,30-32). Effective, sustainable, and culturally sensitive psychosocial

interventions and mental health services are required with particular attention directed to older adults after a disaster (10). Despite the vulnerability, elderly disaster survivors may be relatively resilient and tend to report fewer negative emotional effects (15,26). The knowledge and experience of older people can be considered while developing coping strategies in post-disaster settings. They should be involved in the development of disaster prevention, preparedness, and management programs and seriously recognized as valuable resources for communities (26).

Relocation of elderly people during disasters increases their vulnerability (9,11). Evacuation planning must consider the comprehensive needs of the elderly population, including biological, psychological, and social considerations including the wellbeing and HRQoL of older adults(9).

Ethical problems including financial abuse, neglect, and physical abuse among elderly people in disasters require careful consideration. Training and awareness programs for first responders are needed to raise their awareness so that they can better recognize seniors who might have come from abusive environments, thereby preventing abuse in emergency housing where seniors will be relocated (19).

The present systematic review has certain limitations. First, many types of study were included in this review. This led to heterogeneity among their methodologies, specifically variations in sample

size, chosen variables, and results. This may be interpreted as a limitation of the review in terms of difficulty in analysis and the comparisons of the methodologies, results and validities of the included studies. Second, the review was limited to English-language literature only with in a small number of databases and countries. Another limitation was the lack of generalization of the results obtained from qualitative studies.

In conclusion, this systematic review highlights studies on the vulnerability of elderly people in disasters, with the intent of helping establish appropriate disaster-management plans. Although this review has limitations, information gathered in the study may be significant for developing disaster-management strategies. With the expected increases in disasters and the aging of the population, the vulnerability of the elderly in disasters will become an important topic for further investigation. The health of this vulnerable population is frequently worsened by disasters, and there is a higher incidence of fatal consequences. Comprehensive disaster preparedness is important to improve outcomes for older adults during and after a disaster. Using the bio-psychosocial framework will allow administrators to adapt to the elderly populations' specific combinations of needs and risks. Governments, healthcare professionals, and epidemiologists must make efforts to diminish negative impacts on the elderly and improve elderly care.

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