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Editorial

Climate Change and Health: Insight into a Healthy, Sustainable and Resilient Future

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Several research studies in the literature have alerted us to the impacts of climate variability and change, extreme weather and climate events on people's health [1–12], resulting consequent suffering [13,14] and death [15–20].

The Special Issue entitled "Climate Change and Health: Insight into a Healthy, Sustainable and Resilient Future" is a collection of eight manuscripts from scholars and practitioners with insights into protecting public health from climate change, extreme weather and climate-related hazards. This Editorial will summarize the eight peer-reviewed papers that were published as part of this Special Issue.

The study developed by Rodrigues [21] quantified the impact of climate change on temperature-related, cause-specific mortality while considering adaptations and future demographic changes in the Lisbon Metropolitan Area, Portugal. To achieve this objective, a distributed lag non-linear model was applied to quantify the burden of temperature-related mortality during the present (for reference, 1986–2005) scenario and a future scenario (2046–2065). The findings show that there was an increase of 0.33% in temperature-related excess mortality (95% CI: 0.02 to 0.59) and significantly lower all-cause deaths in the future. Moderate cold exposure under a threshold of 1 °C and a high population scenario reduced future temperature-related deaths and diabetes mellitus (−1.32, 95% CI: −2.65 to 0.23). Similarly, moderate heat exposure under a threshold of 4 °C and a high population scenario had the highest increase in net changes (6.75, 95% CI: −5.06 to 15.32). In a changing climate, this study's findings and methodology have important implications for monitoring and developing targeted prevention plans for non-communicable diseases.

In their research, Çulpan et al. [22] evaluated excess deaths during heat waves between the summer months of 2004 and 2017 in Istanbul and determined a definition of heat waves that can be used in the development of an early warning system, a part of prospective urban heat-health action plans. The total duration of these heat waves was 334 days. In 67% of the heat waves, the death rate was significantly higher than during the reference period. Twenty heat waves that lasted a total of 257 days caused an increased risk of mortality ranging between 7% and 31% and corresponded to a total of 4281 deaths. It was also found that the increase in mortality risk was higher in heat waves where high Excess Heat Factor (EHF) values were long lasting or increased rapidly. In conclusion, the results suggest that EHF is an indicator that can be used in establishing an early warning system in Istanbul.

The study of Ouyang et al. [23] analyzed the global scientific output of research in the field of climate change and health between 1990 and 2020, based on the Web of Science Core Collection database. The results showed that the research output in the field of climate change and health has increased dramatically in the past 30 years, mainly dominated by researchers in developed countries. The percentage of research receiving funding was extremely low before 2008, with a sharp increase in the following few years until reaching a plateau of around 75%. Research conducted only by developing countries received the lowest percentage of funding.

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Zheng et al. [24] investigated the relationship between durations of different daily mean air-temperature categories and mortality in China and forecast future mortality changes in China for 2020–2050 under Representative Concentration Pathways (RCP) 4.5 and RCP 8.5 scenarios. The results suggest that under the RCP 4.5 scenario, the range of mortality will be 3.518% to 7.356% during the 2020–2050 period, and the mortality rate will increase in 86 regions. Under the RCP 8.5 scenario, the range of mortality will be 3.524% to 7.417% during the 2020–2050 period, and the distribution pattern is almost identical to that of the RCP 4.5 scenario.

Xue et al. [25], conducted a comprehensive assessment of drought status and trends based on the Standardized Precipitation Evapotranspiration Index (SPEI) in Northeast China (NEC) from the period of 1990 until 2018. The authors found that NEC has exhibited a general dry tendency over the past three decades. The percentage of annual drought-affected areas increased by 0.7%, and 86.3% of the area exhibited a drying trend. Future dry–wet trends are inconsistent with the current situation. The areas with wetting and drying trends would cover 86.3% and 16.7% of NEC, respectively. From the timeline, the drying trend peaked in 2001, and then it exhibited a mitigation tendency before drying again after 2013. The implementation of ecological restoration projects is primarily responsible for drought mitigation.

The article of Arnold et al. [26] used a case-crossover analysis to describe the historical relationship between heat and non-traumatic mortality in Washington's ten climate divisions. A fixed-effects meta-analysis was used to simplify the exposure–response curves to a single, state-wide value, and the OR of non-traumatic mortality at the 99th percentile of humidex compared to the 50th percentile. Subgroup analyses were also conducted to investigate effect modification by age, sex, race/ethnicity, and cause of death. Finally, the historical exposure–response curves were combined with climate projections to investigate the impact of climate change on an existing public health issue. This study provides evidence that risk increases with age and for diabetic, circulatory, cardiovascular, ischemic, cerebrovascular, and respiratory deaths. The 95% confidence intervals of projected heat-attributable mortality did not overlap with zero in three climate divisions (E Olympic Cascade Foothills, NE Olympic San Juan, and Puget Sound Lowlands). In these three divisions, the average percent increase in heat-attributable mortality across both warming scenarios is 35%, 35%, and 603% in 2030, 2050, and 2080, respectively.

Timlin et al. [27] investigated which perceived environmental and adaptation factors relate to self-rated well-being, quality of life, satisfaction with life, self-rated health, and feeling of empowerment to face the changes relating to permafrost thaw. Based on a self-assessment in this case study, participants from this permafrost community have good holistic well-being and are satisfied with their life. They feel they have the power to face the changes relating to permafrost thaw. Still, central challenges and problems relating to permafrost thaw, e.g., in nature, infrastructure, traditional lifeways, and health and safety, are recognized—and they influence the life and mental well-being of people. Adaptation is important and necessary for study participants; there are no other options in order to continue with life. However, more adaptation actions are needed, and they should be supported and carried out in co-operation with decision-makers from different levels.

The study of Crane et al. [28] aimed to summarize the relevant evidence examining the harm climate change may have on mental health, suggest potential mechanisms, and discuss implications. The authors recommend increased efforts in the creation and implementation of policies that combat the effects of climate changes, including mitigation of greenhouse gases, less reliance on fossil fuels, development of alternative energy sources, prevention of the loss of biodiversity, and reduction in our individual carbon footprints.

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References

1. IPCC. Intergovernmental panel on climate change. In *Climate Change 2022: Impacts, Adaptation, and Vulnerability; Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate, Change*; Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., et al., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2022; p. 3056.
2. Rodrigues, M.; Natário, I.; do Rosário de Oliveira Martins, M. Estimate the effects of environmental determining factors on childhood asthma hospital admissions in Lisbon, Portugal: A time series modelling study. *Theor. Appl. Climatol.* **2021**, *143*, 809–821. [CrossRef]
3. Martínez-Solanas, È.; Quijal-Zamorano, M.; Achebak, H.; Petrova, D.; Robine, J.M.; Herrmann, F.R.; Rodó, X.; Ballester, J. Projections of temperature attributable mortality in Europe: A time series analysis in 147 contiguous regions. *Lancet Planet. Health* **2021**, *5*, e446–e454. [CrossRef] [PubMed]
4. WHO. *Zero Regrets: Scaling up Action on Climate Change Mitigation and Adaptation for Health in the WHO European Region. Key Messages from the Working Group on Health in Climate Change*; World Health Organization, Regional Office for Europe: Copenhagen, Denmark, 2021. Available online: https://apps.who.int/iris/handle/10665/344733 (accessed on 30 June 2023).
5. Ebi, K.L.; Capon, A.; Berry, P.; Broderick, C.; de Dear, R.; Havenith, G.; Honda, Y.; Kovats, R.S.; Ma, W.; Malik, A.; et al. Hot weather and heat extremes: Health risks. *Lancet* **2021**, *398*, 698–708. [CrossRef] [PubMed]
6. EEA. *Climate Change Adaptation and Disaster Risk Reduction in Europe*; EEA Report No. 15/2017; Publications Office of the European Union: Luxembourg, 2017.
7. Salvador, C.; Nieto, R.; Linares, C.; Díaz, J.; Gimeno, L. Short-term effects of drought on daily mortality in Spain from 2000 to 2009. *Environ. Res.* **2020**, *183*, 109200. [CrossRef] [PubMed]
8. van Daalen, K.R.; Romanello, M.; Rocklöv, J.; Semenza, J.C.; Tonne, C.; Markandya, A.; Dasandi, N.; Jankin, S.; Achebak, H.; Ballester, J.; et al. The 2022 Europe report of the Lancet Countdown on health and climate change: Towards a climate resilient future. *Lancet Public Health* **2022**, *7*, E942–E965. [CrossRef] [PubMed]
9. U.S. Global Change Research Program. *Climate Change Impacts in the United States: The Third National Climate Assessment*; Melillo, J., Richmond, T., Yohe, G.W., Eds.; U.S. Global Change Research Program: Washington, DC, USA, 2014. [CrossRef]
10. Rodrigues, M.; Santana, P.; Rocha, A. Modelling climate change impacts on attributable-related deaths and demographic changes in the largest metropolitan area in Portugal: A time-series analysis. *Environ. Res.* **2020**, *190*, 109998. [CrossRef]
11. USGCRP. *Climate Science Special Report: Fourth National Climate Assessment, Volume I*; Wuebbles, D.J., Fahey, D.W., Hibbard, K.A., Dokken, D.J., Stewart, B.C., Maycock, T.K., Eds.; U.S. Global Change Research Program: Washington, DC, USA, 2017; 470p. [CrossRef]
12. Mora, C.; McKenzie, T.; Gaw, I.M.; Dean, J.M.; von Hammerstein, H.; Knudson, T.A.; Setter, R.O.; Smith, C.Z.; Webster, K.M.; Patz, J.A.; et al. Over half of known human pathogenic diseases can be aggravated by climate change. *Nat. Clim. Chang.* **2022**, *12*, 869–875. [CrossRef]
13. Andrews, O.; Le Quéré, C.; Kjellstrom, T.; Lemke, B.; Haines, A. Implications for workability and survivability in populations exposed to extreme heat under climate change: A modelling study. *Lancet Planet. Health* **2018**, *2*, E540–E547. [CrossRef]
14. Ebi, K.L.; Hess, J.J. Health risks due to climate change: Inequity in causes and consequences. *Health Aff.* **2020**, *39*, 2056–2062. [CrossRef] [PubMed]
15. Hajat, S.; Proestos, Y.; Araya-Lopez, J.L.; Economou, T.; Lelieveld, J. Current and future trends in heat-related mortality in the MENA region: A health impact assessment with bias-adjusted statistically downscaled CMIP6 (SSP-based) data and Bayesian inference. *Lancet Planet. Health* **2023**, *7*, e282–e290. [CrossRef]
16. IPCC. Intergovernmental panel on climate change. Summary for Policymakers. In *Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*; Core Writing Team, Lee, H., Romero, J., Eds.; IPCC: Geneva, Switzerland, 2023; 36p, *in press*.
17. Son, J.Y.; Liu, J.C.; Bell, M.L. Temperature-related mortality: A systematic review and investigation of effect modifiers. *Environ. Res. Lett.* **2019**, *14*, 073004. [CrossRef]
18. Rai, M.; Breitner, S.; Wolf, K.; Peters, A.; Schneider, A.; Chen, K. Future temperature-related mortality considering physiological and socioeconomic adaptation: A modelling framework. *Lancet Planet. Health* **2022**, *6*, e784–e792. [CrossRef]

19. EEA. *Climate Change as a Threat to Health and Well-Being in Europe: Focus on Heat and Infectious Diseases*; EEA Report No.7/2022; Publications Office of the European Union: Luxembourg, 2022. [CrossRef]
20. Macintyre, H.L.; Heaviside, C.; Cai, X.; Phalkey, R. Comparing temperature-related mortality impacts of cool roofs in winter and summer in a highly urbanized European region for present and future climate. *Environ. Int.* **2021**, *154*, 106606. [CrossRef]
21. Rodrigues, M. Projections of Cause-Specific Mortality and Demographic Changes under Climate Change in the Lisbon Metropolitan Area: A Modelling Framework. *Atmosphere* **2023**, *14*, 775. [CrossRef]
22. Çulpan, H.C.; Şahin, Ü.; Can, G. A Step to Develop Heat-Health Action Plan: Assessing Heat Waves' Impacts on Mortality. *Atmosphere* **2022**, *13*, 2126. [CrossRef]
23. Ouyang, H.; Tang, X.; Zhang, R. Research Themes, Trends and Future Priorities in the Field of Climate Change and Health: A Review. *Atmosphere* **2022**, *13*, 2076. [CrossRef]
24. Zheng, X.; Ma, Q.; Wang, Y.; Wang, X.; Zhang, X.; Luan, Q. Assessing Impact of Temperature Variability of Climate Change on Mortality Based on Multiple GCM Projections in China. *Atmosphere* **2022**, *13*, 1775. [CrossRef]
25. Xue, L.; Kappas, M.; Wyss, D.; Putzenlechner, B. Assessing the Drought Variability in Northeast China over Multiple Temporal and Spatial Scales. *Atmosphere* **2022**, *13*, 1506. [CrossRef]
26. Arnold, L.; Scheuerell, M.D.; Busch Isaksen, T. Mortality Associated with Extreme Heat in Washington State: The Historical and Projected Public Health Burden. *Atmosphere* **2022**, *13*, 1392. [CrossRef]
27. Timlin, U.; Ramage, J.; Gartler, S.; Nordström, T.; Rautio, A. Self-Rated Health, Life Balance and Feeling of Empowerment When Facing Impacts of Permafrost Thaw—A Case Study from Northern Canada. *Atmosphere* **2022**, *13*, 789. [CrossRef]
28. Crane, K.; Li, L.; Subramanian, P.; Rovit, E.; Liu, J. Climate Change and Mental Health: A Review of Empirical Evidence, Mechanisms and Implications. *Atmosphere* **2022**, *13*, 2096. [CrossRef]