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Health Impacts of Climate Change

1. **Hourly Air Pollutants and Acute Coronary Syndrome Onset In 1.29 Million Patients.** Chen R et al. Circulation. 2022 Apr 22. doi: 10.1161/CIRCULATIONAHA.121.057179. Online ahead of print.
Conclusions: The results suggest that transient exposure to the air pollutants of PM2.5, NO2, SO2, CO, but not PM2.5-10 or O3, may trigger the onset of ACS, even at concentrations below the World Health Organization air-quality guidelines.

2. **Mortality Attributable to Long-Term Exposure to Ambient Fine Particulate Matter: Insights from the Epidemiologic Evidence for Understudied Locations.** Colonna KJ, Koutrakis P, Kinney PL, Cooke RM, Evans JS. Environ Sci Technol. 2022 Apr 20. doi: 10.1021/acs.est.1c08343. Online ahead of print.
Epidemiologic cohort studies have consistently demonstrated that long-term exposure to ambient fine particles (PM2.5) is associated with mortality. Nevertheless, extrapolating results to understudied locations may involve considerable uncertainty. To explore this issue, this review discusses the evidence for (i) the associated risk of mortality, (ii) the shape of the concentration-response function, (iii) a causal interpretation, and (iv) how the source mix/composition of PM2.5 and population characteristics may alter the effect. The accumulated evidence suggests the following: (i) In the United States, the change in all-cause mortality risk per μg/m3 is about 0.8%. (ii) The concentration-response function appears nonlinear. (iii) Causation is overwhelmingly supported. (iv) Fossil fuel combustion-related sources are likely more toxic than others, and age, race, and income may modify the effect. To illustrate the use of our findings in support of a risk assessment in an understudied setting, we consider Kuwait. However, given the complexity of this relationship and the heterogeneity in reported effects, it is unreasonable to think that, in such circumstances, point estimates can be meaningful. Consequently, quantitative probabilistic estimates, which cannot be derived objectively, become essential. Formally elicited expert judgment can provide such estimates, and this review provides the evidence to support an elicitation.

3. **New seasonal pattern of pollution emerges from changing North American wildfires.** Buchholz RR et al. Nat Commun. 2022 Apr 19;13(1):2043. doi: 10.1038/s41467-022-29623-8. https://www.nature.com/articles/s41467-022-29623-8
Rising emissions from wildfires over recent decades in the Pacific Northwest are known to counteract the reductions in human-produced aerosol pollution over North America. Since amplified Pacific Northwest wildfires are predicted under accelerating climate change, it is essential to understand both local and transported contributions to air pollution in North America. Here, we find corresponding increases for carbon monoxide emitted from the Pacific Northwest wildfires and observe significant impacts on both local and down-wind air pollution. Between 2002 and 2018, the Pacific Northwest atmospheric carbon monoxide abundance increased in August, while other months showed decreasing carbon monoxide, so modifying the seasonal pattern. These seasonal pattern changes extend over large regions of North America, to the Central USA and Northeast North America regions, indicating that transported wildfire pollution could potentially impact the health of millions of people.

4. **Aging Hearts in a Hotter, More Turbulent World: The Impacts of Climate Change on the Cardiovascular Health of Older Adults.** Chang AY, Tan AX, Nadeau KC, Odden MC. Curr Cardiol Rep. 2022 Apr 19:1-12. doi: 10.1007/s11886-022-01693-6. Online ahead of print. https://link.springer.com/article/10.1007/s11886-022-01693-6
PURPOSE OF REVIEW: Climate change has manifested itself in multiple environmental hazards to human health. Older adults and those living with cardiovascular diseases are particularly susceptible to poor outcomes due to unique social, economic, and physiologic vulnerabilities. This review aims to summarize those vulnerabilities and the resultant impacts of climate-mediated disasters on the heart health of the aging population.
RECENT FINDINGS: Analyses incorporating a wide variety of environmental data sources have identified increases in cardiovascular risk factors, hospitalizations, and mortality from intensified air pollution, wildfires, heat waves, extreme weather events, rising sea levels, and pandemic disease. Older adults, especially those of low socioeconomic status or belonging to ethnic minority groups, bear a disproportionate health burden from these hazards. The worldwide trends responsible for global warming continue to worsen climate change-mediated natural disasters. As such, additional investigation will be necessary to develop personal and policy-level interventions to protect the cardiovascular wellbeing of our aging population.

4. **Associations between Daily Ambient Air Pollution and Pulmonary Function, Asthma Symptom Occurrence, and Quick-Relief Inhaler Use among Asthma Patients.** Ścibor M, Balcerzak B, Galbarczyk A, Jasienska G. Int J Environ Res Public Health. 2022 Apr 16;19(8):4852. doi: 10.3390/ijerph19084852.
https://www.mdpi.com/1660-4601/19/8/4852
Particulate matter (PM) is harmful to human health, especially for people with asthma. The goal of this study was to enhance the knowledge about the short-term effects of daily air concentrations of PM on health outcomes among asthma patients. The novelty of this study was the inclusion of a homogeneous group of patients (N = 300) with diagnosed and partly controlled asthma. Patients recorded their symptoms, asthma quick-relief inhaler use, and peak

expiratory low (PEF) measurements in a diary for two weeks. Data on particulate air pollution were obtained from stationary monitoring stations. We have shown that particulate pollutants (PM10 and PM2.5) are associated with significant deterioration of PEF and an increase in the frequency of early asthma symptoms, as well as asthma quick-relief inhaler use. These effects are observed not only on the day of exposure, but also on the following day. For public health practice, these results support the rationale for using peak-flow meters as necessary devices for proper asthma self-management and control, especially in locations where the air is polluted with particles. This may decrease the number of asthma patients seeking medical help.

5. **The influence of environmental air pollution on ventricular arrhythmias: a scoping review.** Pallikadavath S, Vali Z, Patel R, Mavilakandy , Peckham N, Clegg M, Sandilands AJ, Ng GA. Curr Cardiol Rev. 2022 Apr 16. doi: 10.2174/1573403X18666220416203716. Online ahead of print. Results of this review identified 27 studies: nine in individuals with implantable cardioverter defibrillators, five in those with ischaemic heart disease, and 13 in the general population. Those with ischaemic heart disease appear to have the strongest association with ventricular arrhythmias in both gaseous and particulate pollution, with all three studies assessing the effects of PM2.5 demonstrating some association with ventricular arrythmia. Conclusion Individuals with ischaemic heart disease may be at an increased risk of ventricular arrhythmias following exposure to air pollution.

6. **Short-Term exposure to ambient air pollution and onset of work incapacity related to mental health conditions.** Bruyneel L, Kestens W, Alberty M, Karakaya G, Van Woensel R, Horemans C, Trimpeneers E, Vanpoucke C, Fierens F, Nawrot TS, Cox B. Environ Int. 2022 Apr 15;164:107245. doi: 10.1016/j.envint.2022.107245. Online ahead of print.
https://www.sciencedirect.com/science/article/pii/S0160412022001714
The OECD estimates that greater work absenteeism is one of the main drivers behind the impact of air pollution on gross domestic product loss, but research linking air pollution with work absenteeism is scarce. With air pollution increasingly being linked to poor mental health, and poor mental health having become one of the main reasons for work absenteeism, we examined whether the onset of work incapacity related to mental health conditions is associated with short-term fluctuations in ambient black carbon (BC), nitrogen dioxide (NO2), ozone (O3), and particulate matter 2.5 (PM2.5), estimating the contributions of these pollutants jointly, while accounting for relative humidity, total solar radiation and temperature. We conducted a bidirectional time-stratified case-crossover study with daily air pollution estimates by municipality linked with 12 270 events of work incapacity related to mental health conditions in 2019 in Belgium. We ran single- and multi-pollutant conditional logistic regression models for three different exposure windows (lag 0, 0-1 and 0-2), considering potential confounding by relative humidity and total solar radiation. We observed positive associations between work incapacity related to mental health conditions and BC, NO2, and O3 exposure, but findings for PM2.5 were inconsistent. Results from multi-pollutant models showed a 12% higher risk of work incapacity for an IQR increase in NO2 and O3 at the day of the event (lag 0), with estimates increasing to about 26% for average concentrations up to two days before the event (lag 0-2). We found evidence for effect modification by age and season in the association with NO2, with highest effect estimates in the age group 40-49 years and in spring and summer.

For O3, we observed effect modification by type of mental health problem. This country-wide study suggests that air pollution aggravates within 48 h a likely existing propensity to enter work incapacity because of mental health conditions.

7. **Carcinogenic air pollution along the United States' southern border: Neighborhood inequities in risk.** Rubio R, Grineski S, Collins T. Environ Res. 2022 Apr 15:113251. doi: 10.1016/j.envres.2022.113251. Online ahead of print.
Air pollution poses serious and socially inequitable risks to public health. Social disparities are marked along the US-Mexico border, yet prior research has not assessed inequities in air pollution exposure across the entire US-side of the border region. We apply an intersectional approach to examine contextually relevant sociodemographic variables, including (1) Hispanic/Latinx ethnicity by race and (2) nativity (US vs. Foreign) by citizenship, and cancer risks attributable to air pollution exposures. We pair data from the 2012-2016 American Community Survey with 2014 National Air Toxics Assessment estimates of carcinogenic risks from all sources of hazardous air pollutants at the census tract level (n = 1448) and use a series of generalized estimating equations to assess inequities in risk. Increased concentrations of renter-occupants, Hispanics, mid-to-high socioeconomic status households, and foreign-born citizens were associated with elevated risks. Hispanic ethnicity intersected with non-White racial identification to amplify risks. In contrast, increased concentrations of non-Hispanic Black people and foreign-born non-citizens were not associated with disparate risks. To ameliorate environmental health inequities in this context, research and policy actions must be tailored to the US-Mexico border and consider intersectional positions within the Hispanic population.

8. **Environmental air pollution and chronic rhinosinusitis: A systematic review.** Leland EM, Vohra V, Seal SM, Zhang Z, Ramanathan M Jr. Laryngoscope Investig Otolaryngol. 2022 Mar 11;7(2):349-360. doi:
10.1002/lio2.774. eCollection 2022 Apr.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9008184/
RESULTS: Literature search produced 11,983 articles, of which 10 met inclusion criteria. Outcomes evaluated included incidence/prevalence, disease severity, quality of life, and histopathologic/microbial changes. Air pollutant exposure was associated with higher odds of CRS, particularly with particulate matter (PM) exposure. Increasing air pollution exposure was also associated with worsened disease severity and detectable histopathologic changes. Impact on quality of life was less clear.
CONCLUSION: Air pollution (particularly PM) is correlated with CRS incidence/prevalence and disease severity, with evidence of histopathologic changes in CRS tissue samples. Further research is warranted to better understand the mechanisms by which air pollution components may cause CRS and type 2 inflammation.
LEVEL OF EVIDENCE: 3a.

WE ACT

9. **Ambitious Climate Goals by the Numbers: Providence Health and Services.** Reynolds P. IEEE Pulse. 2022 Mar-Apr;13(2):23-25. doi: 10.1109/MPULS.2022.3159067.

Health care systems account for about 10% of the carbon dioxide emitted annually in the USA. In fact, American hospitals produce approximately 6 million tons of waste each year and use approximately 7% of all water consumed in commercial and institutional settings. As climate change becomes a daily reality rather than just a future possibility, major hospital systems are actively pursuing ways to reduce their carbon footprint. In this series, IEEE Pulse explores what steps are being taken and what challenges remain in conversation with different health care systems. This feature focuses on the climate change goals of Providence Health and Services.

10. **'Climate change mitigation is a hot topic, but not when it comes to hospitals': a qualitative study on hospital stakeholders' perception and sense of responsibility for greenhouse gas emissions.** Quitmann C, Sauerborn R, Danquah I, Herrmann A. J Med Ethics. 2022 Apr 22:medethics-2021-107971. doi: 10.1136/medethics-2021-107971. Online ahead of print.
https://jme.bmj.com/content/early/2022/04/21/medethics-2021-107971.long
RESULTS: Concerning GHG emissions, hospital stakeholders perceived energy and waste as most relevant emission sources followed by mobility. Climate change mitigation in general was considered as important. However, in their role as patients or employees, hospital stakeholders felt less responsible for climate change mitigation. They saw providing best possible medical care to be the top priority in hospitals and were often concerned that patients' health could be jeopardised by climate change mitigation measures.
CONCLUSION: Perceptions of most important emission sources did not coincide with those in literature, highlighting the need to inform stakeholders, for instance, about pharmaceuticals as important emission source. A frequently perceived conflict between reducing emissions and providing high-quality medical care could be eased, if reducing emissions would not only be justified as a contribution to mitigation, but also as a contribution to preventing ill health-a basic principle of medical ethics.

11. **Green pharmaceutical supply chain coordination considering green investment, green logistics, and government intervention.** Song Z, He S, Wang Y, An J. Environ Sci Pollut Res Int. 2022 Apr 22. doi: 10.1007/s11356-021-18275-8. Online ahead of print.
Despite their important role in the fight against global climate change, the coordination of green pharmaceutical supply chains (GPSC) has rarely been studied. To fill this research gap and realize the optimal green performance of GPSC, this study aimed to investigate the coordination of a GPSC considering green investment, green logistics, and government intervention. Using a game-theoretic approach, we establish decision models and analyze the equilibrium strategies in several GPSC scenarios. A linked two-part tariff (LTPT) contract is proposed for the coordination of the GPSC. In addition, we explore the many important implications of changes in the parameters. This research shows that, under different conditions, governments should reasonably implement different interventions in order to promote the positive global performance of GPSC. Government intervention can increase the benchmark height and make more room for green improvement. The proposed LTPT contract can assist in the realization of GPSC coordination, obtain a greater consumer surplus, and achieve optimal green performance. Higher flexibility-influence coefficients of green degree on costs are conducive to the emission reductions and sustainable development of GPSC. Moreover, cultivating green preference in the market can save the government expenditures on subsidies.

When the green investment coefficient of a GPSC is larger, the GPSC members lack motivation for green improvement, and the government needs to provide more subsidies rather than taxes in order to improve the green degree of the GPSC. Increased rewards from the government to the pharmaceutical manufacturer and the TPLSP will reduce the subsidies for the pharmaceutical retailer. Government intervention influences the scope of an LTPT contract. The findings provide rich managerial insights and implications for the GPSC policymakers and decision-makers in achieving sustainability goals.

12. **Greenhouse Gas Emission Savings in Relation to Telemedicine and Associated Patient Benefits: A Systematic Review.** Donald N, Irukulla S. Telemed J E Health. 2022 Apr 20. doi: 10.1089/tmj.2022.0047. Online ahead of print.
Conclusions: There are substantial carbon savings to be made with telemedicine systems. Furthermore, there are substantial benefits to patients in terms of both time savings and cost savings. Rural and isolated communities or patients needing tertiary or quaternary care may be a particular cohort that might benefit disproportionally from telemedicine and is an area where the largest per capita emission savings can potentially be made.

13. **Toward Assessing Absolute Environmental Sustainability of Chemical Pollution.** Kosnik MB, Hauschild MZ, Fantke P. Environ Sci Technol. 2022 Apr 19;56(8):4776-4787. doi: 10.1021/acs.est.1c06098. Epub 2022 Mar 29.
https://pubs.acs.org/doi/10.1021/acs.est.1c06098
Chemicals are widely used in modern society, which can lead to negative impacts on ecosystems. Despite the urgent relevance for global policy setting, there are no established methods to assess the absolute sustainability of chemical pressure at relevant spatiotemporal scales. We propose an absolute environmental sustainability framework (AESA) for chemical pollution where (1) the chemical pressure on ecosystems is quantified, (2) the ability for ecosystems to withstand chemical pressure (i.e., their carrying capacity) is determined, and (3) the "safe space" is derived, wherein chemical pressure is within the carrying capacity and hence does not lead to irreversible adverse ecological effects. This space is then allocated to entities contributing to the chemical pressure. We discuss examples involving pesticide use in Europe to explore the associated challenges in implementing this framework (e.g., identifying relevant chemicals, conducting analyses at appropriate spatiotemporal scales) and ways forward (e.g., chemical prioritization approaches, data integration). The proposed framework is the first step toward understanding where and how much chemical pressure exceeds related ecological limits and which sources and actors are contributing to the chemical pressure. This can inform sustainable levels of chemical use and help policy makers establish relevant and science-based protection goals from regional to global scale.

14. **Talking about Climate Change and Environmental Degradation with Patients in Primary Care: A Cross-Sectional Survey on Knowledge, Potential Domains of Action and Points of View of General Practitioners.** André H, Gonzalez Holguera J, Depoux A, Pasquier J, Haller DM, Rodondi PY, Schwarz J, Senn N. Int J Environ Res Public Health. 2022 Apr 18;19(8):4901. doi: 10.3390/ijerph19084901.
https://www.mdpi.com/1660-4601/19/8/4901

RESULTS: Respondents (N = 497) expressed a high level of self-reported knowledge regarding climate change, although it was lower for more specific topics, such as planetary health or health-environment co-benefits. Participants mostly agreed that it is necessary to adapt clinical practice to the health impacts of climate change and that they have a role in providing information on climate change and its links to human health.
CONCLUSION: Most of the GPs were concerned about environmental and climate degradation. However, this study revealed a gap between the willingness of GPs to integrate the impact of climate change on health into their clinical activities and their lack of overall knowledge and scientific evidence on effective interventions. A promising way forward may be to develop co-benefit interventions adapted to the clinical setting on diet, active mobility and connecting with nature.

15. **Integrating Youth Perspectives: Adopting a Human Rights and Public Health Approach to Climate Action.** Gasparri G, Tcholakov Y, Gepp S, Guerreschi A, Ayowole D, Okwudili ÉD, Uwandu E, Sanchez Iturregui R, Amer S, Beaudoin S, Sato M. Int J Environ Res Public Health. 2022 Apr 15;19(8):4840. doi: 10.3390/ijerph19084840.
https://www.mdpi.com/1660-4601/19/8/4840
Climate change is a multidimensional issue that affects all aspects of society, including public health and human rights. Climate change is already severely impacting people's health and threatening people's guaranteed fundamental rights, including those to life, health, self-determination, and education, among others. Across geographical regions, population groups and communities who are already marginalized due to age, gender, ethnicity, income, and other socioeconomic factors, are those who are disproportionately affected by climate impacts despite having contributed the least to global emissions. Although scholars have been calling for a human rights-based approach and a health perspective to climate action, the literature looking at this multidisciplinary intersection is still nascent, and governments have yet to implement such intersectoral policies. This commentary begins to reflect on the relationship between climate change, human rights, and public health from the perspective of young people engaged in climate action and discourse at the national and international levels. It presents a way forward on what we, as youth climate advocates and researchers, believe is a priority to bring intersectoral integration of human rights and public health approaches to climate change to fruition. First, scholars and practitioners should examine and support youth-led climate interventions that tackle human rights and public health violations incurred by the climate crisis. Second, participatory approaches to climate change must be designed by working synergistically with climate-vulnerable groups, including children and young people, practitioners and scholars in public health and human rights sectors to holistically address the social, health, and environmental impacts of the climate crisis and root causes of injustice. Finally, we recommend more holistic data collection to better inform evidence-based climate policies that operationalize human rights and public health co-benefits.

16. **Plastic Waste Management Strategies and Their Environmental Aspects: A Scientometric Analysis and Comprehensive Review.** Huang S, Wang H, Ahmad W, Ahmad A, Ivanovich Vatin

N, Mohamed AM, Deifalla AF, Mehmood I. Int J Environ Res Public Health. 2022 Apr 10;19(8):4556. doi: 10.3390/ijerph19084556.
https://www.mdpi.com/1660-4601/19/8/4556
Plastic consumption increases with the growing population worldwide and results in increased quantities of plastic waste. There are various plastic waste management strategies; however, the present management progress is not sustainable, and plastic waste dumping in landfills is still the most commonly employed strategy. Being nonbiodegradable, plastic waste dumping in landfills creates several environmental and human health problems. Numerous research studies have been conducted recently to determine safe and ecologically beneficial methods of plastic waste handling. This article performed a bibliographic analysis of the available literature on plastic waste management using a computational approach. The highly used keywords, most frequently cited papers and authors, actively participating countries, and sources of publications were analyzed during the bibliographic analysis. In addition, the various plastic waste management strategies and their environmental benefits have been discussed. It has been concluded that among the six plastic waste management techniques (landfills, recycling, pyrolysis, liquefaction, road construction and tar, and concrete production), road construction and tar and concrete production are the two most effective strategies. This is due to significant benefits, such as ease of localization, decreased greenhouse gas emissions, and increased durability and sustainability of manufactured materials, structures, and roadways. Conversely, using landfills is the most undesirable strategy because of the associated environmental and human health concerns. Recycling has equal benefits and drawbacks. In comparison, pyrolysis and liquefaction are favorable due to the production of char and fuel, but high energy requirements limit their benefits. Hence, the use of plastic waste for construction applications is recommended.

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News & Commentary

We could still limit global warming to just 2˚C - but there's an 'if'. Thompson B, Petrić Howe N, Bundell S. Nature. 2022 Apr 20. doi: 10.1038/d41586-022-01100-8. Online ahead of print.

Climate Change Affects Health: Are We Listening? Chain GS, Chain BM, Pelliccia FB. Glob Pediatr Health. 2022 Apr 7;9:2333794X221091799. doi: 10.1177/2333794X221091799. eCollection 2022.

IPCC's starkest message yet: extreme steps needed to avert climate disaster. Nature. 2022 Apr;604(7906):413-414. doi: 10.1038/d41586-022-00951-5.

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