Photo: Unsplash

Heat, air pollution, and heart and lung disease

Extreme heat and heat stress, in combination with air pollution (including from wildfires), may exacerbate existing health conditions and lead to death and disease. Rising temperatures and air pollution are two of the most concerning impacts of climate change given the significant effects on heart and lung health.

The findings presented in this factsheet are based on research conducted by the EU Horizon 2020-funded EXHAUSTION project: **Exposure to heat and air pollution in Europe – cardiopulmonary impacts and benefits of mitigation and adaptation**. This project studies how heart and lung disease and deaths are linked to extreme heat and air pollution (including from wildfires) and projects the health burden under different climate scenarios. This pan-European consortium includes specialists in air quality modelling, cardiopulmonary medicine, epidemiology, health impact assessment, economics, and science communication.

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

- The convergence of more frequent and intense heatwaves, often along with air pollution episodes, intensifies the susceptibility to heart and lung disease in Europe.
- An increased risk of cardiopulmonary-related death and disease during heat exposure is reported for Europe. The heat effect was stronger for respiratory deaths and disease than for cardiovascular causes. The elderly (>65 years old) and women were found to be more vulnerable to the adverse health effects of heat.
- Air pollution, especially fine particulate matter (PM), can modify heat-related health effects and intensify cardiovascular and respiratory ailments and premature death.
- The combined impact of heat and air pollution becomes particularly hazardous as heatwaves often increase pollution levels by accelerating chemical reactions, enhancing natural and anthropogenic emissions, promoting stagnant air masses, and contributing to enhanced risk of wildfires.
- Wildfires are, increasingly, an important source of PM2.5 pollution in Europe, particularly in Eastern Europe.
- In addition to areas with high levels of air pollution, greater vulnerability to heat was found among people living in urban areas with dense population and less green space.
- Whereas hot weather often co-occurs with elevated levels of air pollutants, increased outdoor activity in warmer months can also increase exposure to these pollutants.
- When overheated, physiological responses are triggered, such as sweating and elevated heart and breathing rates. As we inhale more air, more pollutants enter our respiratory system. In addition, the body's detoxification process is less effective in extreme heat.

Implications of the research

- Climate change-induced increases in heat and air pollution can lead to significant impacts on heart and lung disease in the general population leading to higher healthcare costs, reduced quality of life and, potentially, more fatalities worldwide.
- These findings underscore the need for national heat-health action plans. These plans should address the risk of co-exposure to heat stress and air pollution and be designed to offer access to cool places, behavioral guidance, adjustments in medication, and effective care for patients with cardiovascular risk. Plans should involve hospitals, care homes, and emergency services and provide concrete strategies for heatwave scenarios.
- In low and middle-income countries where indoor cookstove usage and physically demanding work with heat stress is common, the combined effect of heat and air pollution on health warrants increased attention.

Family watching a wildfire in the distance.
Photo: Unsplash

Who is most at risk?

Some subgroups are more susceptible to heat than others. The elderly, for example, are vulnerable as their bodies are less able to deal with heat due to reduced skin blood flow and sweat rates and they may take medications that elevate their risk. Similarly, people with chronic or pre-existing conditions such as heart or lung disease, diabetes, dementia, or mental illness, are at higher risk. Pregnant women, infants, young children, outdoor manual workers, and low socio-economic status are also vulnerable.

Photo: Istockphoto / Miguel Angel Flores

Conclusion

The impacts of climate change on heart and lung health are clear and significant. Rising temperatures and air pollution due to climate change are having a major impact on public health, leading to increased hospital admissions, disease, and death. The findings highlight the urgent need to limit global warming and improve air quality in Europe and around the world to protect the public's health.

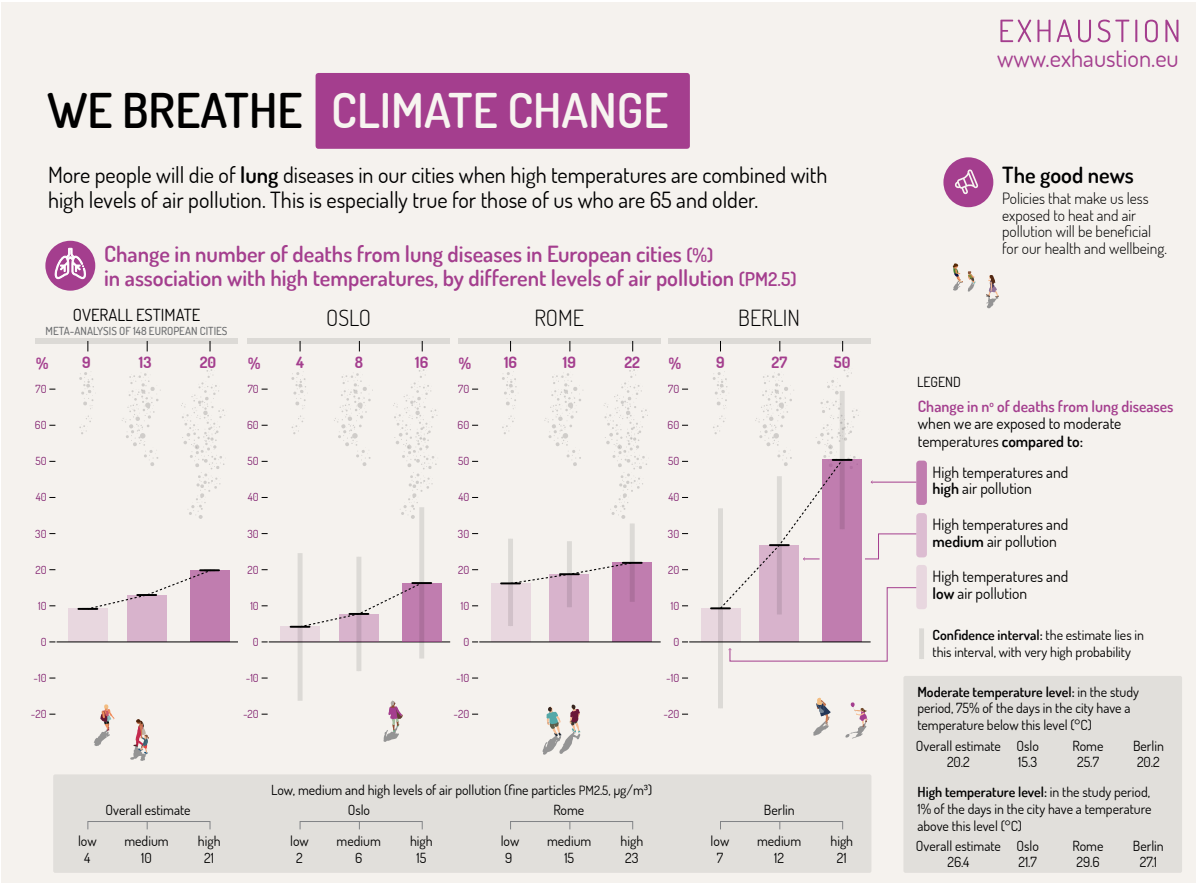

Photo: Unsplash

Publications

Im, U, Geels, C, Hanninen, R, Kukkonen, J, Rao, S, Ruuhela, R, et al. (2022). Reviewing the links and feedbacks between climate change and air pollution in Europe. Frontiers in Env Science, 10, https://doi.org/10.3389/fenvs.2022.954045, https://www.frontiersin.org/articles/10.3389/fenvs.2022.954045/full

Khraishah, H, Alahmad, B, Ostergard, RL, AlAshqar, A, Albaghdadi, M, Vellanki, N, et al. (2022). Climate change and cardiovascular disease: implications for global health. Nature Reviews Cardiology, 19(12): 798-812. doi: 10.1038/s41569-022-00720-x, https://www.nature.com/articles/s41569-022-00720-x

Madureira, H, Pacheco, M, Sousa, C, Monteiro, A, de-Donato, F, De-Sario, M. (2021). Evidences on adaptive mechanisms for cardiorespiratory diseases regarding extreme temperatures and air pollution: A comparative systematic review. Geogr Sustain, 2: 182-94. doi:10.1016/j.geosus.2021.08.001,

Rai, M, Stafoggia, M, de'Donato, F, Scortichini, M, Zafeiratou, S, Fernandez, LV, et al. (2023). Heat-related cardiorespiratory mortality: Effect modification by air pollution across 482 cities from 24 countries. Environment International, 174, 07825, ISSN 0160-4120, doi.org/10.1016/j.envint.2023.107825

Zafeiratou, S, Samoli, E, Dimakopoulou, K, Rodopoulou, S, Analitis, A, Gasparrini, A, et al. (2021). A systematic review of the association between total and cardiopulmonary mortality/morbidity or cardiovascular risk factors with long-term exposure to increased or decreased ambient temperature. Science of the Total Environment, 772:145383, doi: 10.1016/j.scitotenv.2021.145383

Zhang, S, Rai, M, Matthies-Wiesler, F, Breitner. Busch, S, Stafoggia, M, de-Donato, F, et al, (2022). Climate change and cardiovascular disease-the impact of heat and heat-health action plans. European Society of Cardiology, 22 (18): 1-12.

For more information

Website: EXHAUSTION.eu

The entire research factsheet series and other outputs from the ENBEL network can be found on www.enbel-knowledge.eu

This project received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement #101003966.