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COMMENTARY Open Access

Handling the health impacts of extreme climate events

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Abstract

This commentary provides an overview and summary of some of the health impacts of extreme climate events. It goes on to suggest some measures to increase the preparedness of the health sector to cope with extreme events associated with a changing climate.

Keywords: Climate change, Health impacts, Extreme weather events

Introduction: the climate crisis and human health

The global climate crisis is also a threat to human health [23]. Extreme weather events, defined by the Intergovernmental Panel on Climate Change (IPCC) as.

"a pattern of extreme weather that persists for some time, such as a season" [24] may lead to disruptions to food and water security, worsening air quality, the rise of vector-borne diseases, exacerbations of chronic disease, mental health stressors, and worker injury risks. These are just some of the disruptions adversely affecting human health. The social determinants of health, from wealth to housing, can ameliorate or indeed amplify climate impacts on health, with under-resourced and vulnerable communities disproportionately affected such that health equity connects directly to planetary health.

Accompanying rising global temperatures, weather-related natural disasters include heat waves, severe storms (also snow storms), floods and drought. These are increasing, tripling over the last 50 years and responsible for over 60,000 deaths per annum [41]. There have been many studies focusing on extreme events. Figure 1 shows the number of studies for some types of extremes events, clustered into more severe/likely (red), less severe/likely (yellow), no influence (blue) and inconclusive (grey).

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It should be pointed out that climate change occurs in various places, including regions where local population and services (including emergency services, health services, communication and transport infrastructures and social networks) are not always prepared to handle extreme events and their impacts. Here, the term "preparedness" is defined by the United Nations International Strategy on Disaster Reduction as "the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions" [44].

Heatwaves are associated with an increased rate of mortality (Cheng el al.et al., 2018) due to dehydration, heat exhaustion and heat stroke [38]. A study across 43 countries during 1991–2018 attributes 37% (range 20.5–76.3%) of warm-season heat-related deaths to anthropogenic climate change [39]. Heatwaves can lead to urban heat island in cities, and wildfires—in rural areas—causing death directly, with smoke injurious to health [32]. Figure 2 presents a schematic view of the main impacts of heat waves, whereas Table 1 provides some literature related to the topic, which illustrate the scope of the problem.

Extreme temperatures exacerbate drought, leading to dehydration [37] and disturbances to agricultural practices, with downstream impacts on food security and nutrition [11, 25]. The limited availability of clean

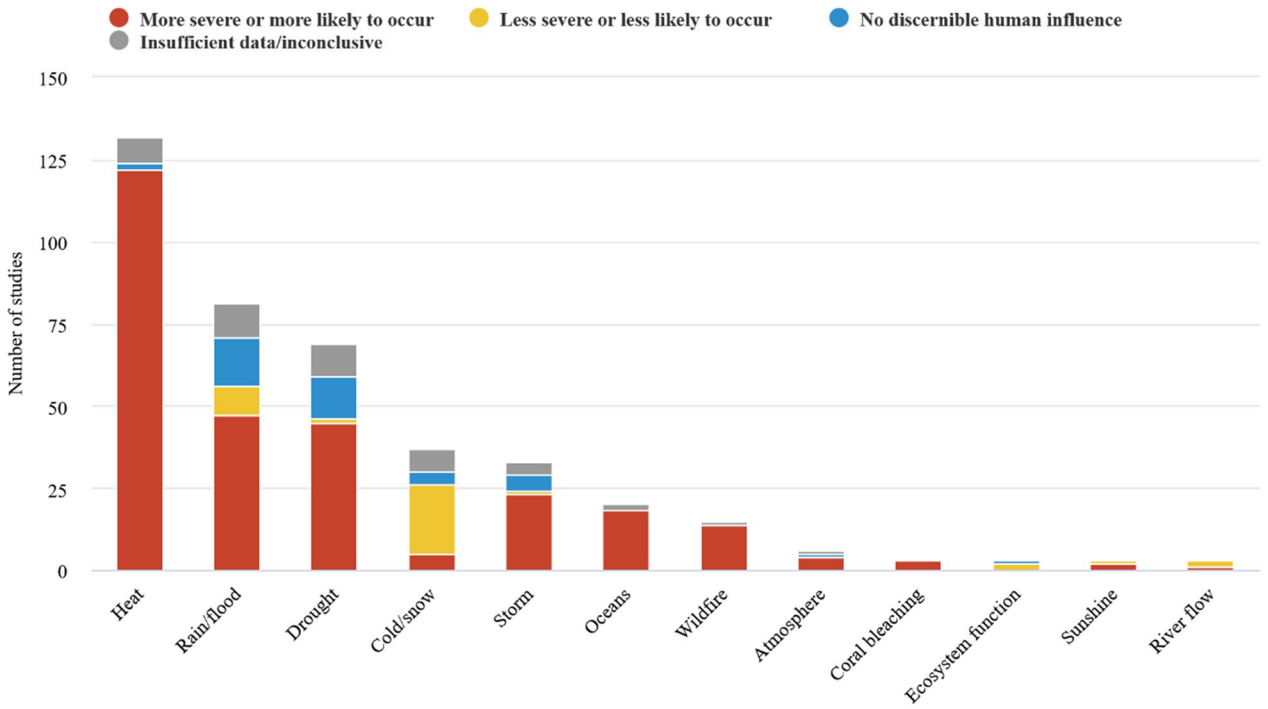

Fig. 1 Number of studies for some types of extremes events (adjusted from Carbon Brief 2021)

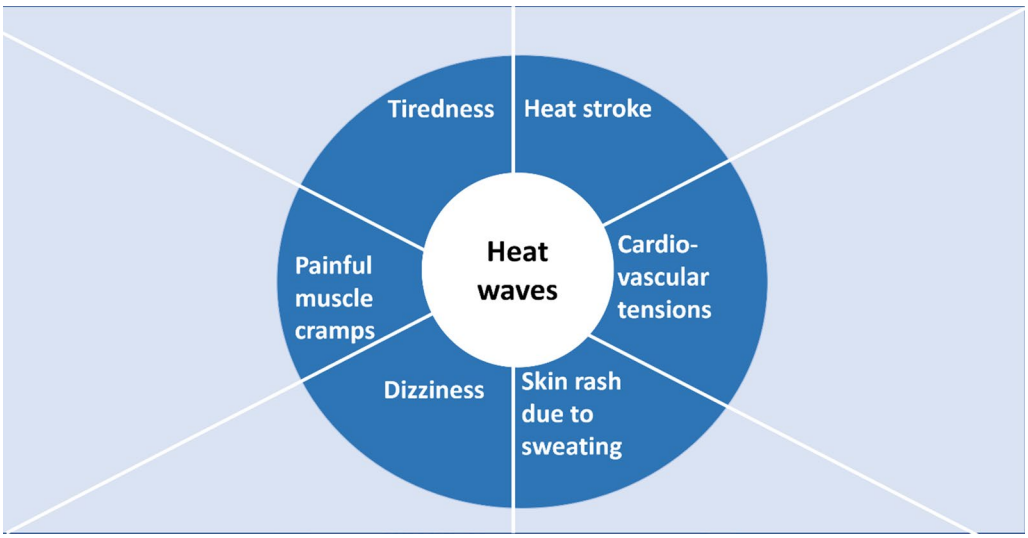

Fig. 2 Some examples of the health impacts of heat waves (the authors)

drinking water contributes to outbreaks of diseases, such as cholera and other diarrheal illnesses [37], as well as conditions related to poor personal hygiene [13]. In some cases, dry conditions can favour mosquito-borne diseases [9].

Heat-related daily mortality is increasing and intensified among other things by the urban heat islands [8, 27]. Disruptions in power supply and transport routes can prevent people accessing health care [10, 43], or heating their homes [2] and may exacerbate respiratory

Table 1 Overview of some of the literature on the health impacts of extreme climate events

Title	Climate change & …	Author(s)
The public health implications of the Paris agreement: a modelling study	Public health policy	Milner et al. [30]
The imperative for climate action to protect health	Public health policy	Haines & Ebi [18]
The 2018 report of the Lancet countdown on health and climate change: shaping the health of nations for centuries to come	Public health policy	Watts et al. [40]
Impacts of extreme weather events and climate change for health and social care systems	Extreme weather and emergency preparedness	Curtis et al. [10]
Climate change, extreme weather events, and human health implications in the Asia Pacific region	Extreme weather and emergency preparedness	Hashim et al. [20]
Projecting heat-related excess mortality under climate change scenarios in China	Heat-related mortality	Yang et al. [45]
Projections of temperature-related cause-specific mortality under climate change scenarios in a coastal city of China	Heat-related mortality	Gu et al. [17]
Projections of temperature-related excess mortality under climate change scenarios	Heat-related mortality	Gasparrini et al. [16]
Effects of air temperature on climate-sensitive mortality and morbidity outcomes among the elderly: a systematic review and meta-analysis of epidemiological evidence	Heat-related mortality	Bunker et al. [6]
Effect of environmental changes on vegetable and legume yields and nutritional quality	Food and nutrition	Scheelbeek et al. [33]
Economic implications of climate change impacts on human health through undernourishment	Food and nutrition	Hasegawa et al. [19]
Analysis and valuation of the health and climate co-benefits of dietary change	Food and nutrition	Springmann [36]
The need for clean air: the way air pollution and climate change affect allergic rhinitis and asthma	Air pollution also by thermic inversion	Eguiluz-Gracia et al. [12]
Climate change health and vulnerability in Canadian Northern Aboriginal communities	Indigenous people	Furgal & Seguin [15]
Vulnerability of indigenous health to climate change: a case study of Uganda's Batwa Pygmies	Indigenous people	Berrang-Ford et al. [3]
Climate change and women's health: impacts and policy directions	Women's health	Sorensen et al. [35]
Global climate change and children's health	Children's health	Ahdoot & Pacheco [1]
Examining relationship between climate change and mental health in the Circumpolar North	Mental health	Willox et al. [42]
Health impacts of climate change and health and social inequalities in the UK	Inequality	Paavola [31]

illness. Cold waves may adversely affect vulnerable people, including women and children and the elderly, the poor and those with pre-existing medical conditions [10]. These groups cannot cope with the health impacts of climate change on their own. Climate change also influences their social networks and communication infrastructures—which are currently the backbones of many social and public services—as well as their living conditions since recovery takes a long time.

Created in 2016, the Global Lancet Countdown (*Lancet* [26] tracks the health implications of the changing climate. Its annual report follows a suite of indicators (43 in 2020) across five domains and informs country-level briefs that aim to direct priorities for public health policy. Table 1 provides an overview, based on examples from the literature on the health impacts of extreme events. It reveals that extreme climate events are not yet fully accommodated within public health policy or health and social care systems. Too often it appears that we are reacting to such events, rather than responding in a more deliberative fashion. Table 1 also serves to highlight the disruption of systems, from emergency medical care through to food and equity. This pervasive impact reflects the interdependencies between climate and health (see Fig. 2), and calls for the inherent interconnections and causality to be reflected in the design of post-modern healthcare. And, it goes further to reveal the challenge of sustaining well-being and human flourishing in the face of an unfettered climate crisis setting up the need for urgent global attention and action.

Climate change also has increased global flooding [14], and has reached new places not affected before, with subsequent immediate, mid-term and long-term effects on health from drowning, injury, and respiratory infections

dependent of the severity of the flood [4, 14]. Landslides can be especially challenging [7].

Mental health issues due to extreme weather events can include anxiety, stress, post-traumatic stress disorder, survivor guilt, mental fatigue and suicidal behaviour, as people grapple with the loss of family, homes and communities due to extreme events such as floods or cyclones (Pillay and van den Bergh 2016, [40]. Changes in food supply and water resources may place additional financial stress on people, exacerbating mental anguish [21]. These elements show the importance of involving local organizations and social networks and the development of a first line of public health services.

Actions needed

Given the far-ranging negative effects of climate change on health, urgent action is needed across many domains. In particular, preventative and adaptive actions that help to reduce the severity of the impacts. However, these may be insufficient given extreme climate events are predicted to become more frequent and expected to appear in new places, with consequent far-reaching economic effects [34]. Such actions should be based on various measures: first, observing how climate change expresses itself in new places, secondly, better preparedness of the local emergency services, in order to react in real time to reduce health and mental health impacts. These first line public health services should be integrated with the involvement of the local collectives and social networks. In addition, other actions are needed such as systematic data management and integrated surveillance, transdisciplinary and interdisciplinary studies, international cooperation, ensuring water and food security, increased funding for climate and health research, practice, modelling and prediction (e.g. [22, 28]. Another area is the education of medical and healthcare staff. In this context, it is critically important to include the theme 'climate and health' as part of the core professional curriculum and practice in training physicians, nurses and allied health professions and senior health executives since extreme weather events not only have an impact on healthcare, but also on the operations of health services [29].

The interconnections among climate change, health and equity demand research-led solutions for the present and future generations, with ecosystem restoration a necessary public health intervention [5]. Climate change mitigation, at the level of the individual, community and local/national governments must be actioned. Strengthening public awareness about the recommended behaviours during extreme events is important and can be achieved by involving the media and healthcare workers. In addition, traditional and indigenous knowledge should be integrated into modern medical technology to help reduce health impacts from heatwaves and other climate events. Business and health insurers should prioritize risk management of climate-related health as well as 'greening' their own operations.

With global temperatures already 1 °C higher than the pre-industrial times, and projections that CO_2 emissions will continue to climb through 2040, climate and health is a new frontier for science—one we must tackle now to avoid further catastrophic consequences of extreme events associated with climate change on human mortality and morbidity.

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