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Health Impacts of Climate Change

1. **Ambient Air Pollution and Atherosclerosis: Recent Updates.** Bevan GH, Al-Kindi SG, Brook R, Rajagopalan S. *Curr Atheroscler Rep.* 2021 Aug 21;23(10):63. doi: 10.1007/s11883-021-00958-9. <https://www.ahajournals.org/doi/10.1161/ATVBAHA.120.315219>

PURPOSE OF REVIEW: During the past century, exposure to particulate matter (PM) air pollution < 2.5 μm in diameter (PM_{2.5}) has emerged as an all-pervading element of modern-day society. This increased exposure has come at the cost of heightened risk for cardiovascular (CV) morbidity and mortality. Not only can short-term PM_{2.5} exposure trigger acute CV events in susceptible individuals, but longer-term exposure over years augments CV risk to a greater extent in comparison with short-term exposure. The purpose of this review is to examine the available evidence for how ambient air pollution exposure may precipitate events at various time frames.

RECENT FINDINGS: Recent epidemiological studies have demonstrated an association between ambient PM_{2.5} exposure and the presence and progression of atherosclerosis in humans. Multiple animal exposure experiments over two decades have provided strong corroborative evidence that chronic exposure in fact does enhance the progression and perhaps vulnerability characteristics of atherosclerotic lesions. Evidence from epidemiological studies including surrogates of atherosclerosis, human translational studies, and mechanistic investigations utilizing animal studies have improved our understanding of how ambient air pollution may potentiate atherosclerosis and precipitate cardiovascular events. Even so, future research is needed to fully understand the contribution of different constituents in ambient air pollution-mediated atherosclerosis as well as how other systems may modulate the impact of exposure including adaptive immunity and the gut microbiome. Nevertheless, due to the billions of people continually exposed to PM_{2.5}, the long-term pro-atherosclerotic effects of this ubiquitous air pollutant are likely to be of enormous and growing global public health importance.

2. **Air Pollution's Effects on Newborns' Thyroid Hormones.** Kuehn BM. JAMA. 2021 Aug 17;326(7):592. doi: 10.1001/jama.2021.13123.

<https://jamanetwork.com/journals/jama/fullarticle/2783053>

Exposure to fine particulate pollution during the first and third trimesters is associated with disturbances in newborns' thyroid hormones, according to a study published in the journal Environmental Research.

The investigators measured weekly exposure to fine particulate matter smaller than 2.5 μm (PM_{2.5}) in diameter and nitrogen dioxide throughout the pregnancies of 463 women living in Northern Spain. They also measured the newborns' total thyroxine levels in blood samples collected via heel prick 48 hours after birth. There was no association between the mother's exposure to nitrogen dioxide during pregnancy and her newborn's thyroid hormone levels. However, high levels of exposure to PM_{2.5} during the first trimester were associated with lower thyroxine levels in newborns. Conversely, exposure to high PM_{2.5} levels in the final weeks of pregnancy was associated with higher thyroxine levels in newborns. The results are consistent with those of a US study.

3. **Associations between wildfire smoke exposure during pregnancy and risk of preterm birth in California.** Heft-Neal S, Driscoll A, Yang W, Shaw G, Burke M. Environ Res. 2021 Aug 14:111872. doi: 10.1016/j.envres.2021.111872. Online ahead of print.

There is limited population-scale evidence on the burden of exposure to wildfire smoke during pregnancy and its impacts on birth outcomes. In order to investigate this relationship, data on every singleton birth in California 2006-2012 were combined with satellite-based estimates of wildfire smoke plume boundaries and high-resolution gridded estimates of surface PM_{2.5} concentrations and a regression model was used to estimate associations with preterm birth risk. Results suggest that each additional day of exposure to any wildfire smoke during pregnancy was associated with an 0.49 % (95 % CI: 0.41-0.59 %) increase in risk of preterm birth (<37 weeks). At sample median smoke exposure (7 days) this translated to a 3.4 % increase in risk, relative to an unexposed mother. Estimates by trimester suggest stronger associations with exposure later in pregnancy and estimates by smoke intensity indicate that observed associations were driven by higher intensity smoke-days. Exposure to low intensity smoke-days had no association with preterm birth while an additional medium (smoke PM_{2.5} 5-10 $\mu\text{g}/\text{m}^3$) or high (smoke PM_{2.5} > 10 $\mu\text{g}/\text{m}^3$) intensity smoke-day was associated with an 0.95 % (95 % CI: 0.47-1.42 %) and 0.82 % (95 % CI: 0.41-1.24 %) increase in preterm risk, respectively. In contrast to previous findings for other pollution types, neither exposure to smoke nor the relative impact of smoke on preterm birth differed by race/ethnicity or income in our sample. However, impacts differed greatly by baseline smoke exposure, with mothers in regions with infrequent smoke exposure experiencing substantially larger impacts from an additional smoke-day than mothers in regions where smoke is more common. We estimate 6,974 (95 % CI: 5,513-8,437) excess preterm births attributable to wildfire smoke exposure 2007-2012, accounting for 3.7 % of observed preterm births during this period. Our findings have important implications for understanding the costs of growing wildfire smoke exposure, and for understanding the benefits of smoke mitigation measures.

4. **Short-term exposure to fine particulate air pollution and emergency department visits for kidney diseases in the Atlanta metropolitan area.** Bi J, Barry V, Weil EJ, Chang HH, Ebel S. *Environ Epidemiol.* 2021 Aug 6;5(4):e164. doi: 10.1097/EE9.000000000000164. eCollection 2021 Aug.

https://journals.lww.com/environepidem/Fulltext/2021/08000/Short_term_exposure_to_fine_particulate_air.5.aspx

Toxicological evidence has shown that fine particulate matter (PM_{2.5}) may affect distant organs, including kidneys, over the short term. However, epidemiological evidence is limited.

OBJECTIVES: We investigated associations between short-term exposure to PM_{2.5}, major PM_{2.5} components [elemental carbon (EC), organic carbon (OC), sulfate, and nitrate], and gaseous co-pollutants (O₃, CO, SO₂, NO₂, and NO_x) and emergency department (ED) visits for kidney diseases during 2002–2008 in Atlanta, Georgia.

METHODS: Log-linear time-series models were fitted to estimate the acute effects of air pollution, with single-day and unconstrained distributed lags, on rates of ED visits for kidney diseases [all renal diseases and acute renal failure (ARF)], controlling for meteorology (maximum air and dew-point temperatures) and time (season, day of week, holidays, and long-term time trend).

RESULTS: For all renal diseases, we observed positive associations for most air pollutants, particularly 8-day cumulative exposure to OC [rate ratio (RR) = 1.018, (95% confidence interval [CI]: 1.003, 1.034)] and EC [1.016 (1.000, 1.031)] per interquartile range increase exposure. For ARF, we observed positive associations particularly for 8-day exposure to OC [1.034 (1.005, 1.064)], EC [1.032 (1.002, 1.063)], nitrate [1.032 (0.996, 1.069)], and PM_{2.5} [1.026 (0.997, 1.057)] per interquartile range increase exposure. We also observed positive associations for most criteria gases. The RR estimates were generally higher for ARF than all renal diseases.

CONCLUSIONS: We observed positive associations between short-term exposure to fine particulate air pollution and kidney disease outcomes. This study adds to the growing epidemiological evidence that fine particles may impact distant organs (e.g., kidneys) over the short term.

WE ACT

5. **A robust fuzzy multi-objective programming model to design a sustainable hospital waste management network considering resiliency and uncertainty: A case study.** Negarandeh R, Tajdin A. *Waste Manag Res.* 2021 Aug 19;734242X211038134. doi: 10.1177/0734242X211038134. Online ahead of print.

<https://journals.sagepub.com/doi/full/10.1177/0734242X211038134>

With the increase in the number of patients and activity of hospitals, the issue of hospital waste management (HWM) is becoming more and more challenging and worrying. In addition to financial losses, there will be irreparable damage to the ecosystem and environment which will create many problems for people (because the job of some people in the area is livestock and agriculture and they have a lot to do with their surroundings). It also doubles the need to pay attention to the issue of sustainable development (simultaneous attention to social, economic and environmental dimensions) in waste management. Moreover, the climatic and geographical conditions and lack of proper waste management in this area lead to major

problems. Therefore, in this research, by developing a novel multi-objective mixed integer linear programming model, HWM is addressed in the hospitals of Sari, Iran. The aim is to design an HWM network considering sustainability, resiliency and uncertainty. In order to deal with uncertainty, a robust fuzzy programming approach is employed, and then an improved goal programming technique and Lp-metric method is proposed to solve the model. It was revealed that goal programming outperforms the Lp-metric method in terms of all objectives. Furthermore, the obtained results demonstrate the applicability and efficiency of the proposed methodology to design an efficient sustainable HWM network.

6. **Getting to the heart of transformation.** Vogel C, O'Brien K. Sustain Sci. 2021 Aug 14:1-7. doi: 10.1007/s11625-021-01016-8. Online ahead of print.

<https://link.springer.com/article/10.1007/s11625-021-01016-8>

Climate change, biodiversity loss, the COVID-19 pandemic, and growing inequity and poverty are some of the key global challenges facing us today. These multiple and interacting crises have elicited growing appeals to the need for transformation. Yet while the scholarly literature on transformations is expanding rapidly, the concept risks becoming an empty buzzword or an alibi for superficial interventions and business-as-usual responses within research, policy and practice communities. In this perspective, we look more closely at what is needed to generate the deep and enduring changes that are called for to address multiple, interacting challenges. We do this by focusing on the prefix 'trans-', which signifies moving "across, over, or beyond" the current state of affairs, and we consider how the potential for equitable and sustainable transformations lies in our capacity to transcend entrenched boundaries and limits. Focusing on transdisciplinary, transgressive, and transcendent approaches, we reflect on how individuals, groups, and organizations can plant seeds and help to nurture the potential for radical transformative change at all scales.

7. **The climate and health benefits from intensive building energy efficiency improvements.** Gillingham KT, Huang P, Buehler C, Peccia J, Gentner DR. Sci Adv. 2021 Aug 20;7(34):eabg0947. doi: 10.1126/sciadv.abg0947. Print 2021 Aug.

<https://advances.sciencemag.org/content/7/34/eabg0947>

Intensive building energy efficiency improvements can reduce emissions from energy use, improving outdoor air quality and human health, but may also affect ventilation and indoor air quality. This study examines the effects of highly ambitious, yet feasible, building energy efficiency upgrades in the United States. Our energy efficiency scenarios, derived from the literature, lead to a 6 to 11% reduction in carbon dioxide emissions and 18 to 25% reductions in particulate matter (PM_{2.5}) emissions in 2050. These reductions are complementary with a carbon pricing policy on electricity. However, our results also point to the importance of mitigating indoor PM_{2.5} emissions, improving PM_{2.5} filtration, and evaluating ventilation-related policies. Even with no further ventilation improvements, we estimate that intensive energy efficiency scenarios could prevent 1800 to 3600 premature deaths per year across the United States in 2050. With further investments in indoor air quality, this can rise to 2900 to 5100.

8. **Mapping healthcare waste management research: Past evolution, current challenges, and future perspectives towards a circular economy transition.** Ranjbari M, Shams Esfandabadi Z, Shevchenko T, Chassagnon-Haned N, Peng W, Tabatabaei M, Aghbashlo M. *J Hazard Mater.* 2021 Jul 27;422:126724. doi: 10.1016/j.jhazmat.2021.126724. Online ahead of print.
Improper healthcare waste (HCW) management poses significant risks to the environment, human health, and socio-economic sustainability due to the infectious and hazardous nature of HCW. This research aims at rendering a comprehensive landscape of the body of research on HCW management by (i) mapping the scientific development of HCW research, (ii) identifying the prominent HCW research themes and trends, and (iii) providing a research agenda for HCW management towards a circular economy (CE) transition and sustainable environment. The analysis revealed four dominant HCW research themes: (1) HCW minimization, sustainable management, and policy-making; (2) HCW incineration and its associated environmental impacts; (3) hazardous HCW management practices; and (4) HCW handling and occupational safety and training. The results showed that the healthcare industry, despite its potential to contribute to the CE transition, has been overlooked in the CE discourse due to the single-use mindset of the healthcare industry in the wake of the infectious, toxic, and hazardous nature of HCW streams. The findings shed light on the HCW management domain by uncovering the current status of HCW research, highlighting the existing gaps and challenges, and providing potential avenues for further research towards a CE transition in the healthcare industry and HCW management.
9. **Why We Should Preach to the Climate Change Choir: The Importance of Science Communication That Engages People Who Already Accept Climate Change.** Duffy MA. *Am Nat.* 2021 Sep;198(3):433-436. doi: 10.1086/715153. Epub 2021 Jun 16.
Climate change is one of the most urgent issues facing society today, and scientists have an important opportunity to teach students and other audiences about climate change. With climate communication, it can be tempting to think that the primary goal should be to get more people to accept climate change, but true climate literacy requires not just an understanding of the reality of climate change but also acting on that understanding. Here, I argue that there is an important role for communicating about climate change with people who already accept that it is occurring. Such communication can help people improve their understanding, increasing their certainty regarding climate change and its drivers, and spur them to take action. Social science research has important insights regarding how to communicate in a way that encourages people to change behaviors, including aiming to increase personal and collective efficacy and helping people figure out how to meet key needs while reducing greenhouse gas emissions. Climate change communicators should seek out audiences that already accept climate change, helping those individuals deepen their understanding and energizing and empowering these people to act.
10. **Do legislated carbon reduction targets influence pro-environmental behaviours in public hospital pharmacy departments? Using mixed methods to compare Australia and the UK.** Singleton JA, Lau ET, Nissen LM. *PLoS One.* 2021 Aug 18;16(8):e0255445. doi: 10.1371/journal.pone.0255445. eCollection 2021.
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0255445>

Pharmaceuticals and their packaging have a significant negative impact on the environment providing a very strong argument for action on the part of pharmacists and pharmacy technicians to engage with pro-environmental behaviours (PEBs) in their workplaces. The aims of this research were therefore to investigate in hospital pharmacists and pharmacy technicians, 1) factors affecting engagement with workplace PEBs, and 2) determine if legislated carbon reduction targets in the UK influenced workplace PEBs in the UK compared with Australia which does not have legislated carbon reduction targets. The environmentally responsible disposal of pharmaceutical waste was the PEB of interest in this study. A mixed methods research design was utilised and a conceptual model (key variables: environmental attitude, concern, and knowledge, and organisational factors) was developed to identify factors influencing workplace PEBs. Participants were from five hospitals in Queensland, Australia and five NHS hospitals in England, UK. There was no statistically significant difference in environmental attitude or concern between the two groups-most had a mid-environmental attitude score and low levels of environmental concern. Participants lacked knowledge of the issue and the link between the environment and public health. Both Australian and UK participants reported recycling packaging waste was not a priority in the hospital pharmacy workplace (even in hospitals with recycling capability) as hospitals focused on compliance with clinical (contaminated) and confidential waste streams. Environmental attitude, knowledge, and concern therefore appeared to be weak influences on intention to perform workplace PEBs with workplace social norms (compliance due to audits) appearing to be a significant mediator of action. The key difference between the cohorts was that UK pharmacists felt waste was not in the scope of their role, and therefore not their responsibility. This study identified that legislated carbon reduction targets did not influence hospital pharmacy workplace PEBs-neither cohort reported engaging significantly in workplace PEBs. UK Government and NHS sustainability policy did not appear to have disseminated to pharmacy department level of UK public hospitals to any great extent.

[**Lancet Planetary Health**](#) – *open-access, interdisciplinary journal focused on sustainability*

News & Commentary

[Mitigating climate change must be a priority for public health.](#) The Lancet Public Health. Lancet Public Health. 2021 Aug 18;S2468-2667(21)00190-0. doi: 10.1016/S2468-2667(21)00190-0. Online ahead of print.

[Environmental Racism and Climate Change - Missed Diagnoses.](#) Salas RN. N Engl J Med. 2021 Aug 18. doi: 10.1056/NEJMp2109160. Online ahead of print.

['Polluter pays' policy could speed up emission reductions and removal of atmospheric CO\(2\).](#) Stainforth DA. Nature. 2021 Aug;596(7872):346-347. doi: 10.1038/d41586-021-02192-4.

[The Journey to Health Parity: From Coronavirus to Climate Change.](#) McDougale L; June 27, 2021. J Natl Med Assoc. 2021 Aug;113(4):366-367. doi: 10.1016/j.jnma.2021.07.002.

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