Vulnerability of older adult populations to climate-related heat events

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The elderly are a diverse population, but as a group they face some common vulnerabilities to climate change. Elderly populations in general are more physiologically, socioeconomically, and geographically vulnerable than most other groups. These aspects of vulnerability will be examined and placed within a the context of two climate-related aspects of heat: high temperature (such as heat waves), and diurnal temperature range (DTR), or the range in temperature experienced in a single day. Vulnerability can be said to relate to “geographic space, where vulnerable people and places are located, or social space, who in those places are most vulnerable” (Cutter, 1996:533). As further established by Cutter, “proximity to the source of threat, incident frequency or probability, magnitude, duration or spatial impact” can increase vulnerability (1996). This continuous view of vulnerability influences the intersecting causes and effects of heat-related mortality and morbidity among elderly populations.

In general, “elderly” refers to people over the age of 65 (Gamble et al, 2013), though the term does not have a precise definition. The very old are generally defined as those over the age of 85 (Gamble et al, 2013), though once again this definition is fluid. In many post-industrial nations the elderly represent a growing segment of the population. Currently in the United States, the elderly, including the very old, make up 13% of the population, but this proportion is expected to rise to 20% by 2040 (Gamble et al, 2013). In the West, this growth can be explained by the ageing of the baby boomer generation and higher “survivorship,” or surviving otherwise fatal conditions in modern times (Gamble et al, 2013). This demographic shift is occurring in conjunction with climate change, which is expected to result in more frequent, intense, and lengthy periods of adverse weather such as heat waves (Yang et al, 2013). In people over the age of 65, the rate of heat stroke is 12-23 times higher than in other age groups and this number is probably underreported due to no clear definition of heat stroke and the different manifestations of heat-related mortality (Gamble et al, 2013). Elderly populations are more vulnerable to the effects of heat, especially the exceptional heat events that are expected to occur in many places due to climate change.

Elderly people are more physiologically vulnerable than many other groups. High ambient temperatures lead to an increase in mortality that can last for several weeks (Yang et al, 2013). For the elderly specifically, the physical changes associated with old age, along with complications of diseases and medications, can increase their susceptibility to climate-related heat increases in. Thermoregulatory capacity, or the ability for a body to regulate its temperature may be reduced with the normal process of ageing (Gamble et al, 2013, pp3). Diabetes, a condition that affects 19.1% of people between the ages of 65 and 74 in the United States, is also a risk factor for heat-related morbidity (Gamble et al, 2013). Some drugs, such as psychotropic and cardiac medications, can also inhibit thermoregulatory capacity by imitating or masking the effects of heat exposure (Sampson et al, 2013). Cardiovascular conditions also contribute to increased sensitivity to hot temperatures as well as air pollution (Gamble et al, 2013).

Dementia and other cognitive impairments can negatively impact a person's ability to adapt to high temperatures. Among people aged 71-79 years in the United States 5% are estimated to have a form of dementia and other cognitive impairments affect 16%. The numbers rise to 37% affected by dementia, and 39% by other cognitive impairments over 90 years of age (Agarwal et al, 2009 as cited in Gamble et al, 2013). Dementia and cognitive impairments amplify the physical limitations of aging in elderly population's abilities to cope and adapt to heat events (Tillett, 2013). Additionally, older women face greater risks associated with heat events than men due to higher rates of functional limitation, co-morbidity (having more than one ongoing ailment at a time), and cognitive and mental conditions than men (Gamble et al, 2013).

A further area of vulnerability is elderly people who have lived long-term in temperate climates who become particularly high-risk during heat events because they are neither physiologically nor behaviourally adapted to high temperatures (Gamble et al, 2013). As many north-eastern North American cities such as Toronto and Chicago have seen heat waves in recent years, concerns about behavioural adaptations are particularly pressing. Physiological conditions associated with ageing are significant because the base level of vulnerability to heat is already quite high. Increased frequency, duration, and intensity of heat events due to climate change today and in the future will further increase mortality in elderly populations without appropriate and prompt adaptation strategies.

Heat events also expose the socioeconomic vulnerability of older populations. In general, people of lower socioeconomic status are more vulnerable to the impacts of climate change than those of high socioeconomic status. As stated by Yang et al, “The increased vulnerability of people with low socioeconomic status may be related to poor baseline health status, limited access to health care and poor living condition” (2013, pp4). Homes without cooling appliances or with fewer rooms are implicated in increased heat-relate mortality (Gamble et al, 2013). Many retired adults live on fixed incomes or in poverty and thus may not have the financial resources to pay for air conditioning during heat waves (Tillett, 2013). Some older adults may have air conditioners but be reluctant to use them during heat waves due to operating costs (Gamble et al, 2013). Poorer elderly people are therefore more exposed to the effects of heat events. Another socioeconomic indicator of vulnerability to climate-related heat events is attainment of a high school education. As stated by Gamble et al, “[f]ailing to complete high school is a proxy both for lower income and literacy rates, because the latter may predict the success of risk communication” (2013, pp 4) such as public service announcements about heat events and adaptive behaviours to stay cool and safe in high temperatures and heat waves.

Vulnerability is compounded when an older person, who is already considered a disadvantaged minority, also belongs to other disadvantaged minority groups. Older people of colour with disabilities, or who are economically disadvantaged, have higher baseline vulnerability that can be attributed to lower general health status, less access to health care, and worse housing stock (Gamble et al, 2013). Older adults living in deteriorating urban neighbourhoods face additional challenges, as they may not feel safe in their own neighbourhoods. These people may put themselves in “self-imposed house arrest” (Browning et al, 2006, as cited in Gamble et al, 2013, pp4) and thus may not seek help in their communities even when in need. These deteriorating neighbourhoods are less able to care for their disadvantaged elderly populations because they often lack resources to facilitated adaptation strategies (Gamble et al, 2013). Additionally, older adults who keep themselves in a sort of self-imposed house arrest or are otherwise isolated are at higher risk for mortality during heat events. They may not receive warnings, or may underestimate the urgency of taking precautions to adapt to heat events (Gamble et al, 2013). Furthermore they may not contact family or friends even when in need because elderly people value their independence and may not wish to feel like a burden (Sampson et al, 2013).

Elderly people are also vulnerable to climate-related heat events due to geographical factors. For example, in the United States, elderly populations are growing in the Northeast and Midwest, two areas that according to the United States Environmental Protection Agency are expected to experience extreme heat events more frequently (Gamble et al, 2013). Urban elderly are also more likely to be exposed to high temperatures due to the heat island phenomenon (Gamble et al, 2013). That being said, urban elderly are more easily able to connect to services and social support systems and it has also been shown that people living in high rises or paved-over areas are more likely to implement heat reduction strategies during heat waves (Sampson et al, 2013). Another health risk associated with climate-related temperature increases is longer allergen seasons, and an expansion of the areas affected by some allergens. Ragweed pollen, for example, is expected to be in season longer and is moving farther North into Canada (Gamble et al, 2013).

Indoor heat stroke is another heat-related cause of mortality that disproportionately affects elderly people. As outdoor temperatures may be expected to spike more frequently with climate change, indoor temperatures will also increase unless cooling appliances such as electric fans and air conditioners are used. An elderly person may be at risk if they do not use a cooling appliance when indoor temperatures are high, or only use the cooling appliances when the temperature is already dangerously high (over 28 degrees Celsius according to standard ISO 7243) (Kondo et al, 2012). Based on these standards, a study in Japan found that during the day 15.4% of elderly people in the sample would be considered to be at high risk for indoor heat stroke (Kondo et al, 2012). This number rises to 19.1% at night, as people are susceptible to heat stress while sleeping (Kondo et al, 2012). The authors of the report also note that the actual number of elderly at risk in Japan after the earthquake and tsunami in 2011 is likely higher because of energy rationing and related public service announcements discouraging electricity consumption (Kondo et al, 2012). To help prevent mortality due to indoor heat stroke, timers or thermostats on fans and air conditioners should be used to maintain cooler temperatures day and night (Kondo et al, 2012).

While the most obvious form of heat risk comes from heat stroke due to high outdoor and indoor temperatures, there are other ways in which climate-related heat events may negatively impact human health. Diurnal temperature range, and indoor heat stroke are two such phenomena for which elderly populations are particularly at risk for heat-related mortality. Diurnal temperature range (DTR) describes the difference between daily maximum and minimum temperatures. Studies in Guangzhou, South Korea, Japan, and Mexico City have indicated a positive correlation between high DTR and mortality (Yang et al, 2013). The elderly have been shown to be among the most at-risk groups for mortality linked to DTR (Yang et al, 2013). High DTR has particularly strong effects on people with respiratory and cardiac diseases, and has been implicated in increased incidents of strokes, three conditions that are already prevalent in elderly populations (Yang et al, 2013). In studies of DTR, similar to other forms of heat-related vulnerability, low levels of education are a risk factor for mortality as education indicates socioeconomic status and literacy (Yang et al, 2013). The effects of DTR can persist for up to four days, meaning that considering only single-day mortality and applying single-day adaptation measures may not be significant in addressing DTR (Yang et al, 2013). A study in Guangzhou, China, a subtropical city where residents are already adapted to fairly high temperatures indicated that the highest mortality rates for high DTR occurred when the mean temperature was below 22 degrees Celsius and even had a negligible effect when mean temperatures were above 22 degrees Celsius (Yang et al, 2013). As temperatures and weather are becoming less predictable and stable with climate change, the effects of changes in temperature even at mild temperatures must be addressed, especially in high-risk populations such as the elderly. According to the Guangzhou study, a one degree increase in DTR corresponds to a 0.47% increase in non-accidental mortality (Yang et al, 2013).

Mortality due to DTR and indoor heat stroke point to a lack of infrastructure for adapting to heat events and mitigating their impacts on elderly populations. This lack of infrastructure can be on a municipal level, as seen during the Chicago heat wave of 1995 where brownouts and blackouts caused by increases in electricity demand prevented even those who were financially capable from cooling their homes (Gamble et al, 2013). Poorer neighbourhoods are even more vulnerable, partly due to decaying commercial and community services. Level of neighbourhood decline is also positively correlated with heat-related mortality (Gamble et al, 2013).

Social service infrastructure must also be robust enough to weather a major heat event, for example ambulances and emergency personnel must be available to meet the needs of older adults suffering heat stress (Gamble et al, 2013). Many older adults are staying independent longer through self-managed care rather than being institutionalized. In the case of an extreme weather event it may be difficult for first responders to know where these people live to attend to their needs (Gamble et al, 2013).

Despite the odds stacked against them, there are several adaptation strategies that could be implemented to reduce the vulnerability of older adults to climate-related heat events. It has been shown that less than half of the overall population are likely to change their behaviour even after advisory warnings are given (Sampson et al, 2013). In elderly populations this reticence can be attributed to a reluctance to identify as “old” and vulnerable, and therefore a reluctance to respond to public service campaigns targeting older people (Sampson et al, 2013). Additionally, the high costs of operating air conditioners prevent many older people from taking precautions during heat events (Sampson et al, 2013). As elderly people may not see themselves as “at risk”, the most effective ways to communicate risks are through external cues such as public messages (Sampson et al, 2013). Older people are also more likely to change their behaviour if they see that an acquaintance has suffered negative consequences from heat events. To attempt to negate the adverse effects of high DTR specifically, Yang et al recommend implementing an early warning system for large DTR. Additionally, community programs could be put in place to inform high-risk groups and the public at large about individual adaptation measures that can be taken long-term (Yang et al, 2013). Early warning systems could also be implemented for other heat events such as heat waves. Also working to reduce the vulnerability of older populations is the changing nature of this demographic. With more elderly people having high school educations, they will become more likely to be socioeconomically robust and able to fully understand risk messages (Gamble et al, 2013).

Outside of the home, cooling centres can be established as central and social locations where at-risk groups can go to cool down (Kondo et al, 2012). These cooling centres can be community centres, parks with mist machines and shaded areas, or may be part of an assisted living or seniors complex (Sampson et al, 2013). Within neighbourhoods and communities, block or floor captains can be established to check on their neighbours during heat events. Block or floor captains serve as social support but may also more effectively be able to communicate risks and information about available services because they are peers from the community (Sampson et al, 2013). This sort of peer support can be especially useful in areas where residents may be distrustful of organizations running cooling centres or other services (Sampson et al, 2013). Within communities, registries of at-risk people, including the elderly could be established so that community and emergency personnel will know who to check on during heat events (Tillett, 2013). In this way, collective security can reduce the vulnerability of high-risk groups such as the elderly (Kelly and Adger, 2000).

Public service messages may be more effective if they are tailored to address common misguided behaviours, such as how to properly use a fan and hydrate, as well as symptoms that may indicate heat stress (Sampson et al, 2013). These messages should not be made to specifically target elderly people, as they may not identify as part of this group. Instead, public campaigns should target the population as a whole and include variations that are culturally and economically appropriate for a wide range of backgrounds (Sampson et al, 2013). Primary health care providers should also be on-board with preventing heat-related health problems among the elderly. For example, before summertime, doctors can mention to their patients some ways to prevent heat stress, as well as outline how any medications they may be taking could affect their ability to recognize when they are overheated (Sampson et al, 2013).

As an alternative to cooling appliances, which also contribute to electricity consumption and climate change, modifications can be made to homes to keep them cooler even during heat events. Installing green roofs, planting trees and shrubs around the home (Tillett, 2013), awnings, strategic ventilation, and insulation may be applicable to some housing types in some locations (Sampson et al, 2013). As these renovations may be quite costly, subsidies could be provided to poorer elderly people to retrofit their homes or even to purchase and operate cooling appliances (Kondo et al, 2012).

Though older adults are physiologically, socioeconomically, and geographically vulnerable to a wide range of climate-related heat phenomena, a combination of adaptation techniques and the changing nature of the elderly demographic may help decrease the overall vulnerability of the elderly. As the elderly represent a diverse group of people it is necessary to recognize a wide variety of vulnerabilities and also adaptation strategies. As factors influencing vulnerability are varied and intersecting, adaptation strategies must address social, infrastructure, and economic concerns on a variety of levels in order to lower the risk of heat stress among the elderly due to climate-related heat events.

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