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Health Impact of Climate Change in Older People: An Integrative Review and Implications for Nursing

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Abstract

Purpose: Older people account for the highest proportion of mortality from extreme weather events associated with climate change. This article aims to describe the health impacts of climate change on older people.
Type of Study: An integrative review was conducted with 30 studies retrieved from PubMed, EBSCO, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) on climate stressors, determinants of resilient capacity, risk factors, and health outcomes.
Findings: Heat, temperature variability, and air pollution increase mortality risk in older people, especially from cardiovascular and respiratory diseases. Floods are linked with increasing incidence of post-traumatic stress disorder, depression, and anxiety. Facing these adversities, older people exhibit both vulnerability and resilience.
Conclusions: Research gaps exist in understanding the full spectrum of the resilience experience of older people, and appreciating areas wherein nursing can play a pivotal role.
Clinical Relevance: Recognizing the vulnerabilities of older people in the context of climate change is important. Identifying opportunities to promote resilience is an important focus for nurses to develop tailored and targeted nursing interventions.

Climate change has been associated with adverse health outcomes, and older people are disproportionally affected (Gamble et al., 2013; Haq & Gutman, 2014). Research has investigated the impact of climate change and health in the general population, but few studies have been conducted specifically investigating the impact on older people (Gamble et al., 2013; Hosking & Campbell-Lendrum, 2012). The World Health Organization (WHO, 2015) claims that climate variability and change has both direct and indirect effects. Direct effects include extreme weather events such as heat waves, cold waves, and natural disasters. Indirect effects include ecosystem effects (i.e., aeroallergens, increase in vector species), environmental effects (i.e., diminished air quality, compromised water supply), and socio-economic effects (i.e., food and economic insecurity, relocation, and community disruption). These direct and indirect effects lead to rising morbidity and mortality related to cardiovascular diseases, other noncommunicable diseases, infectious and water-borne diseases, malnutrition, and mental health problems.

Most of the scientific literature describes health impacts in terms of morbidity and mortality—conceptualizing older people as vulnerable—and there are research gaps describing the older person's experience between the occurrence of a climate stressor and illness or death. Within this context, nursing theories and frameworks can be used to examine the human response to climate stressors over and above the morbidity and mortality discourse. These frameworks include Roy's Adaptation Model

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(Roy, 2009), the Comprehensive Health Seeking and Coping Paradigm (Nyamathi, 1989), Resilience Ageing Model (Hicks & Conner, 2014), and Society to Cells Resilience Framework (Szanton & Gill, 2010). Of these four, the Society to Cells Resilience Framework provides a holistic lens that goes beyond the traditional deficit-based perspectives and considers the intersectionality of cellular to societal factors leading to resilience. In this context, resilience can be defined as resistance, rebound, and recovery of mental and physical health after a challenge. It is determined by resilient capacity, which is the potential or ability to be resilient resulting from interactions with societal, community, family, individual, physiological, and cellular factors across the life course (Szanton & Gill, 2010).

This review aims to describe the scientific literature pertaining to the health impacts of climate change in older people from a holistic standpoint. It likewise attempts to identify areas of resilience in older people where nurses can tailor interventions to prevent adverse health outcomes.

Methods

An integrative review of the literature was conducted to synthesize and critique the various methodologies used to investigate climate change and health outcomes in older people. The steps suggested by Whittemore and Knafl (2005) were followed in the review: problem identification, literature search, data evaluation; data analysis, and finally data presentation. Review questions lifted from the Society to Cells Framework (Szanton & Gill, 2010) guided the literature search: (a) What are the climate stressors affecting the health of older people? (b) What health outcomes are associated with these stressors? (c) What factors contribute to resilience (resilient capacity) from cellular to societal levels? And (d) How are health impacts of climate change measured? A climate stressor is defined as an environmental change resulting from climate variability, such as extreme weather events and changes in air quality (Gamble et al., 2013).

An extensive literature search was conducted in electronic databases such as PubMed, EMBASE, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL), as well as a manual search of available literature online in consultation with a health librarian. The key words climate change, global warming, health, vulnerability, resilience, coping, quality of life, older person, senior citizen, and elderly were used in the search. The inclusion criteria were original research-based (quantitative, qualitative, or mixed methods research) articles published in English from 2007 to 2017. Exclusion criteria included abstracts that did not mention older people in the results and inaccessible full text. A manual search using Google Scholar was also implemented.

Using various combinations of the key words, the search yielded a total of 278 articles. Removing duplicates reduced this number to 230. Further applying the inclusion criteria reduced the number to 111 articles, removing those that were not in English or did not involve humans. From these, those that did not mention older people in the results of the abstract were excluded, resulting in 28 articles. Two more articles were included in the review from Google Scholar. The literature search and review process is summarized in **Figure 1**.

The studies were initially rated in terms of relevance on a 3-point scale: 2 for *relevant*, 1 for *somewhat relevant*, and 0 for *not relevant*. Studies rated "0" were eliminated. The 30 studies were also rated in terms of rigor, with the following criteria: (a) had validity/trustworthiness, (b) had reliability/confirmability, (c) had sufficient sample size, and (d) utilized appropriate data collection methods and analysis. Studies that did not meet the first two criteria were to be automatically dropped. None of the 30 studies were excluded, but threats to validity and potential sources of measurement error were noted, as were the strengths of the study.

Studies with similar themes were grouped according to the research question they answered. Initially, studies were grouped according to climate stressor. Themes were noted using Whittemore and Knafl's (2005) elements of data analysis: noting patterns, seeing plausibility, clustering, counting, making contrasts and comparisons, discerning common and unusual patterns, subsuming particulars into general, noting relations between variability, finding intervening factors, and building a logical chain of evidence. Commonalities in health outcomes and determinants of resilient capacity were also noted.

Results

Twenty-four studies were quantitative, three were qualitative, and another three used mixed methods. Thirteen (43%) of the studies were from North America and Europe, another 13 (43%) from Asia, and the remaining 4 (14%) from Australia. Almost all of the retrieved studies were from high-income countries.

Climate Stressors

Three climate stressors attributed to climate change were reported in the studies. These were temperature-related changes (e.g., temperature variability, extreme heat, extreme cold), typhoons and associated flooding, and decreasing air quality. The most frequent of these was heat-induced health effects. Of the 30 articles, 13

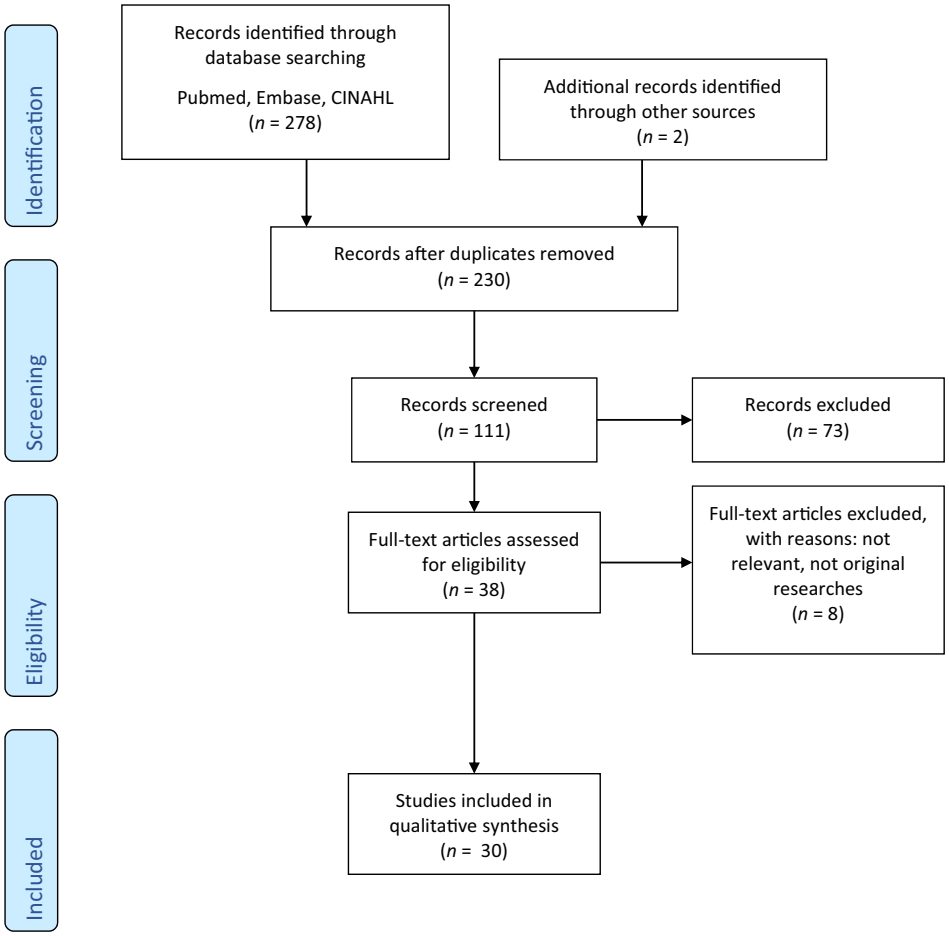

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (Moher, Liberati, Tetzlaff, Altman, The PRISMA Group, 2009).

(43%) were on heat as a climate stressor, 9 (30%) were on temperature variability, 7 (23%) were on storms or floods, 3 (10%) included air pollution as an added factor, and another 3 (10%) were on climate change and disasters in general.

Perceptions on Climate Change and Health

Older people recognize that environmental changes resulting from climate change can affect their health (Ostapchuk, Harper, Cunsolo Willox, Edge, & Rigolet Inuit Community Government, 2015; Rhoades, Gruber, & Horton, 2017). Others are more skeptical about climate change and "believe it to be a hoax." They do not perceive extreme heat as a threat due to available protective measures such as air conditioning equipment, and they are already accustomed to the changing weather patterns (Abrahamson et al., 2009; Loughnan, Carroll, & Tapper, 2014).

Health Impacts of Climate Change

Most frequently, studies on the health impacts on climate change (20%) examined mortality from cardiovascular diseases. This was followed by studies of mortality from respiratory diseases, resilience, hospitalization risk, and increasing mental health problems, which account for 10% of studies each. Fewer (6%) were on deaths from drowning and injuries, increasing vector-borne disease, effects on health-related quality of life, and successful ageing.

Thirty percent of the studies described health impacts of climate change in terms of morbidity and mortality using large datasets from surveillance or cohort data. In general, increasing temperature is associated with an increase in mortality (Cheng et al., 2014; Dong, Zeng, Ma, Li, & Pan, 2016; Son, Lee, Anderson, & Bell, 2012; Yin & Wang, 2017). Mortality due to cardiovascular diseases was reported to increase by 24% during periods of temperatures above 27.7oC lasting for more than

5 days (Dong et al., 2016), rising to a 94% increase on the 10th day of temperatures higher than 33oC (Yin & Wang, 2017). A 1.9oC increase in maximum daily temperature corresponds to a 3% increase in cardiovascular mortality (Cheng et al., 2014).

Another similarly designed study contends that increases in mortality per degree humidex above 35.7oC were only significantly different in people over 85 years old. When compared to the majority of findings, the differences in these studies were attributed to the contribution of relative humidity to the model (Isaksen, Yost, Hom, & Fenske, 2014) or when wind speed is considered, which mitigates adverse effects (Xu et al., 2013). Decreased air quality in combination with heat stress was reported to increase risk for chronic obstructive pulmonary disease (COPD) mortality 1.048 times for every 1°C increase in summer temperature (Zanobetti, O'Neill, Gronlund, & Schwartz, 2012). Harlan et al. (2014) reported that mortality increases exponentially at temperatures above 42oC for cardiovascular diseases and stroke, and at temperatures above 43oC for COPD. Other illnesses such as diabetes were reported less often, and no studies were conducted on the effect on nutrition.

Extreme heat events are associated with increasing risk for hospitalization (Bobb, Obermeyer, Wang, & Dominici, 2014; Chan, Goggins, Yue, & Lee, 2013; Chau, Wong, & Woo, 2014). Relative risk values were 2.14 for hospitalization for heat stroke and 1.18 for fluid and electrolyte disorders (Bobb et al., 2014). For ischemic heart diseases, Chau et al. (2014) asserted that colder temperatures pose a greater risk for hospitalization compared to warmer summer temperatures. For various diseases, hospital admissions increased by 4.5% for every 1oC increase in temperature. Admissions for infectious diseases increased among people ≥75 years of age during extremely hot or cold temperatures (Chan et al., 2013). For vector-borne diseases, a 1oC increase in the range between the maximum and minimum daily temperature increases the incidence of dengue fever by 11.9% in older people and 9.9% in the general population. The incidence of dengue fever was reported as 87 per 100,000 in people 60 to 69 years of age compared to 44 per 100,000 in those under 40 years of age (Xiang et al., 2017).

Morbidity and mortality related to typhoons and flooding are predominantly related to injuries, drowning, and mental health problems such as depression, posttraumatic stress disorder (PTSD), and anxiety (Bei et al., 2013; Myung & Jang, 2011; Sirey et al., 2017). Older people are at a higher risk for drowning compared to their younger counterparts (Ching, de los Reyes, Sucaldito, & Tayag, 2015; Myung & Jang, 2011). After a flood, 17% of older people reported PTSD symptoms that may require management (Bei et al., 2013), while 14% tested positive for depression (Sirey et al., 2017).

Resilience and Quality of Life in Climate-Affected Communities

Only 4 (13%) of the studies investigated resilience and only one examined quality of life as outcomes of extreme weather events that are specific to older people. Three of the four studies were qualitative and examined the resilience experienced after a flood. In contrast to the stereotypes of frailty, older people were reported to be resilient or demonstrate characteristics of resilience after a flooding experience (Brockie & Miller, 2017; Cohen et al., 2016; Hrostowski & Rehner, 2012; Nitschke et al., 2013; Sirey et al., 2017). They reported "a new sense of commitment and belonging to their communities, interest and appreciation of life, and a rediscovery of their abilities to make valuable contributions" (Hrostowski & Rehner, 2012, p. 343). Community resilience was reported to be higher in those 61 to 75 years of age compared to their younger counterparts (Cohen et al., 2016). Older people perceive themselves as survivors rather than victims of floods and identified prior experience and social capital as determinants of resilience (Brockie & Miller, 2017). They were 4.49 times more likely to have an emergency evacuation plan and have a 3-day supply of medications compared to their younger counterparts (Kang, 2014). Older people reported changes in their quality of life after a flooding experience (Sirey et al., 2017; Wu et al., 2015).

Studies on heat as a climate stressor have not reported on resilience as an outcome, but rather they have focused on protective factors or behaviors of older people during extreme heat. These protective behaviors include taking showers, wearing light clothing, drinking more liquids (Nitschke et al., 2013), and using air conditioning equipment (Loughnan et al., 2014).

One study looked into successful aging (under climate change conditions) measured in terms of health status, performance of activities of daily living, and social activities. Though the study covered an interesting concept, its rigor could not be fully assessed with missing information on the methodology. They concluded that older people of low socio-economic status, those with poor health status, and those who were socially isolated were most at risk (Wanka et al., 2014).

Determinants of Resilient Capacity

Forty percent of studies mentioned certain determinants of resilient capacity. At the individual level, this includes personal disaster preparedness (Kang, 2014), coping strategies (Bei et al., 2013), personal strength

(Hrostowski & Rehner, 2012), perceived positive impact after flood (Sirey et al., 2017), and (personal heat) protective behaviors (Abrahamson et al., 2009; Loughnan et al., 2014; Nitschke et al., 2013). At the family and community level, social support (Brockie & Miller, 2017; Sirey et al., 2017) and connectedness (Nitschke et al., 2013) were reported. Those with two or more family members are 2.92 times most likely to have a 3-day supply of medications compared to those living alone (Kang et al., 2014). The physical environment, such as adequate green space, likewise provided additional protection (Zanobetti et al., 2012).

A huge proportion of studies on older people emphasized the concept of vulnerability. Describing risk factors, physiologic studies have reported that impairments in cardiovascular function result in increased mortality from cardiovascular disease (Ren et al., 2011; Stotz et al., 2014). Increasing age, low income, sex, disability, comorbidities, and living alone have been identified as contributors to vulnerability (Laverdiere et al., 2015; Nitschke et al., 2013; Rhoades et al., 2017). Isaksen et al. (2014) reported that non-Whites were at greater risk for heat-related mortality. At least one study each reported on either all men, all women, or subjects who were predominantly White. Males were at a greater risk to die from typhoons (Myung & Jang, 2011) and hospitalized for ischemic heart disease (Chau et al., 2014). Other studies documented that females are at a higher risk for heat-related deaths (Dong et al., 2016; Nitschke et al., 2013; Yin & Wang, 2017). This is in contrast to an epidemiologic study in China reporting higher risk in males (Cheng et al., 2014).

Using the literature search strategy, no studies were retrieved pertaining to physiologic indicators of resilience and access to care of older people during extreme weather events. Most of the studied risk and protective factors were shared with younger populations. No studies were retrieved on nursing interventions that promote resilience in this context.

Measuring Health Impacts of Climate Change

Heat as a stressor was measured differently: either as temperature variability (Harlan et al., 2014; Ren et al., 2011), temperature-humidity index (Dong et al., 2016; Isaksen et al., 2014), or the presence of a heat wave (Bobb et al., 2014; Son et al., 2012). Typhoons and flooding were more straightforward, measured by the presence of a storm or flood (Bei et al., 2013; Ching et al., 2015). However, the duration and intensity of these events were not quantified in the studies. Morbidity and mortality data were gathered from disease surveillance data or existing cohort studies.

Resilience was examined more qualitatively. Only one study used a quantitative measure—the Conjoint Community Resiliency Assessment Measure—to examine community resilience of older people (Cohen et al., 2016). Health-related quality of life was also reported to be measured by the SF-36 or the shorter version SF-12 (Bei et al., 2013; Wu et al., 2015). No tools were reported to measure determinants of resilient capacity as a whole in the reviewed studies, but rather, data on these determinants was gathered through structured questionnaires or qualitative methods.

Discussion

A considerable amount of literature is available describing the health impacts of climate change on older people. An emerging field of investigation is known as climate gerontology (Haq & Gutman, 2014). Though an attempt was made in this article to examine resilience in older people, it cannot be denied that the approach to this topic in the prevailing literature is still from the standpoint of the older person being a "victim" or being "vulnerable."

One of the issues in the climate change and health discourse is the multitude of factors contributing to health outcomes including identified vulnerabilities of older people. Most of these factors are shared with younger age groups. It is therefore interesting to determine how much climate stressors contribute to explaining the variability between vulnerability and adverse health outcomes. Considering the complexities involved in this phenomenon of interest, researchers have the flexibility to utilize multiple methods from quantitative, to qualitative, to mixed approaches. Epidemiologic studies are appropriate in quantifying the risk posed by climate stressors on health outcomes, whereas qualitative methods give more in-depth information and meaning to the experience (Ostapchuk et al., 2015; Rhoades et al., 2017). Secondary analysis of existing cohort data or of disease surveillance data gives the advantage of large sample sizes; however, there may be limited flexibility in ensuring the quality of data that are available. Climate change skeptics have questioned these findings on the basis of the wide confidence intervals reported (Verner et al., 2016).

The results of this review are consistent with a scoping review conducted by Hosking and Campbell-Lendrum (2012) wherein the majority of the studies on climate change and health were from high-income countries. Research from low and middle economies are encouraged to identify country-specific factors that may affect both risk and resilience. Considering the different contextual factors that may come into play within and between

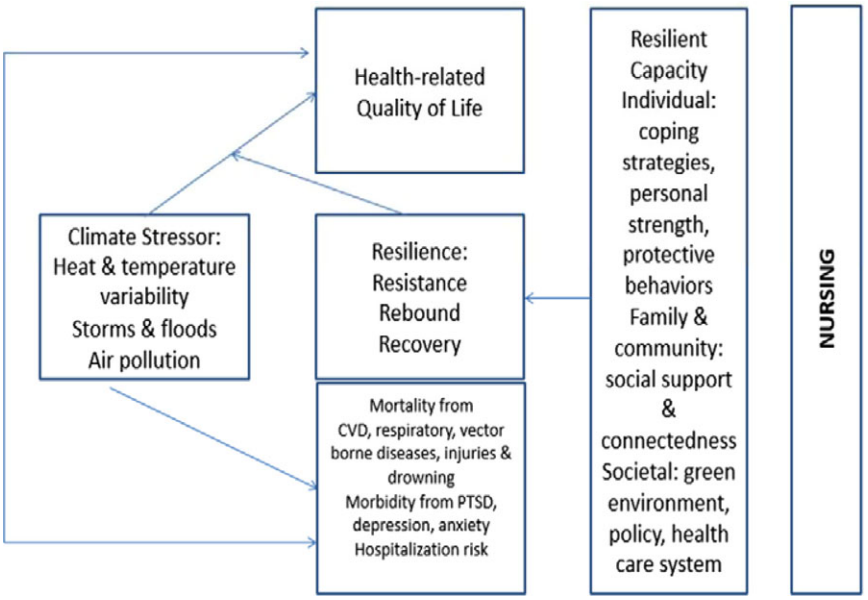

Figure 2. Climate change and health in older person.

countries, risk and resilience data may vary, as in the case of this review, which covers several countries across different continents (WHO, 2015).

Risk for mortality and hospitalization may also vary due to the different ways of measuring and defining hot and cold days and heat waves (which have at least 12 definitions across countries). The same can be said of the different measurements of temperature, such as average daily temperature, minimum and maximum daily temperature, and humidity index (Song et al., 2017). The risk may also vary depending on when data collection was done after the climate stressor.

This review supports the position that climate change is associated with adverse health outcomes and that older people are disproportionally affected (Alderman, Turner, & Tong, 2012; Bunker et al., 2016; Kenny, Yardley, Brown, Sigal, & Jay, 2010). There is a need to conduct more research on the resilience of older people in climate-affected communities—from the individual to the community level. Though qualitative studies have given useful insights into the resilience experience of older people, additional quantitative measures will be equally important in understanding the experience. At least three resilience instruments were found to be of good psychometric validity when used among older people: the Connor Davidson Resilience Scale, Wagnild and Young's Resilience Scale, and the Brief Resilient Coping Scale (Cosco et al., 2016). Available quantitative resilience measurements in later life are suggested to be validated in the context of climate change and country-specific factors. The relationship between resilience and health-related quality of life likewise needs further exploration (Hicks & Conner, 2014).

Though the majority of the studies supported adverse health outcomes from climate change, the dissenting views of other older people warrants further examination. Statements that they are not at risk due to available resources for adaptation suggests some level of resilience. In the language of the Society to Cells Framework, the climate stressor viewed as a challenge is mitigated by resources contributing to resilient capacity (Szanton & Gill, 2010). This is an excellent opportunity for nurses to examine resilience characteristics such as hardiness, coping, and self-concept, and to build on these to achieve better client outcomes (Hicks & Conner, 2014). At the individual level, much can be done to maximize personal strength, adaptive coping strategies, and personal protective behaviors. At the family and community level, building social support from family and community-based organizations is an important measure. Ostapchuk et al. (2015) pointed out the importance of the role of older people as sources of wisdom and experience in the climate change and health discourse. At the societal level, much work is anticipated in advocating for policies to promote access of care and institute mechanisms for climate change–resilient healthcare systems (Haq & Gutman, 2014). As summarized in **Figure 2**, climate stressors result in morbidity and mortality among older people. Resilience moderates these outcomes as well as health-related quality of life. Resilience, on the other hand, is affected by resilient capacity, which is determined by cellular to societal factors (where nursing plays

an important role). In general, older people may have differing levels of vulnerability, but the outcomes will be determined also by their level of resilient capacity. This relationship is also indicative of the extent to which older people perceive climate change has the capacity to impact their health.

This review may be limited in terms of including only articles in the English language. Some literature in other languages may substantially contribute to what is known about the topic. It is likewise noted that the retrieved studies were from countries where the population is ageing. This may contribute to some form of bias and does not necessarily indicate that climate change is not affecting older people in other countries. Moreover, limitations may likewise occur from the set of key words and databases used in the search.

Conclusions

Older people are faced with unique challenges in the event of climate change. Nurse researchers play an important role in the scientific inquiry of building resilience and averting adverse health outcomes through practice and policy.

Clinical Resources

- Climate change and extreme heat events. https://www.cdc.gov/climateandhealth/pubs/climatechangeandextremeheatevents.pdf
- HelpAge Disaster resilience in an ageing world. http://www.unisdr.org/2014/iddr/documents/DisasterResilienceAgeingWorld.pdf
- Climate change and the health of older adults. https://www.cmu.edu/steinbrenner/EPA%20Factsheets/older-adults-health-climate-change.pdf
- Older persons in emergencies: An active ageing perspective. http://www.who.int/ageing/publications/EmergenciesEnglish13August.pdf
- Climate change and health in the Western Pacific Region. http://iris.wpro.who.int/bitstream/handle/10665.1/12401/9789290617372_eng.pdf
- Climate change and health. http://www.who.int/globalchange/en/
- Climate change. http://www.who.int/topics/climate/en/

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