



Extreme events as sources of health vulnerability: Drought as an example



Kristie L. Ebi^{a,*}, Kathryn Bowen^{b,c,2}

^a University of Washington, Seattle, WA, USA

^b Australian National University, Canberra, ACT, Australia

^c Melbourne Sustainable Society Institute, University of Melbourne, Melbourne, VIC, Australia

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ABSTRACT

The health risks of climate change arise from the interactions of the hazards associated with a changing climate (e.g. increases in the frequency and intensity of extreme weather and climate events, such as drought), the communities exposed to those hazards, the susceptibility of communities to adverse health impacts when exposed, and the capacity to prepare for and cope with the hazard. However, there is a very limited understanding of how extreme weather and climate events could themselves be sources of vulnerability. Drought is used as an example of an extreme event that can simultaneously be a current hazard and can directly and indirectly influence future vulnerability. A better understanding of droughts and other extreme events as sources of vulnerability is needed, including (i) the patterns of risks and how these could change over time, (ii) the reasons for any changes, (iii) how these risks could affect human health and well-being, and (iv) the longer-term consequences of extreme events for vulnerability. This knowledge will become increasingly important for managing risks to health as the frequency and intensity of extreme weather and climate events increase with climate change.

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1. Introduction

In vulnerable regions, extreme weather and climate events³ can lead to disasters with significant impacts on human and natural systems. Historically, extreme events were generally rare in any one location, with time between events when human and natural systems could recover from the impacts experienced. However, as climate change increases the frequency, intensity, and duration of some extreme weather and climate events (IPCC, 2012; IPCC, 2013), the time between extreme events will shorten across this century. Further, the type and pattern of extreme events may shift, with alternating floods and droughts in many locations, leading to communities and nations requiring more integrated preparedness

to extreme events. As extreme events become more common and more intense, these events themselves will be one factor determining vulnerability to subsequent events. Given the importance of these extreme events, it is surprising that there has been limited attention to this issue in the scientific literature.

The paper first reviews a framework for evaluating the risks of extreme weather and climate events; review trends in these events; and then focuses on drought as an example of an extreme event that could affect the vulnerability of individuals, communities, and health systems to future events.

2. Framework of the risks of extreme weather and climate events

The magnitude and pattern of impacts from extreme weather and climate events are due to the characteristics of the extreme event, the extent of exposure of human and natural systems to the event, the susceptibility of those systems to harm, and their ability to cope with and recover from the event (IPCC, 2012; NRC, 2013). An extreme event can alter vulnerability to future events by changing the extent of exposure (e.g. reducing the presence or effectiveness of coastal barriers), the susceptibility of exposed human and natural systems (e.g. making individuals and communities more or less susceptible by affecting access to and/or

* Corresponding author.

E-mail addresses: krisebi@uw.edu (K.L. Ebi), kathryn.bowen@anu.edu.au (K. Bowen).

¹ Center for Health and the Global Environment, School of Public Health, 4225 Roosevelt Way NE #100, Seattle, WA 98105, USA.

² National Centre for Epidemiology and Population Health, College of Medicine, Biology and Environment, Australian National University, Canberra, ACT 0200, Australia.

³ The definition of extreme weather and climate events used is the one used in IPCC 2012: The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.

effective functioning of healthcare facilities or the proportion of the population vulnerable to an event), or the ability of organizations and institutions to effectively and efficiently prepare for and manage events. Understanding the magnitude and pattern of impacts and of the factors increasing (or decreasing) susceptibility and coping abilities is vital to modifying current policies and to implementing new policies and programs to increase resilience to extreme events.

There is abundant literature on factors that increase vulnerability to extreme weather and climate events (e.g. IPCC, 2012), with less emphasis on how extreme events themselves alter the sensitivity and coping capacity of human systems to future events. The wide range of factors that describe vulnerability can be divided into environmental, social, and economic dimensions (Cardona et al. 2012). Environmental dimensions include physical variables (e.g. location-specific context for human-environment interactions); geography, location, and place; and settlement patterns and development trajectories. Social dimensions include demographic variables (education, human health and well-being); cultural variables; and institutions and governance. Crosscutting factors include relevant and accessible science and technology. In the health sector, important factors include the health of the population and the status of health systems (e.g. ability of healthcare facilities, laboratories, and other parts of the health system to manage an extreme event)

From the perspective of the health sector, vulnerability is viewed as the summation of all risk and protective factors that determine whether an individual or subpopulation experiences adverse health outcomes from exposure, in this case, to an extreme event (Balbus and Malina 2009). Sensitivity to an event is viewed as an individual or subpopulation's increased responsiveness, often for biological reasons such as the presence of a chronic disease. There is a rich literature describing particular factors that increase human health vulnerability to particular extreme events. The poor, pregnant women, children, individuals with chronic medical conditions, and individuals with mobility and/or cognitive constraints are at increased risk of adverse health outcomes during an extreme event (Balbus and Malina 2009). In addition, the social determinants of health influence vulnerability. These include access to health care services, access to and quality of education, availability of resources, transport options, social capacity, and social norms and culture.

Fig. 1 shows the framework used to explore the key drivers of vulnerability in the health sector to extreme weather and climate events. Impacts can be categorized into those that affect environmental services, social and economic factors, or health status and health systems. Impacts on environmental services that could

affect future vulnerability to extreme events include availability of safe water (including quality and quantity), food security, and consequences of extreme events that affect ecosystem services such as wildfires, coastal erosion, and saltwater intrusion into freshwater sources. Impacts on community services, livelihoods, and social capital include economic resources, infrastructure, access to services, and social capital. Impacts on health status and health systems include stress, mental illness as a consequence of the event or recovery, worsening chronic diseases, and undernutrition.

2.1. Trends in extreme weather and climate events

The IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX; IPCC, 2012) and the IPCC Working Group II contribution to the 5th Assessment Report (IPCC, 2013) assessed to what extent current and projected climate change is affecting or could affect the magnitude and pattern of extreme weather and climate events. Overall, Seneviratne et al. (2012) concluded that *a changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of weather and climate extremes, and can result in unprecedented extremes*. Conclusions include that there is *medium confidence that since the 1950s, some world regions experienced a trend to more intense and longer droughts, particularly in southern Europe and West Africa. Droughts became less frequent, less intense, or shorter in central North America and northwestern Australia*. For precipitation and flooding, Seneviratne et al. (2012) concluded it is *likely that the number of heavy precipitation events increased significantly in more regions than there were decreases, with strong regional and sub-regional variations. There is limited to medium evidence to assess whether there have been climate-driven changes in the magnitude and frequency of floods*

Projections for how climate change could affect the magnitude and pattern of future extreme events varies by event, with confidence in projections driven by robustness in understanding the drivers and processes leading to particular events and the underlying evidence base. Natural climate variability is one of the key sources of uncertainty in projections over coming decades because the extent of climate change over this period is expected to be small compared with natural variability (Seneviratne et al. 2012). For some extremes, such as precipitation-related extremes, uncertainties in climate models are key. For other extremes, such as temperature extremes, future greenhouse gas emissions and the sensitivity of the climate system to those emissions are key drivers of uncertainty. Given the complex nature of the climate system, the authors concluded that low probability, high impact changes

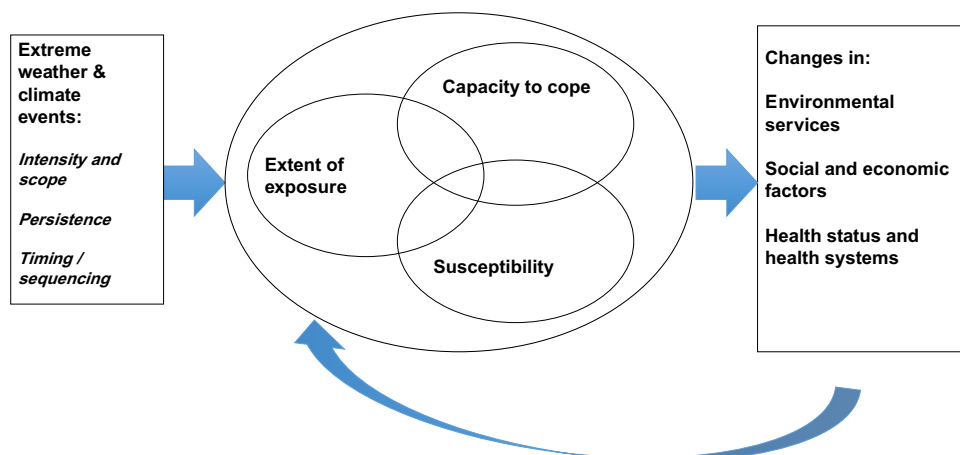


Fig. 1. Key drivers of health vulnerability to extreme weather and climate events.

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