Heart, Lung and Circulation (2023) **32**, 1–3
1443-9506/22/$36.00
https://doi.org/10.1016/j.hlc.2022.12.009

EDITORIAL

Environment, Climate and Cardiovascular Health: What We Know, What We Need to Know and What We Need to Do

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Keywords Environment • Climate • Cardiovascular disease

Climate change is now considered the biggest threat to the human population of the 21st century [1], and we are faced with a situation where environment, climate and health are interconnected. Human health is reliant on planetary health. In Australia, the Black Summer bushfires (2019–2020) burned more than 24 million hectares of Australian bushland. Recent datasets of satellite imagery of burned areas, observations of climate and weather, and simulated fuel loads have since been confirmed to be part of a clear trend of worsening fire weather and ever-larger forest areas burned by bushfires [2]. Intense fires in the Amazon also captured global attention in 2019 for the destruction of natural ecosystems and smoke production in the region. Both bushfires raged through the colloquial 'lungs of the world' in 2020, with widespread regional public health consequences, including premature death related to smoke pollution [3]. When the Call for Papers for this Special Edition on Environment, Climate and Cardiovascular Health went out in 2021, we could not know what the next disaster in our region would be. Then, in Australia in 2022, we experienced severe and widespread flooding. These and other extreme weather events are anticipated to continue and indeed increase in response to climate change [4]. As 2023 begins, the contributions in this Special Edition of *Heart Lung and Circulation* share a common message—we know a lot, we need to learn a lot more, and there is lot (more) we can all do to prevent, ameliorate, and manage the cardiovascular effects of these environmental and climate disasters.

Cardiovascular disease (CVD) is the leading cause of death globally [5]. Importantly, clinicians, policy makers, and stakeholders need to be cognisant that vulnerable populations are at greater risk from sudden or extreme changes in environmental conditions. As an example, Magdy and colleagues highlight the cardiovascular consequences of

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extreme weather conditions in Port Macquarie, NSW, Australia [4]. They point out that natural disasters have a disproportionately greater impact on individuals living in regional and remote areas, not only in terms of property damage but also in effects on public infrastructure and access to services, which exacerbated existing health disadvantages. In a Call to Action from the Cardiac Society of Australia and New Zealand (CSANZ) Nursing Council, Inglis and colleagues also identify groups who may be unable to safeguard against the shock of climate events or to engage in critical actions that reduce impact on their cardiovascular health, including First Nations peoples, people who are elderly and frail and those from low-socioeconomic status households [6]. The Call states that such groups need targeted preventive actions and support so that they can be protected from potentially avoidable harm.

This Special Edition highlights the importance of health professionals working in cardiovascular health taking leadership and in understanding how their care of patients can be part of the problem. Specifically, Szirt and colleagues write that the healthcare sector contributes to nearly 5% of global carbon emissions [7], and that the exponential growth of medical waste poses a significant challenge to environmental sustainability. Szirt et al. outline how healthcare workers in cardiac catheter labs can make a meaningful change to their practice and contribute towards a more sustainable future by taking advantage of opportunities to reduce waste [7]. These include adopting a "lean" mentality, "The Five R-Concept"—to Reduce, Reuse, Recycle, Rethink and Research, and avoiding the use of unnecessary equipment and material [8]. This approach may well conflict with single-use device policy and practice but nevertheless represents a challenge that we need to confront.

Ambient air pollution is recognised to be a significant contributor to the burden of CVD and mortality. However, there is much yet to be understood about the connection between air pollution and CVD [9], and several reports in this Special Edition help further our understanding. A systematic review of more than three decades of research reported in multiple databases by Fathieh and colleagues found that particulate matter <2.5 μm ($PM_{2.5}$) was the most studied pollutant, followed by particulate matter between 2.5 μm–10 μm (PM_{10}), nitrogen dioxide (NO_2) and ozone (O_3) [10]. The researchers identified key activated pathophysiological pathways that lead to myocardial and vascular injury in response to air pollutants—activation of systemic and local inflammation, oxidative stress, endothelial dysfunction, and autonomic dysfunction. In an original research article, Lankaputhra and colleagues suggest that an imbalance in cardiac autonomic function is a key mechanism of the adverse cardiovascular effects of bushfire smoke [11]. They found that exposure to bushfire smoke (planned burning) in two rural towns in Victoria, Australia, was associated with reduced overall and long-term heart-rate variability (measured with repeat 24-hour Holter electrocardiography).

In a Japanese case-crossover study, Zhao and colleagues aimed to determine the associations between the incidence of acute cardiac events and both gaseous (carbon monoxide, nitrogen oxides, photochemical oxidants and sulfur dioxide) and particulate matter [12]. They found that short-term exposures to sulfur dioxide and nitrogen oxides are associated with an increased risk of out-of-hospital cardiac arrest. In an Iranian ecological study, Mohammadian-Khoshnoud et al. found that responses to air pollutants differed between men and women in terms of hospitalisation for acute myocardial infarction, indicating that gender-stratified analysis is important [13]. In India, seeking to detect regional vulnerabilities and provide forewarnings, Sajith Kumar et al. observed that economically developed states may be contributing a greater share of air pollution-attributed CVD [14].

On a reassuring note, it is hoped this Special Edition will deepen awareness and understanding and subsequently assist in promoting effective actions that combat the causes and effects of adverse cardiovascular health outcomes related to the environment and climate. In a prospective randomised crossover trial protocol, Barbhaya and colleagues hypothesise that the use of personal protective aids (such as home indoor air purifiers and N95 masks) could decrease blood pressure in people with hypertension and fasting blood glucose levels in those with diabetes [15]. These authors hypothesise their study will ultimately demonstrate whether personal protective aids can be a viable adaptation measure for people living with hypertension and diabetes in areas with a high burden of air pollution.

The global COVID-19 pandemic has caused unparalleled disruption and seems ubiquitous in its presence [16]. In this edition, Cowie and colleagues remind us that the particles dispersed in our environment also include the spread of aerosolised respiratory particles that can lead to the transmission of diseases such as COVID-19 [17]. The results of their prospective, observational cohort study provide a caution for readers: wearing a surgical face mask while exercising indoors at high intensity on a cycle ergometer may only have a limited effect on reducing the spread of such particles. Measures for safer indoor exercise need to emphasise distance and airflow and not rely solely on mask-wearing.

Looking forward, Poon and colleagues aim to assist in developing a nationwide climate-health projection model to improve health care resource allocation for the combined effects of temperature and humidity [18]. Their modelling, based on multiple datasets, demonstrated that different carbon emission climate scenarios would lead to very different projected demands for respiratory disease-related lengths-of-stay in intensive care units. In brief, the highest carbon emission climate scenario led to an almost two-fold higher demand for intensive care.

At the population-level, Chaseling and colleagues write of the importance for heat–health advice to be evidence-based [19]. They call for the development and dissemination of scientifically supported public policy advice to mitigate the

adverse health outcomes of extreme heat for vulnerable populations. Feng and colleagues advise that 'urban reforestation', including an increase in tree canopy cover, may protect cardiovascular health, particularly for people living in houses [20]. Study participants numbered about 87,000 living in houses and 18,000 living in apartments derived from the 45 and Up Study (Sax Institute) baseline survey [21], with 10 years of linked hospitalisation and death data. Astell-Burt and colleagues also report that Australians are ready to receive "nature prescriptions"—that is, prescribing time in nature—as an adjunct to standard care [22]. As a preliminary exercise to assist in developing future trials, they surveyed levels of need and interest in nature prescriptions in adults with cardiovascular diseases, psychological distress, and concomitants, such as obesity, loneliness and burn-out. Most participants were interested in a nature prescription—a pro-environmental, pro-social, low-cost, and highly scalable intervention.

We hope our readers will be inspired to join the *Special Issue: Environment, Climate and Cardiovascular Health* authors in seeking to understand the causes and effects of environmental and climate change on our cardiovascular health and to learn how to better respond to, and, preferably, prevent the adverse impact of environmental factors on health outcomes. As our invited editorialists Ferguson and Davidson affirm, meeting the challenges ahead successfully will need a whole-of-planet effort [23].

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