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EARLY CAREER PERSPECTIVE

Climate Change and Cardiovascular Health

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Climate change—which encompasses the long-term changes in temperature and weather patterns seen since the Industrial Revolution attributed in large part to increasing levels of greenhouse gases—is increasingly recognized for its far-reaching consequences on human health.[1] The consequences of fossil fuel combustion that range from air pollution to extreme heat and to severe weather patterns can translate both directly and indirectly to increases in cardiovascular morbidity and mortality.[2] The exposure pathways that link climate change to health outcomes vary based on both geographic context (eg, people living in flood-prone areas face different challenges from those living in drought-prone areas) and sociodemographic context (eg, people with limited economic resources may be particularly vulnerable to health impacts of a changing climate for which they lack the resources to overcome the effects). Accordingly, better understanding of the effects of climate change is of increasing importance for clinicians to empower them to develop strategies to reduce its burden on the health of their patients. This article will identify climate-sensitive environmental stressors, discuss their effects on cardiovascular health, and review the unique risks faced by vulnerable communities cared for by cardiovascular disease specialists.

CLIMATE-SENSITIVE STRESSORS AND CARDIOVASCULAR HEALTH

Climate-sensitive stressors include air pollution, extreme heat, and severe weather patterns, which in turn can affect food, power, and water supply and quality, which can also impact migratory patterns of both humans and vector-borne diseases. Floods and resulting power outages have both been associated with an increased risk of hospitalization for cardiovascular disease, particularly when the power outage exceeds the 75th percentile of distribution (corresponding to 1.72% of total customers being affected by the power outage).[3] High temperatures lead to increasing levels of ground-level ozone, a greater risk of wildfire and dust storms, and a higher demand for electricity—which in turn increases demand for fossil fuel combustion and air pollution. Air pollution—such as elevated levels of fine particulate matter—has detrimental effects on cardiopulmonary health.[4] Globally, the age-standardized death rates attributable to air pollution vary by region, with rates ranging from <21/100 000 in the United States and Canada to >80/100 000 in China and India, according to the 2020 Global Burden of Disease Study.[5] Separately, extreme heat is linked to increased cardiovascular disease–related emergency department visits.[6] Heat stress can manifest physiologically via increased cardiac workload (to compensate for the body's vasodilatory response to heat), hemoconcentration, and inflammation, and in severe circumstances it can lead to autonomic dysfunction. Furthermore, current climate models predict that certain regions of the globe will experience more intense rainfall, coastal flooding, and storm surges in the face of global warming.[7] Destructive windstorms significantly impact cardiovascular mortality, as heart disease has been shown to be a major cause of death (representing 11% of deaths) in

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posthurricane mortality data, following drowning and trauma- or injury-related deaths.[8] When examining hospitalization records in Orleans Parrish after Hurricane Katrina in 2005, a week after landfall the cardiovascular disease rates increased to 26.3±23.7 and 16.6±11.7 cases/d per 10 000 people (P<0.001) for Black and White patients, respectively (from pre-Katrina baseline rates of 7.4±2.7 and 7.1±2.8 cases/d per 10 000 people for Black and White patients, respectively).[9] Increased incidence and mortality of myocardial infarction was also demonstrated after Hurricane Sandy in 2012.[10] When examining areas highly impacted by Hurricane Sandy in 2012, compared with regional data from the past 5 years preceding the hurricane, there was a 22% increase in myocardial infarction incidence and a 31% increase in myocardial infarction 30-day mortality.[10] These changes in climate also impact agricultural production, food security, and political stability, particularly among vulnerable communities and regions. One study found that the probability of new civil conflict arising in the tropics doubled during the years of El Niño–Southern Oscillation.[11] Although the impact of these events on cardiovascular disease is difficult to quantify, they are unlikely to encourage the adoption or maintenance of a heart-healthy diet, regular cardiovascular exercise, and access to care, all of which are fundamental in maintaining cardiovascular health.[12] Large research gaps in quantifying the impacts of climate change on cardiovascular health remain, and given the complex and multidisciplinary nature of the topic, stand to benefit from interdisciplinary collaborations among clinical cardiologists, climate scientists, and environmental epidemiologists, among other research professionals, to better elucidate the overall burden of disease and what mitigation and/or adaptation strategies are most cost effective.

CONSIDERATIONS FOR VULNERABLE COMMUNITIES

Although all communities will have challenges in the face of climate change, certain communities might be more sensitive to them and have less adaptive capacity to cope with these changes, resulting in worse health outcomes. Mortality from floods, droughts, and storms was 15 times higher in highly vulnerable regions compared with regions with low vulnerability between 2000 and 2010.[13] In particular, older adults, people with preexisting cardiovascular disease, and those with limited socioeconomic standing are particularly vulnerable. For example, people living in poverty are more likely to be exposed to extreme heat, air pollution, and resulting cardiovascular disease.[1] One study on ambient air pollution and mortality after cardiac transplantation found an increased mortality hazard ratio of 1.26 per 10 $\mu g/m^3$ increase in annual fine particulate matter.[14] Air pollution in particular is the strongest environmental risk factor of cardiovascular disease.[5] In addition to the negative health impacts that vulnerable communities face as a result of heat waves, wildfires, and air pollution, the reduced access to green space that can result from these events has also been independently associated with higher rates of cardiovascular disease.[15] Furthermore, people with heart failure might be less able to cope with power outages that result from a heat wave or delays in medication delivery stemming from delayed shipping attributed to drought or postponed or canceled visits with their care providers. This increased health risk among people with cardiovascular disease emphasizes the importance of assisting our patients to assess their exposures and help minimize their risk profiles.

CONCLUSIONS

The extent to which our world's climate and weather patterns will continue to change and their ultimate impact on human health is difficult to predict, but it is clear that climate change has already adversely affected health globally.[13] Although we are increasingly aware of the risks that climate change poses to human health, there is still much work to do to increase our understanding of the mechanisms though which these health effects are mediated and the most effective strategies to minimize these health risks through both adaptation and mitigation strategies. Current strategies to reduce known risks of cardiovascular disease include adaptation strategies at the individual level (eg, ensuring that patients have access to air conditioning on extreme heat days) and mitigation strategies at the societal level (eg, advocating for regulations that stop pollution at its source). Environmental exposures and our changing environment are intricately related to cardiovascular health. Accordingly, it is vital that we as clinicians better understand the health effects of climate change to empower our patients to develop strategies to reduce their risk of cardiovascular disease.

ARTICLE INFORMATION

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Disclosures

None.

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