Climate Change and Aging: A systematic Review

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Abstract

In this systematic review, we analyze the literature through Web of Science's SCI-Expanded containing the words "aging" or "aged" and "climate change" and receiving at least four citations per year since publication (n = 607 articles). After discarding irrelevant articles (ie, "aging infrastructure"), the 177 remaining articles overwhelmingly (60%) fall into two categories: temperature/mortality (n= 85; 48%) and temperature/morbidity (n = 22; 12%). However, many other important climate topics related to aging remain underdeveloped. Notably, adaptation (n = 50; 29%), vulnerability (n = 27; 16%), emissions/mitigation (n = 19; 11%), climate perceptions (n = 13; 8%), drought (n = 4; 2%), and food security (n = 2; 1%) remain understudied. Furthermore, more than half of the studies were conducted in the United States (n = 46; 26%), China (n = 0; 0%), Globally (n = 21; 12%), and Australia (n = 11; 6%), suggesting a paucity of information in the Global South (n = 11) where climate impacts will be greatest. There were more studies specifically on Spain (n = 12) than specifically on the entire African continent (n = 5). Finally, 27 articles (16%) offered projections in some form, most to the middle of the century. Gerontologists and aging scientists should look beyond the relationship between heat and mortality to offer a more holistic view of aging and climate change. Prospective analyses, as opposed to retrospective, could shed additional light on the link between aging and climate change.

Keywords: population aging; demography; climate impacts; mitigation; adaptation

1 Introduction

Two seemingly immutable trends will crash head-on during this century: the global populace will continue to age and global climate change impacts will worsen as the century progresses. By the end of the century, when climate change impacts will be considerably more intense than today, the Global populace exposed to these impacts will be decidedly older, amplifying climate change impacts. Many of the anticipated impacts from climate change disproportionately impact the elderly versus younger, more vigorous age groups making these two trends particularly potent when taken together.

Consider this: the Global populace will age universally. The global population aged 75+ is expected to grow from 271M people today to nearly 1.4B people by 2100 (Division 2019). Today, only Japan, Italy, and Germany have median ages in excess of 50. But by 2100, 54% of countries will be as old as or older than these countries are today. These demographic trends are well known (Lutz et al. 2008, Beard et al. 2016).

While the global, dramatic aging shift occurs, the world will continue to warm. Climate projections suggest global temperatures are likely increase more than 3 degrees Celsius by 2100 compared to the pre-industrial period (Arias et al. 2021). These temperature increases will likely usher in increasingly frequent and destructive extreme weather events, more frequent droughts and wildfire risks, extreme heat, and substantially increase the burden on health services (Pörtner et al. 2022). Low-lying coastal areas will experience increased coastal flooding and the submergence of many coastal cities appears likely (Kulp & Strauss 2019). Climate change will make the world of 2100 considerably more precarious compared to today, a precarity amplified by a globally aging populace.

Nearly every climate impact is heightened by age due to the older people's social vulnerability and physiological susceptibility. Older adults have increased social vulnerability to psychological stresses due to environmental change, reduced ability to adapt, limited transportation, reduced mobility, smaller social networks, lower incomes, chronic health problems, social isolation, cognitive decline, and general fragility (Kovats & Hajat 2008). This elevated social vulnerability combines with older adult's increased physiological vulnerability to extreme heat and cold, extreme weather events, and infectious diseases to create a biophysical cocktail of potential catastrophe.

Additionally, climate change and aging intersect in multiple ways, beyond just climate impacts. Older adults play important roles in the mitigation or reduction of carbon emissions (O'Neill et al. 2010, Büchs & Schnepf 2013). Adaptation to climate impacts greatly vary among older populations (Huang et al. 2011, Guo et al. 2012) and perceptions of climate risks can serve as barriers to effective adaptation (Hansen et al. 2011, Abrahamson et al. 2008). Yet, as we show in this article, most research concerning aging and climate change tends to focus on the impact of extreme temperatures on older populations. A more holistic view of the aging and climate change literature could shed light on the varied relationships between older adults and global environmental change.

In this article, we conduct a systematic review of the literature surrounding climate change and aging. For a full submission, we will investigate commonalities along mitigation, adaptation, and retrospective vs. prospective studies.

2 Methods and Materials

We use a systematic literature review to assess the literature on climate change and aging.

2.1 Document selection

We used a keyword search on Clarviate's Web of Science-expanded search engine using the Boolean operator "TS=(aging OR aged OR elderly) AND TS=("climate change")." We selected Web of Science due to its comprehensive scientific coverage of peer-reviewed literature. We conducted the search on September 7, 2022. This search retrieved an initial universe of 16,828 articles. We filtered these results to include articles of relatively high impact, defined subjectively as those articles with at least four citations per year (n = 3,852). To further isolate those articles pertaining to aging and climate change, we further restricted our search to those articles containing the words (aging or aged or elderly) in the abstract (n = 607).

We then reviewed these articles for relevance, discarding articles concerning "aging infrastructure" or "aging forests" to isolate articles on human aging and climate change. This yielded a total of 177 articles included in this systematic review (**Figure 1**).

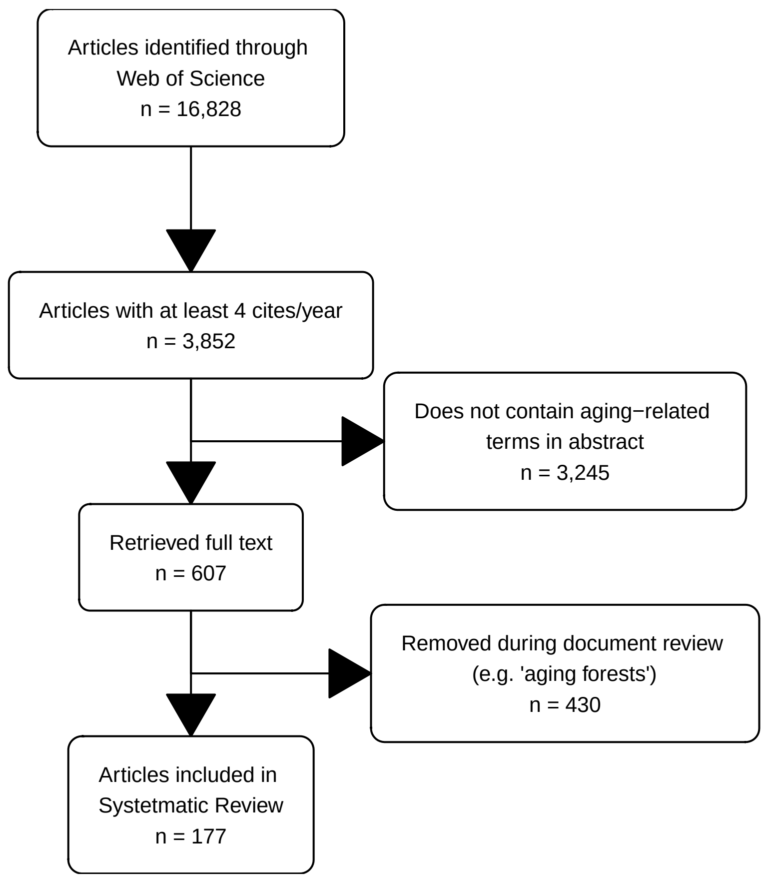


Figure 1: PRISMA Flow Diagram.

2.2 Document review

Following our document selection and screening, 607 articles were retained for full review. We developed a questionnaire to survey these articles to document and characterize the primary topics of climate change. We developed this questionnaire to standardize the analysis, produce descriptive statistics, and examine trends. We coded all papers based on (1) the primary and (2) secondary climate effect studied, (3) the climate impact type (sensitivity, vulnerability, or exposure), (4) the climate impact studied (morbidity, mortality, etc.), if the article concerned (5) mitigation, (6) adaptation, (7) or perceptions, if the article included a projection (8), the historic time period (9), and the general area the study was conducted (10). Additionally, we gathered general information on authorship, publication year, and citation counts. We conducted an extensive full-text review of all (n = 607) articles using this questionnaire. We assessed the primary finding in articles where multiple climate impact types or climate impacts were studied.

2.3 Analysis

All (n = 16,828) articles were retained for validation. All data were entered into an Excel spreadsheet. We used R to analyze the data and to produce descriptive statistics and visualizations.

3 Data Availability

The underlying computer code and data that support the findings of this study are available in the Supplementary Material and have been deposited in Zenodo (DOI).

4 Results

4.1 Figure: Heat Map of Topics and Bar Chart (Kyle)

Figure 2 illustrates the co-occurrences of climate effects and impacts. The overwhelming majority of articles in our sample concerned temperature as a climate effect (n = 148).

Some examples of climate effects which were classified as temperature include heat (n = 32), heatwaves (n = 16), daily temperature range (n = 9) and ambient temperature (n = 6).

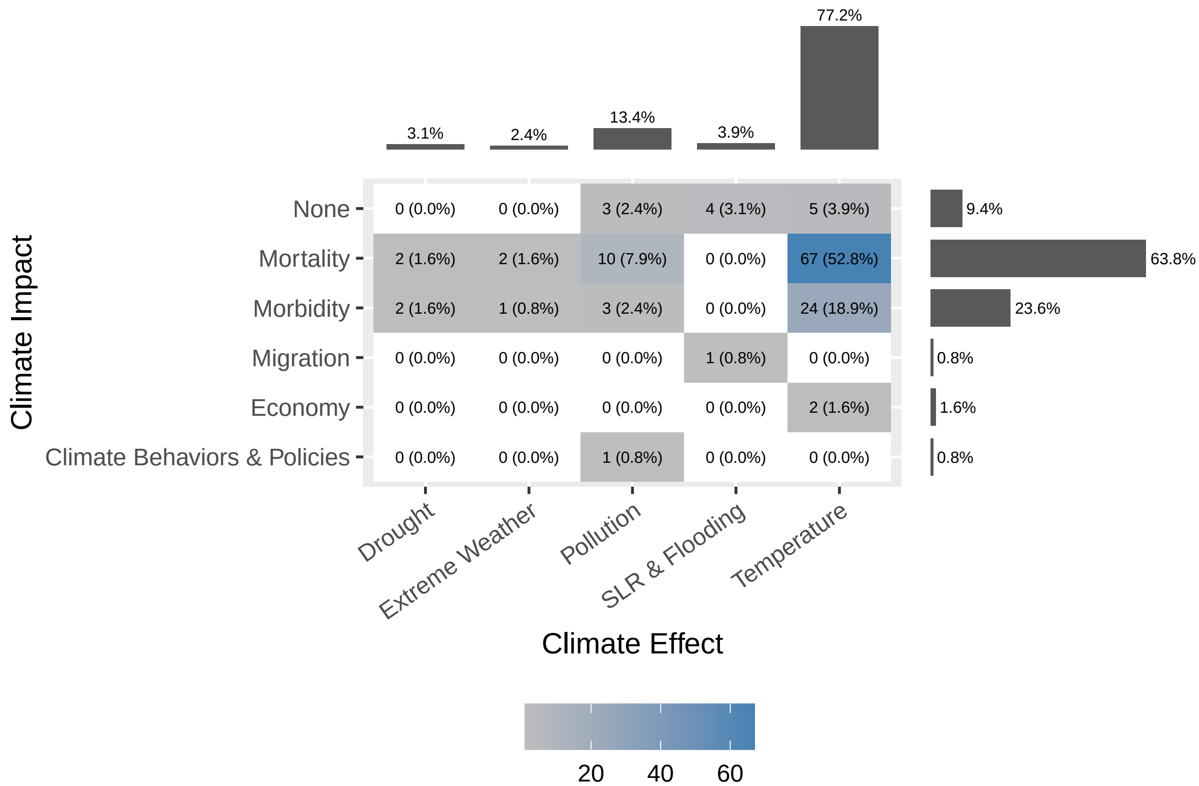
The large majority of articles in our sample concerned the climate impact on mortality (n =100) and morbidity (n = 30). The morbidity category included articles which specifically observe “morbidity” (n = 18), hospital admissions (n = 9) and ambulance attendance (n = 1), among others.

More than half of the articles in our sample which included climate effects were specifically about the impact of temperature on mortality (n = 67). The second most frequent climate effect and impact to be studied together was temperature and morbidity (n = 24). Our findings suggest that the most popular climate change features studied in relation to aging populations are temperature effects like heat index and temperature variability on morbidity and mortality metrics like hospital attendance or years of life lost.

There is also a small section of literature which concerns the effect of pollution on aging populations. (n = 19. Most of these, like temperature, concerned pollution’s impact on either mortality (n = 10) or morbidity (n = 3).

There is a paucity of information on how droughts, extreme weather and sea-level rise will be impacting aging human populations. Cumulatively, 20 articles observed any of these effects of climate change.

Importantly, very few articles observe the relationships between these climate effects and human behaviors, such as migration, economic activity and climate behaviors & policies (n = 4). This gap is particularly pressing because it speaks to aging populations’ abilities to respond to climate change. It is conceivable that aging populations may respond to sea-level rise with migration, urban heat islands with outdoor green spaces, extreme weather events with improved household infrastructure, or seasonal temperature variation with voting behavior. All of these examples demonstrate how climate effects can impact human behavior and consequently adaptive capacity, and all remain understudied.



4.2 Figure: Map of the Literature (Matt)

References

Abrahamson, V., Wolf, J., Lorenzoni, I., Fenn, B., Kovats, S., Wilkinson, P., Adger, W. N. & Raine, R. (2008), 'Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK', *Journal of Public Health* **31**(1), 119–126. **URL:** *https://academic.oup.com/jpubhealth/article-lookup/doi/10.1093/pubmed/fdn102*

Arias, P., Bellouin, N., Coppola, E., Jones, R., Krinner, G., Marotzke, J., Naik, V., Palmer, M., Plattner, G.-K., Rogelj, J. et al. (2021), 'Climate change 2021: The physical science basis. contribution of working group14 i to the sixth assessment report of the intergovernmental panel on climate change; technical summary'.

Beard, J. R., Officer, A., De Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J.-P., Lloyd-

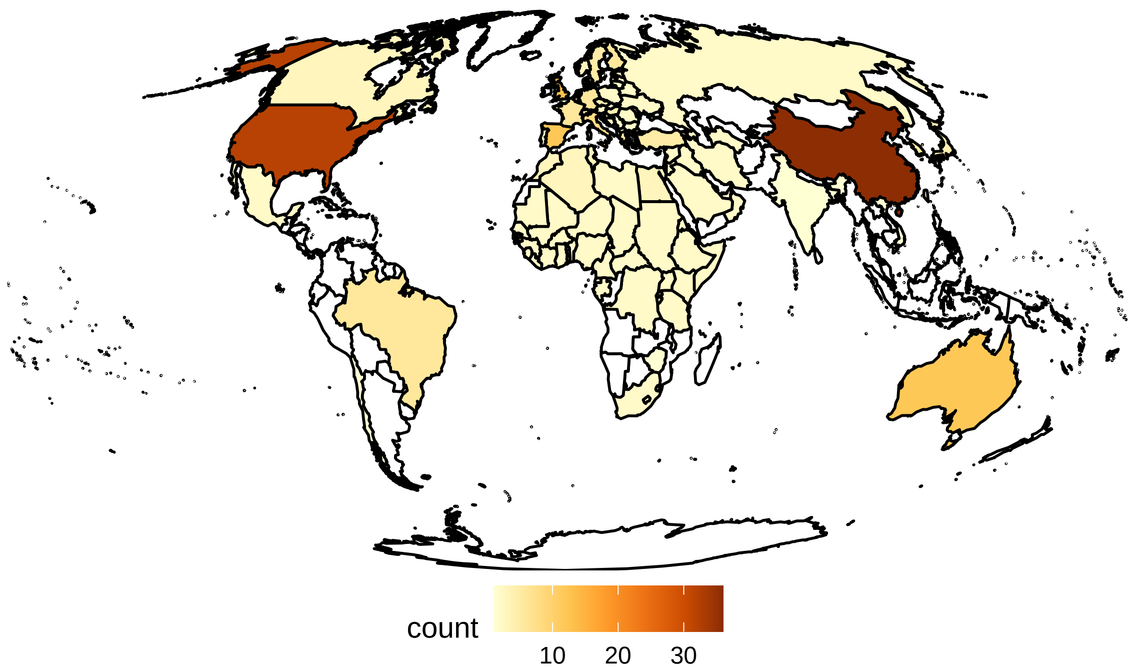


Figure 2: Map of study location frequency.

Sherlock, P., Epping-Jordan, J. E., Peeters, G. G., Mahanani, W. R. et al. (2016), 'The world report on ageing and health: a policy framework for healthy ageing', *The lancet* **387**(10033), 2145–2154.

Büchs, M. & Schnepf, S. V. (2013), 'Who emits most? Associations between socio-economic factors and UK households' home energy, transport, indirect and total CO2 emissions', *Ecological Economics* **90**, 114–123.
URL: *https://linkinghub.elsevier.com/retrieve/pii/S0921800913000980*

Division, U. N. P. (2019), *Wpp2017: world population prospects 2017*.
URL: *https://CRAN.R-project.org/package=wpp2017*

Guo, Y., Barnett, A. G. & Tong, S. (2012), 'High temperatures-related elderly mortality varied greatly from year to year: important information for heat-warning systems', *Scientific Reports* **2**(1), 830.
URL: *http://www.nature.com/articles/srep00830*

Hansen, A., Bi, P., Nitschke, M., Pisaniello, D., Newbury, J. & Kitson, A. (2011), 'Perceptions of Heat-Susceptibility in Older Persons: Barriers to Adaptation', *International Journal of Environmental Research and Public Health* **8**(12), 4714–4728.
URL: *http://www.mdpi.com/1660-4601/8/12/4714*

Huang, G., Zhou, W. & Cadenasso, M. (2011), 'Is everyone hot in the city? Spatial pattern of land surface temperatures, land cover and neighborhood socioeconomic characteristics in Baltimore, MD', *Journal of Environmental Management* **92**(7), 1753–1759.
URL: *https://linkinghub.elsevier.com/retrieve/pii/S0301479711000454*

Kovats, R. S. & Hajat, S. (2008), 'Heat stress and public health: a critical review', *Annu. Rev. Public Health* **29**, 41–55.

Kulp, S. A. & Strauss, B. H. (2019), 'New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding', *Nature communications* **10**(1), 1–12.

Lutz, W., Sanderson, W. & Scherbov, S. (2008), 'The coming acceleration of global population ageing', *Nature* **451**(7179), 716–719.

O'Neill, B. C., Dalton, M., Fuchs, R., Jiang, L., Pachauri, S. & Zigova, K. (2010), 'Global demographic trends and future carbon emissions', *Proceedings of the National Academy of Sciences* **107**(41), 17521–17526.
URL: *https://pnas.org/doi/full/10.1073/pnas.1004581107*

Pörtner, H.-O., Roberts, D. C., Adams, H., Adler, C., Aldunce, P., Ali, E., Begum, R. A., Betts, R., Kerr, R. B., Biesbroek, R. et al. (2022), 'Climate change 2022: Impacts, adaptation and vulnerability', *IPCC Sixth Assessment Report* .