

## Research Article

# Effect of Climate Change on Health in Older Persons

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### Abstract:

On a global scale, the population aged 65 and over is the fastest growing age group. By the year 2050, one in six people will be aged over 65 years, compared to only one in eleven during 2019. The adverse effects of climate change have a broad range of negative impacts on human health and psychosocial status. For the vulnerable ageing population, often limited by their physical, cognitive, psychosocial conditions and economic resources, the effects of climate change can be exceptionally challenging. Compounded by pre-existing medical conditions, immunosenescence, and the presence of various geriatric syndromes, the older persons find themselves at risk of disease exacerbation when exposed to climate-related stressors compared to younger adults. This review is aimed at exploring various aspects of climate change and its impact on older persons' health.

**Keywords:** climate change, older person, health

## INTRODUCTION

Older adults (over 65 years of age) are more sensitive to environmental changes, have increased exposure to climate stressors and have a decreased adaptive capacity rendering them more vulnerable to the effects of climate change.<sup>(1)</sup> Not only do shifting weather patterns, temperature changes and extreme weather events have a profound effect on the environment, they have physiological, functional and psycho-social consequences for older adults, who are often unable to adapt to these changes (Table 1). Climate related adverse effects can be either a direct consequence of extreme weather events or as an indirect consequence of poor water, air and soil quality. Longevity results in prolonged exposure to various pollutants and environmental toxins which increases the risk of morbidity in older age.<sup>(1)</sup> Limited access to essential resources, compromised food security and changes in vector-borne diseases indirectly contribute to increased mortality in this group. Non-climate related risks such as location and urbanization, inadequate housing and safety concerns impact the effect of climate change by affecting exposure to climate stressors.<sup>(1)</sup>

Altered thermoregulatory responses to temperature change and immunosenescence are normal ageing processes. These responses can be further hampered by certain geriatric syndromes (Figure 1). Geriatric syndromes are a heterogeneous group of physical, cognitive and functional disorders

with multiple causality and no simple cure.<sup>(2)</sup> The syndromes most impacted by climate change include cognitive dysfunction, frailty multimorbidity and polypharmacy.<sup>(3)</sup> Moreover, frail older adults contribute to the carbon footprint by excessive resource utilization. The carbon footprint increases as costs escalate because frailty is associated with increased risk of hospitalisation, length of stay and use of medication and equipment such as continence products and mobility aids.<sup>(4)</sup>

### Temperate extremes

Globally, heat waves have caused tens of thousands of deaths, the majority of these being in patients over 65 years with attributable mortality due to the effects of heat waves being disproportionately higher in this group. <sup>(1)</sup> The major impact of heat waves is on cardiovascular health with the older adult being the most vulnerable.<sup>(5)</sup> Extreme heat causes dehydration and requires an increased cardiac output to disperse heat via evaporation. Older adults have reduced water volume and many are on medication that either cause dehydration or impair thermoregulation.<sup>(6)</sup> People with pre-existing myocardial dysfunction are prone to cardiac ischaemia and cardiogenic shock during heat waves.<sup>(7)</sup> Heatstroke, the most severe of the heat-associated illnesses, occurs more commonly in the elderly, especially in those who are dependent and

**Table 1.** Direct and indirect impact of climate change on the older adult

Climate change event	Direct impact	Indirect impact
Heat waves	Cardiovascular dysfunction and shock <ul style="list-style-type: none"> <li>• Dehydration</li> <li>• Medication</li> <li>• Function of ageing</li> </ul>	Socioeconomic factors <ul style="list-style-type: none"> <li>• Poor quality housing</li> <li>• Lack of air-conditioning</li> </ul>
Air quality	Exacerbation of existing cardiopulmonary illnesses Higher pollen/mould concentrations: Increase frequency of emergency visit for various cardiopulmonary complications	Potential to accelerate trajectory of geriatric syndromes especially frailty and dementia
Water quality and quantity	Floods damage infrastructure Increased contaminant in water sources	Water-borne illnesses leading to morbidity and mortality Safety issues regarding access to water
Infectious diseases	Air-pollution increases respiratory tract infections Poor water quality leads to diarrhoeal illness Vector-borne illnesses from mosquitoes and ticks Function of ageing <ul style="list-style-type: none"> <li>• Immunosenescence</li> <li>• Homeostasis</li> </ul>	Delirium from infection leading to other geriatric syndromes
Extreme weather events	Higher rates of mortality/injury/disability	Interruption in medical care for chronic diseases: leading to exacerbation of underlying illness Physical dependency limits a safe and timeous evacuation Contributes to mental health disorders Retirement plans and economic stability
Food safety and security	Malnutrition	Disruption in food production: affecting food security Rising food cost: contributes to non-adherence to prescription medication and compromise on food quality

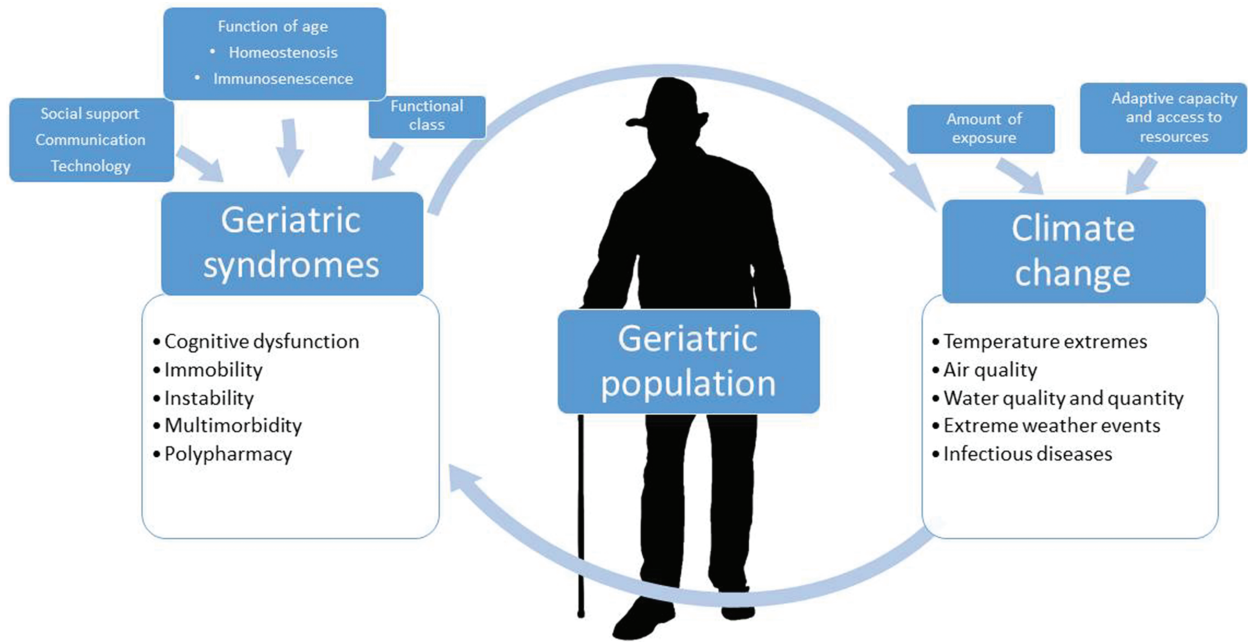
chronically ill.(8) Higher temperature variability increases the risk of dementia associated hospitalization. Heat stress worsens the autonomic symptoms in Parkinson's disease by promoting mitochondrial dysfunction, oxidative stress and neuroinflammation.(9) Social factors such as living in urban area with a "heat island effect" and economic factors such as the inability to afford good quality housing and air-conditioning, renders older persons prone to temperature related adverse effects.(1)

Less appreciated is the morbidity and mortality caused by cold temperatures. Older adults are vulnerable to hypothermia because of impaired thermoregulation caused by ageing, medications, decreased heat production from sarcopenia and inactivity and neurological and endocrine comorbidities. Cold-related illnesses can be exacerbated by common geriatric syndromes such as frailty, polypharmacy, multimorbidity and most importantly, cognitive impairment.(5)

### Air quality

Air-pollution contributes to 6.7 million deaths per annum. Over half of these deaths occur in those aged above

65 years, and about half are due to cardiorespiratory diseases.(10) Although the negative effects of air pollution on health is not restricted to older persons, due to pre-existing medical conditions and impaired cardiovascular reserve, the older individual often presents with more severe disease. In addition, the aging process leads to impaired vascular pulmonary barrier function, rendering the older person less capable of protecting themselves from the noxious effects of inhaled-toxins.(11) Various mechanisms have linked poor air quality to climate change. Global warming has led to the development of significant ground-level ozone contributing to the exacerbation of existing cardiopulmonary illnesses such as asthma, chronic obstructive pulmonary disease and ischaemic heart disease, resulting in premature death. Global ozone depletion has also shown to contribute to the increased incidence of skin malignancies such as melanomas and basal cell cancer.(12) Additionally, warmer weather and higher carbon dioxide levels has led to an increase in seasonal production of allergenic pollen and mould spore counts, contributing to allergenic sensitisation and more frequent emergency visits for attacks of asthma, myocardial infarction and stroke.(13) The rapidly



**Figure 1.** The interplay between the geriatric syndromes and climate change

rising exposure to wildfires fumes and dust storms, especially in drought-stricken areas, has shown to increase the admission rate to the emergency department amongst older persons with cardiopulmonary complications.(14)

Furthermore, commonly encountered age-related disorders such as frailty and dementia are not only found to be associated with inhalation of airborne particulate matter but also has the potential to accelerate their trajectory.(15)

### Water quality/quantity

Access to water and the quality thereof are fundamental to maintaining health in older adults but climate change impacts both processes.

Climate change affects water availability in various ways. Although human factors such as overpopulation and industrial pollution play a larger role in water quality degradation, climate change and extreme weather events exacerbate these problems by impacting both water quality and quantity. Floods damage infrastructure and cause the release of sewage and chemicals into bodies of water and reservoirs.(16,17) Changes in rainfall and temperature both increase contaminants and chemical compositions of water sources, impacting on the water quality and microbials found in the water.(17) A constant good quality water supply is essential for an aging vulnerable population. Water is required for drinking, hygiene and food preparation. Limited access to good quality water is especially problematic for older adults who have either physical or cognitive disabilities, rendering them unable to mobilize to acquire this basic necessity.(18) Chemically polluted

or contaminated water is a concern to older adults who are prone to infections and chemical side effects.(16) As a function of ageing, older adults are more susceptible to dehydration and infection. Water-borne diarrheal illnesses disproportionately affect immunocompromised, frail older adults. Those fully dependent on care-givers for all activities of daily living are at the highest risk of infection from contaminated water. Heavy metal contamination over long periods of time can lead to organ dysfunction, cognitive impairment and malignancy.(16)

### Infectious diseases in the older adult

Age-related changes to the immune system are termed immunosenescence. It affects both innate and acquired immunity and leads to chronic long-term inflammation called inflammaging and culminates in a reduced ability to fight infection. Homeostenosis is the concept of an age-related decrease in resistance to stressful stimuli.(3,19) Climate change impacts infectious diseases in older adults in a multitude of ways. Firstly, air pollution and atopy promote susceptibility to infection. Secondly, poor water quality increases exposure to water-borne pathogens and thirdly, the spread of vector-borne diseases notably mosquitos and ticks have a more profound effect on the health of the older adult.(1,3) Extreme weather events are responsible for disease outbreaks while global warming tends to change disease patterns and redistribution of infectious diseases.(19) Flooding and temperature changes increase the incidence of water-borne diarrheal illness which are often mild but may become fatal in the presence of a compromised

immune system.(1)Although there is no direct link between climate change and Covid-19, the risk of zoonotic disease transmission due to vector-borne diseases is worrisome as global warming contributes to suitable habitats for such vectors.(7) Older adults are at risk of severe disease as well as the impact of social isolation in times of pandemics. Higher temperatures cause a proliferation of vectors such as mosquitos and ticks which are responsible for many different human illnesses, notably malaria and dengue fever. (3) Diagnosing infections in the older adult is difficult as symptoms are vague and typical signs such as fever may be absent. Infection can lead to delirium which increases the risk of other geriatric syndromes.

### Extreme weather events

One of the devastating impacts of climate change is the rise in severity of seasonal environmental phenomena. Past experiences have shown that older persons are at a disproportionately higher risk of mortality, injury and disability from natural disasters.(19). Destructive forces such as floods, hurricanes, tornadoes, severe thunderstorms, and winter storms pose a challenge for older persons particularly dependent on healthcare service delivery systems. Older adults have a higher burden of chronic disease, hence interruptions in their health care can further exacerbate their underlying conditions. Health care facilities commonly utilized by older persons includes pharmacies, dialysis centres, cancer units, acute coronary units and infusion centres amongst others. During a natural disaster, access to such facilities is often limited, contributing to adverse health consequences.(19)

Furthermore, higher rates of physical, cognitive and social immobility amongst older persons, especially those in nursing homes, hinders their ability for a timeous and safe evacuation during natural catastrophes. Older persons' vulnerability to disasters is not only physical but psychological too. Meta-analysis and systemic reviews have reported considerable evidence showing older adults when compared to the younger population, are twice more likely to experience post-traumatic stress disorder symptoms and 1.7 more likely to develop adjustment disorder when exposed to natural disasters.(20)

During the recovery period following natural disasters, older persons encounter considerable amount of morbidity and hardship as they are often relocated to area of safety that are poorly equipped to meet their medical, social and financial needs.(21)

### Food safety and security

Global warming affects food security through food availability, accessibility, utilisation and affordability. The recent covid-19 pandemic, world political conflicts and climate shocks has led to the rise in food inflation by more than 5% in some countries.(22) In the United States, across a 10-year period (2007–2016), food insecurity increased significantly from

5.5% to 12.4% among older adults; this increase being more pronounced among lower-income older adults.(23) It has been shown that functional impairment in older individuals can also contribute to their inability to secure and access sufficient, safe and nutritional food.(24) In addition, the effects of climate change on critical infrastructure have adversely affected agricultural production and commercial trade, further contributing to food insecurity.(25)

Economic vulnerability is commonly encountered in older persons especially in low-income countries. Estimates of poverty in older people varies between countries across the world, i.e. 2% in Netherlands versus 80% of older persons living under the national poverty line in Zambia.(26) Low-income older adults living with chronic illness are confronted with resource-related issues such as food insecurity and cost-related medication non-adherence. Those who experience food insecurity are most likely to practice harmful coping strategies resulting in non-adherence to prescription medication.(27) Emerging evidence has also linked food insecurity to lower cognitive function in older individuals.(28) Consequently, food insecurity can result in a cascade of reactions that leaves the older person at risk of poor health and disease complication.

Finally, affordability of food can be the largest barrier to food access for many older individuals. Older persons, especially those with fixed incomes, may ultimately compromise on food quality by choosing low cost (frozen food) and lower nutritious food. Frozen food vs fresh food products carry varying risk for contamination with foodborne pathogens such as salmonella and campylobacter.(29) Older adults compared to younger counterparts are at greater risk of contracting foodborne diseases and have higher rates of hospitalization due to their weakened immune-system.(30)

### Solutions

Both short-term and long-term interventions are required to enhance the older person's adaptive capacity. At an individual level, older adults with a poor socioeconomic status, who are unable to access services and those living in sub-standard housing are most at risk.(1) Technology can be used to allow access to early warning systems for extreme weather events. Education is needed to teach older adults about the risks associated with climate change as well as relatively simple solutions such as drinking more fluids during heat waves.(1)

At a community and population level, preparations for extreme weather events such as evacuation plans are of paramount importance. Those living in care facilities or with mobility and cognitive dysfunction, will require additional help and attention. Social networks including family and social connections, religious and welfare groups must be strengthened as these groups can identify at risk persons and help with evacuation plans as well as supply and distribution if needed. They can also act as the liaison between

the individual and health care services. Community registers of older adults will also facilitate better communication and easier access for the most vulnerable members of our community.

At a policy level, the importance of climate change and its effects on the older adult must be realized. Climate gerontology, an emerging field looking at the interaction of climate change and challenges experienced by older people, should be prioritized as a research field. In fact, harnessing the power of older people to environmental activists and providing them with training and education may be a solution. Medical professionals need to realize that older people often present with subtle signs in relation to climate stressors and they need to recognize and be aware of geriatric syndromes.

## CONCLUSION

Climate change affects all ages but its impact on the ageing population is disproportionate. Factors including the physiological ageing process, physical and cognitive impairment and socioeconomic limitations influence how the older person responds to potentially threatening environmental changes. This unique constellation of factors together with underlying medical conditions increases their vulnerability to catastrophic events. While scientific registers and data collection relating to climate change dates to the 17 century, older adults especially those who have witnessed the effects of climate change first-hand, can impart valuable lesson on its devastating effects. Insight into specific needs and vulnerabilities of the older population allows clinicians to pre-empt and strategically plan for events that would otherwise lead to worse consequences.

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