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Deaths from extreme temperatures around the world

Climate change is intensifying the frequency, intensity, and geographic reach of heatwaves and wildfires, posing a direct threat to human health and well-being. The lethal combination of rising temperatures and air pollution has led to a global rise in heat-related deaths especially affecting vulnerable populations. Extreme temperature exposure from heat or cold, not only triggers immediate risks like dehydration, heatstroke or hypothermia, but also elevates hospitalizations and mortality rates across various conditions such as diabetes, heart disease, respiratory ailments, and mental health disorders.

The findings presented in this factsheet are from two projects: 1) EXHAUSTION (Exposure to heat and air pollution in Europe – cardiopulmonary impacts and benefits of mitigation and adaptation), funded by EU Horizon 2020, is a pan-European consortium dedicated to studying heart and lung disease and deaths due to extreme heat and air pollution (including from wildfires) under

selected climate scenarios. 2) HEATCOST (Health effects and associated socio-economic costs of increasing temperatures and wildfires: a global assessment), funded by the Belmont Forum, aims to quantify health risks from heat and air pollution under different climate scenarios.

The purpose of this factsheet series is to showcase key findings from research on climate change and health from projects funded by the EU and Belmont Forum which are part of the ENBEL network. The series includes only findings from research produced by four EU-funded projects

and one JPI Climate-funded project in the ENBEL network as well as from projects funded through the Belmont Forum Climate, Environment and Health Collaborative Research Action (CEH1).

Key findings

- Research by Zhao and colleagues (2021) analyzed data from 750 locations in 43 countries around the world from 2000 to 2019 and found that more than 5 million deaths per year were associated with extreme temperatures (hot and cold).
- Research by Vicedo-Cabrera and colleagues (2021) used data from 732 locations in 43 countries and concluded that nearly 37% of heat-related deaths during warm seasons from 1991 to 2018 could be attributed to human-induced climate change. This study reveals the broad geographic reach across all continents underscoring the global nature of this issue.
- A systematic review conducted by Hu and colleagues (2023) studied how air pollution combined with heat may enhance health risks potentially leading to more deaths. This study analyzed 22 studies from different parts of the world published during a 30-year timespan which revealed more heat-related deaths during times with high levels of pollution from ozone (O₃) and dust (i.e., particulate matter, PM_{1.0}).
- Research by Lo and colleagues (2022) analyzed data from 445 communities in 20 countries and regions and found that increased temperature variability, known as diurnal temperature range, is linked to higher death rates.
- Masselot and colleagues (2023) studied data from 854 urban areas in Europe (2000–2019) and estimated that nearly 20 000 excess heat-related deaths and approximately 200 000 excess cold-related deaths each year with the highest effect among both heat and cold temperatures in Eastern European cities.
- A study by Rai and colleagues (2023) investigated the interactive effect of air pollution and heat using data from 482 locations in 24 countries and found that deaths from both cardiovascular and respiratory disease increased during high summer temperatures, with a higher risk for deaths from respiratory disease.
- With continued global warming, heat-related deaths are projected to exceed cold-related deaths in Europe during the 2nd half of this century, especially among southern regions.
- Elevated temperatures and heatwaves can trigger conditions such as heat exhaustion, heatstroke, and dehydration resulting in more emergency room visits, hospital admissions, and deaths.

Tokyo, Japan - July 6, 2013: A heatwave wipes across Japan on Saturday, temperatures rise beyond 30 degrees in many places nationwide. One senior gets heat stroke and lies on the ground while the paramedics rush to the scene.
Photo: Istockphoto / Tsuji



Implications of the research

- Extreme temperature-related deaths from climate change, exacerbated by air pollution, are linked to an increase in deaths throughout the world.
- Heat-health action plans and early warning systems should consider and incorporate specific air pollutants to refine thresholds and upscale levels of response. This ensures that the public is alerted to dangerous conditions and can take necessary measures to prevent avoidable health effects and deaths during periods of severe heat.
- Research findings reveal that more attention should be paid to hot and highly polluted days given the potential for health damage.

Who is most at risk?

- Vulnerable groups including the elderly, children, those who are socially isolated, and individuals with chronic diseases, are most at risk. Vulnerability also varies according to geographical location, personal surroundings (i.e., housing), and other factors such as socio-economic status.
- While the health impacts stemming from extreme temperatures are largely preventable, it is crucial that these vulnerable groups are alerted and adopt measures to protect their well-being, particularly during heatwaves.

Conclusion

These research findings underscore that extreme hot and cold temperatures are increasing deaths in many parts of the world. More importantly, the combined impact of high temperatures and air pollutants can intensify harmful health effects, particularly for respiratory and cardiovascular diseases. Thus, there is a critical need for policies and strategies to mitigate the devastating consequences of extreme temperatures. The evidence from the research supports strong mitigation efforts to reduce future warming and enhance resilience.



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For more information

Websites:

- HEATCOST:
cicero.oslo.no/en/projects/heatcost
- EXHAUSTION:
www.exhaustion.eu

Publications:

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Vicedo-Cabrera, AM, Scovronick, N, Sera, F, Roye, D, Schneider, R, Tobias, A, et al. (2021). The burden of heat-related mortality attributable to recent human-induced climate change. *Nature Climate Change*, 11:492-500. doi.org/10.1038/s41558-021-01058-x

Zhao, Q, Guo, Y, Ye, T, Gasparrini, A, Tang, S, Overcenco, A. (2021). Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study. *The Lancet Planetary Health*, 5(7): e415-25. [doi.org/10.1016/S2542-5196\(21\)00081-4](https://doi.org/10.1016/S2542-5196(21)00081-4)

