

Fire and Flood: The Cardiovascular Impact of Natural Disasters—A Regional New South Wales Experience



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The adverse impact of environmental factors on health outcomes is increasingly recognised, and climate change is projected to drastically influence a variety of climate-sensitive health outcomes worldwide [1]. Australia has experienced a series of extreme weather events in quick succession and events are anticipated to increase in response to climate change [2]. Individuals living in regional and remote areas are disproportionately affected by the impact of natural disasters—property damage, damage to public infrastructure, poor access to services and emotional impacts [3]. In this Commentary, we highlight the cardiovascular consequences of extreme weather conditions in Port Macquarie, exacerbating existing health disadvantages in this vulnerable regional population.

Despite being known for its idyllic climate, Port Macquarie, in the mid-north coast of New South Wales, has borne the brunt of a series of extreme natural disasters over the last 2 years. During the height of the floods in early 2021, the mid-north coast region was declared a disaster zone, 18,000 individuals were forced to evacuate their homes overnight, schools were closed and workers were told to stay at home [4]. Less than 18 months prior, the region was impacted by the catastrophic bushfire period of late 2019, and further devastating flooding has occurred in Northern New South Wales this year. In addition to the toll exacted on economy and infrastructure, we also found a noticeable deviation in cardiovascular presentations. During the bushfire

season from 1 August 2019 to 1 February 2020, an audit of cardiology admission records identified a 50% reduction in ST-segment elevation myocardial infarction (STEMI) presentations at our institution, compared to the preceding 6 months and the same 6-month period in the preceding year (14 cases from 1 August 2019 to 1 February 2020 compared to 28 cases from 1 February 2019 to 1 August 2019 and 27 cases from 1 August 2018 to 1 February 2019).

Bushfires and Cardiovascular Disease

Several mechanisms have been proposed to explain the cardiovascular effects of bushfires, predicated on biological plausibility. Fine particulate matter with a diameter of 0.1–2.5 μm ($\text{PM}_{2.5}$) is considered to be a primary mediator [5]. $\text{PM}_{2.5}$ elicits complex direct and indirect effects on the cardiovascular system including neuroendocrine activation, vascular interactions, epigenetic changes and systemic inflammation. $\text{PM}_{2.5}$ is also associated with increased blood pressure and dyslipidaemia. Together, these factors accelerate the progression of atherosclerosis and potentiate plaque rupture [5]. Despite biological plausibility, the evidence for a causal association between bushfire smoke and cardiovascular outcomes is limited. A small study based in Melbourne, found an association between exposure to forest fire smoke and the

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rate of out-of-hospital cardiac arrests [6]. Other studies have not shown an association between exposure to bushfire smoke and adverse cardiovascular events [7–9].

On 15 November 2019, Port Macquarie recorded the fourth highest level of particulate matter (PM_{2.5}) in New South Wales since 1994 due to bushfire smoke (443 µg/m³, 18 times the benchmark national standard) [10]. The town experienced at least 44 days above the PM_{2.5} benchmark. Unexpectedly, we observed a significant reduction in STEMI presentations during this period, despite biological plausibility for an association between PM_{2.5} and cardiovascular events. It is possible that lack of access to vital infrastructure and health care services may have contributed to a proportion of missed STEMIs in this vulnerable population. It also raises the concern of avoidance behaviour and other negative psychological responses during natural disasters, similar to the phenomenon that was associated with delayed and missed STEMI presentations during the COVID-19 pandemic [11].

Floods: The Cardiovascular Collateral Damage

An interesting case during the floods in Port Macquarie was that of a 62-year-old man who suffered an inferior STEMI due to stent thrombosis after evacuation and interruption to antiplatelet medications (Box 1). Lack of access to medication, which is prevalent in up to 48% of individuals who are evacuated to shelters, is one of the most significant challenges of controlling and managing cardiovascular disease in natural disasters [12]. Delayed effects on adherence to medication may extend for up to 2 years. Another pertinent case during the Port Macquarie floods was that of a 70-year-old woman who presented with Takotsubo cardiomyopathy triggered by loss of property (Box 1). The first two cases of flood-induced Takotsubo cardiomyopathy were reported in survivors of the 2011 Queensland floods [13]. A cross-sectional survey of Queensland residents during the floods in 2011 quantified the psychological stressors during this period. 3.9% of respondents thought they might be “badly injured or die” and 14.3% felt “terrified, helpless or hopeless” [3]. 7.1% of respondents were “still currently distressed” between 2 and 5 months after the disaster and 8.6% were “worried about how they would manage”. The prevalence of these responses was higher among individuals from remote and regional areas, highlighting the underlying vulnerability of these populations to stress-induced cardiovascular disease.

The ‘Second Wave’—a Delayed Increase in Cardiovascular Disease after Natural Disasters

A recent systematic review which studied the incidence and prevalence of cardiovascular diseases in natural disasters found a delayed increase in the prevalence of acute coronary

Box 1. Pertinent Cardiology Presentations at Port Macquarie Base Hospital during the Floods in 2021.

Case 1: A 62-year-old man with a history of percutaneous coronary intervention to the right coronary artery presented with an inferior ST segment elevation myocardial infarction. He had been evacuated by State Emergency Services 2 weeks prior and had subsequently lost access to his antiplatelet medications. He underwent urgent coronary angiography which revealed stent thrombosis in the right coronary artery.

Case 2: A 70-year-old woman presented with chest pain after loss of her property due to flooding. Her electrocardiogram demonstrated anterior ST-segment elevation. Echocardiography and coronary angiography confirmed Takotsubo cardiomyopathy.

syndromes after floods and hurricanes—a so-called ‘second wave’ [12]. A notable example is Hurricane Katrina, which was associated with a four-fold increase in the incidence of acute coronary syndromes in New Orleans for at least 10 years following the hurricane [14]. This persistent effect was attributed to factors such as post-traumatic stress disorder, which was found to be an independent predictor of cardiovascular events, as well as an increase in traditional cardiovascular risk factors. Second and third waves of cardiovascular disease have also been anticipated in the post-COVID-19 era, due to avoidance behaviour, delayed presentations, suboptimal management of cardiovascular risk factors and the psychosocial impact of the pandemic [15,16]. There is growing concern that a second wave or ‘impending tsunami’ of cardiovascular disease may emerge in the mid-north coast region, which has been impacted by a series of major natural disasters in quick succession, punctuated by the intercurrent stressors of the COVID-19 pandemic.

Recommendations for Future Practice and Research

1. Natural disasters exact complex biological effects, negative psychological behaviours and damage to property and public infrastructure, all of which contribute to significant cardiovascular consequences. Climate change and the prediction of more frequent extreme weather conditions in the future mandates the need for disaster planning, particularly for vulnerable regional and remote populations that are already suffering from existing health disparities.
2. Campaigns to raise awareness of the short- and long-term cardiovascular consequences of extreme weather events, and to facilitate rapid access to essential health care services during these challenging times, may mitigate the

missed presentations and avoidance behaviour that may have accounted for the reduction of STEMI presentations at our institution and thereby prevent a delayed surge in cardiovascular disease.

- As the effects of climate change in Australia continue to rise, there is a need for ongoing research into the impact of climate change on health—and specifically among people in regional and remote populations.

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Conflicts of Interest

There are no conflicts of interest to disclose.

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