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Editorial

Population Aging and Heat Exposure in the 21st Century: Which World Regions Are at Greatest Risk?

Deborah Carr, PhD, FGSA,[1,*] Ian Sue Wing, PhD,[2] Giacomo Falchetta, PhD,[3,4] and Enrica De Cian, PhD[3,5]

[1]Department of Sociology and Center for Innovation in Social Science, Boston University, Boston, Massachusetts, USA.
[2]Department of Earth & Environment, Boston University, Boston, Massachusetts, USA.
[3]European Institute for Economics and the Environment (EIEE), Euro Mediterranean Center on Climate Change, Venice, Italy.
[4]International Institute for Applied Systems Analysis, Laxenburg, Austria.
[5]Department of Economics, Ca'Foscari University of Venice, Venice, Italy.

*Address correspondence to: Deborah Carr, PhD, FGSA. E-mail: carrds@bu.edu

The co-occurring trends of rising temperatures and population aging threaten to create "hotspots" of rapidly growing concentrations of older adults and increasing high-temperature extremes in several world regions (1,2). These combined stressors will place intense demands on local governments, healthcare systems, and service providers to develop infrastructures and response systems that meet older adults' distinctive needs. However, hotspots in lower-income nations across the Global South may lack the resources and institutional capacity to respond effectively (3), while hotspots in historically Republican-leaning U.S. states like Texas and Oklahoma currently lack climate action plans that could protect large and growing populations of older adults (4,5). In this editorial, we describe the outsized impacts of extreme heat on older adults' well-being, document how the geographic patterning of population aging and rising temperatures places particular regions at risk, and urge tailored preventative efforts and adaptations to protect older adults.

Climate Change, Extreme Heat, and Older Adults' Well-Being

The 9-year period between 2015 and 2023 had the highest average temperatures since global records began in 1880 (6), a phenomenon attributed to atmospheric accumulation of heat-trapping greenhouse gases (GHGs) emitted by human activities (7). The past 2 decades also have witnessed a dramatic increase in the frequency and intensity of other extreme weather events that can threaten older adults' safety, including extreme cold, hurricanes, blizzards, flooding, droughts, and wildfires (8). Extensive research has documented how extreme heat, in particular, exacerbates older adults' morbidity, mortality, and mental health problems (9,10). Age-related biological changes reduce older adults' capacity to thermoregulate. Medications commonly used by older adults can cause side effects that intensify heat-related symptoms like dehydration. Extreme heat can trigger flare-ups in chronic health conditions including rheumatoid arthritis, chronic obstructive pulmonary disease, asthma, chronic kidney disease, hypertension, type 2 diabetes, and cardiovascular disease. Physical, cognitive, motor, and sensory impairments may undermine an older adult's capacity to understand, prepare for, and respond to heat extremes, such as evacuating or traveling to a cooling center (11).

Extensive research documents the harmful consequences of climate change for *individual* older adults' well-being, yet it is critical to also advance understanding of older adults' exposure to extreme weather at the *population level*. Geographic regions projected to experience the steepest increases in average daily temperatures and the relative size of their older populations will have the highest levels of population-level heat exposure, placing intense demands on governments, healthcare providers, and first responders to develop appropriate response systems and infrastructures.

Population Aging and Rising Temperatures

The global population is aging at an unprecedented pace. The age 65+ population is projected to double by the mid-21st century, from just over 1 billion today to more than 2 billion (or 20% of the global population) by 2050. However, geographic regions vary widely in the relative size and growth of their aged populations. Wealthier regions primarily in the Global North, including Europe, North America, and Oceania, currently have older populations due to below replacement-level fertility rates and long life expectancies. Conversely, lower-income countries in Africa, Latin America, and parts of Asia have relatively younger populations, due to high fertility rates and shorter lifespans (12). Heat exposures also vary regionally due to physical processes within the Earth system. On average, Africa is the hottest continent, whereas Europe historically has been among the coolest (6). The specific climate adaptation approaches that regions undertake should consider both heat extremes and the size and geographic distribution of potentially vulnerable older populations (8).

Future Projections: Which Regions Are at Greatest Risk?

Our research has brought together population projections for 199 nations across the world and 3 109 counties in the coterminous United States with climate model output archived by NASA to project co-occurring trends of population aging and rising temperatures in the mid-21st century (1,2). By 2050, more than 23% of the world population aged 69 and older (up from 14% in 2020) will reside in climates with average maximum temperatures exceeding 99.5°F (37.5°C)—even brief exposure to which can be dangerous to older adults. The consequence is around 200 million additional older adults exposed to the risk of extreme heat by 2050, especially in Africa and Asia.

Regional comparisons reveal 2 clear patterns. Historically cooler regions with older populations are projected to experience the *steepest relative increases in temperature* over the next 3 decades, whereas historically hotter regions with younger populations will experience an *unprecedented surge in the size of their aged populations*. Europe and North America will likely experience the fastest increases in temperature, and increasingly severe acute high-temperature episodes, while experiencing more modest population aging. Conversely, nations across the Global South will experience relatively less stark increases in their already high temperatures in conjunction with longer periods of hot weather, but at the same time experience increases in total population size and the share of the total population that is elderly. We see parallel trends within the United States. Historically cooler Northeast and upper Midwest regions are projected to see rising temperature extremes but little growth in their older adult populations. Already hot southern states, especially in the desert Southwest, will see slightly higher temperatures but for longer portions of the year, coinciding with rapid population aging.

Tailored interventions and adaptations will be necessary to effectively respond to these different situations. Rapidly aging hot regions will have unprecedented numbers of older adults at risk of heat exposure, intensifying strains on healthcare systems, public utilities, and other aspects of the infrastructure. These strains are further intensified in hot regions that are vulnerable to climate-related disasters including hurricanes, floods, and wildfires. Municipalities may need to develop evidence-based approaches like training first responders about the special needs of older adults, especially those who may be unable or unwilling to leave their homes during lengthening periods of extreme heat. The development or expansion of registries and surveillance data on older adults, and the use of geographic information systems also can help target assistance such as wellness checks in areas with high concentrations of older adults. Coordinated programs to provide accessible public cooling infrastructures in areas with rising concentrations of older adults also may be necessary (11).

Historically cooler and older regions also will require tailored adaptations. Older residents of rapidly warming regions may underestimate or not fully understand the harmful health impacts of worsening heat extremes. Older homes in Europe and the U.S. Northeast tend to lack air conditioning, and retirees on a fixed income may be reluctant or unable to pay for (or operate) cooling systems. These regions also may require broader investments in passive cooling technologies, heat-resilient housing, and green spaces in urban areas. The health workforce may require training to become "'climate–environment' competent" to help older patients assess and manage their exposures to extreme heat, and associated risks (13).

Contextual factors, such as the economic resources available for infrastructure investments, as well as the political and public will to implement carbon neutrality goals, may influence local and regional capacity to address climate change impacts (14). For instance, lower-income countries may lack the resources to implement mitigation and adaptation policies on their own, without assistance from affluent nations (15). In the United States, politically conservative states, which tend to cluster in hotter regions such as the South and generally have lower per capita incomes, are less likely to have climate action plans or GHG emission reduction goals (4,5).

We have focused on age structure only as an indicator of regional risk, yet future research also should consider the spatial concentrations of other at-risk populations, including persons with low income, or with substandard housing lacking air conditioning. More broadly, researchers should identify the distinctive challenges facing regions with inadequate physical (eg, urban areas that are "heat islands"), social (eg, networks of support and social infrastructure), and intangible (eg, knowledge to adapt) infrastructures (16). Future climate change and population aging are inevitable and intertwined. We urge researchers, practitioners, and policymakers to heed the conclusions of a recent Pan American Health Organization/World Health Organization (PAHO/WHO) (8) report: "the next 10 years will be critical for the agendas of both climate change and health aging. Stakeholders in both agendas must understand the interconnections and find ways to amplify and reinforce them mutually for the benefit of people in the second half of their lives for now, for future generations."

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Conflict of Interest

None.

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