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Health impacts of climate extremes

Climatic factors are an important determinant of various vector-borne diseases, many enteric illnesses and certain water-related diseases. Relationships between year-to-year variations in climate and infectious diseases are most evident where climate variations are marked, and in vulnerable populations. The El Niño phenomenon provides an analogue for understanding the future impacts of global climate change on infectious diseases.

Extreme climate events are expected to become more frequent with climate change. These disruptive events have their greatest impact in poor countries. The two categories of climatic extremes are:

- Simple extremes of climatic statistical ranges, such as very low or very high temperatures
- Complex events: droughts, floods, or hurricanes

The Pacific-based El Niño-Southern Oscillation (ENSO), an approximately semi-decadal cycle, influences much of the world's regional weather patterns. Climate change is likely to increase the frequency and/or amplitude of El Niño.[1] It illustrates well how climatic extremes can affect human health.

Climate, weather, El Niño and infectious diseases

Both temperature and surface water have important influences on the insect vectors of vector-borne infectious disease. Of particular importance are vector mosquito species, which spread malaria and viral diseases such as dengue and yellow fever. Mosquitoes need access to stagnant water in order to breed, and the adults need humid conditions for viability. Warmer temperatures enhance vector breeding and reduce the pathogen's maturation period within the vector organism. However, very hot and dry conditions can reduce mosquito survival.

Malaria, today, is mostly confined to tropical and subtropical regions. The disease's sensitivity to climate is illustrated by desert and highland fringe areas where higher temperatures and/or rainfall associated with El Niño may increase transmission of malaria[2]. In areas of unstable malaria in developing countries, populations lack protective immunity and are prone to epidemics when weather conditions facilitate transmission.

Dengue is the most important arboviral disease of humans, occurring in tropical and subtropical regions, particularly in urban settings. ENSO affects dengue occurrence by causing changes in household water storage practices and in surface water pooling. Between 1970 and 1995, the annual number of dengue epidemics in the South Pacific was positively correlated with La Niña conditions (i.e., warmer and wetter).[3]

Rodents, which proliferate in temperate regions following mild wet winters, act as reservoirs for various diseases. Certain rodent-borne diseases are associated with flooding, including leptospirosis, tularaemia and viral haemorrhagic diseases. Other diseases associated with rodents and ticks, and which show associations with climatic variability, include Lyme disease, tick borne encephalitis, and hantavirus pulmonary syndrome.

Many diarrhoeal diseases vary seasonally, suggesting sensitivity to climate. In the tropics diarrhoeal diseases typically peak during the rainy season. Both floods and droughts increase the risk of diarrhoeal diseases. Major causes of diarrhoea linked to heavy rainfall and contaminated water supplies are: cholera, cryptosporidium, E.coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A.

Temperature extremes: heatwaves and cold spells

Extremes of temperature can kill. In many temperate countries, death rates during the winter season are 10-25% higher than those in the summer. In July 1995, a heatwave in Chicago, US, caused 514 heat-related deaths (12 per 100,000 population) and 3300 excess emergency admissions.

Most of the excess deaths during times of thermal extreme are in persons with preexisting disease, especially cardiovascular and respiratory disease. The very old, the very young and the frail are most susceptible. In terms of the amount of life lost, the mortality impact of an acute event such as a heatwave is uncertain because an unknown proportion of deaths are in susceptible persons who would have died in the very near future.

Global climate change will be accompanied by an increased frequency and intensity of heatwaves, as well as warmer summers and milder winters. Predictive modelling studies, using climate scenarios, have estimated future temperature-related mortality. For example, the annual excess summer-time mortality attributable to climate change, by 2050, is estimated to increase several-fold, to between 500-1000 for New York and 100-250 for Detroit, assuming population acclimatisation (physiological, infrastructural and behavioural)[4] Without acclimatisation the impacts would be higher.

The extent of winter-associated mortality directly attributable to stressful weather is less easy to determine. In temperate countries undergoing climate change, a reduction in winter deaths may outnumber the increase in summer deaths. Without better data, the net impact on annual mortality is difficult to estimate. Further, it will vary between populations.

Natural disasters

The effects of weather disasters (droughts, floods, storms and bush-fires) on health are difficult to quantify, because secondary and delayed consequences are poorly reported. El Niño events influence the annual toll of persons affected by natural disasters.[5] Globally, disasters triggered by droughts occur especially during the year after the onset of El Niño.

Globally, natural disaster impacts have been increasing. An analysis by the reinsurance company Munich Re found a tripling in the number of natural catastrophes in the last ten years, compared to the 1960s. This reflects global trends in population vulnerability more than an increased frequency of extreme climatic events. Developing countries are poorly equipped to deal with weather extremes, even as the population concentration increases in high-risk areas like coastal zones and cities. Hence, the number of people killed, injured or made homeless by natural disasters has been increasing rapidly.

Table 5.1. shows the numbers of events, deaths and people affected by extreme climatic and weather events in the past two decades, by geographic region.

Conclusion

The increasing trend in natural disasters is partly due to better reporting, partly due to increasing population vulnerability, and may include a contribution from ongoing global climate change. Especially in poor countries, the impacts of major vector-borne diseases and disasters can limit or even reverse improvements in social development. Even under favourable conditions recovery from major disasters can take decades.

Short-range climatic forecasts may help reduce health impacts. But early warning systems must also incorporate monitoring and surveillance, linked to adequate response capacities. Focusing attention on current extreme events may also help countries to develop better means of dealing with the longer-term impacts of global climate change, although this capacity may itself decline because of cumulative climate change. For example, increased food imports might prevent hunger and disease during occasional drought, but poor, food-insecure, countries may be unable to afford such measures indefinitely in response to gradual year-by-year drying.

Table 5.1. Numbers of extreme climatic/weather events, people killed and affected, by region of the world, in the 1980s and 1990s

	1980s			1990s		
	Events	Killed (thousands)	Affected (millions)	Events	Killed (thousands)	Affected (millions)
Africa	243	417	137.8	247	10	104.3
Eastern Europe	66	2	0.1	150	5	12.4
Eastern Mediterranean	94	162	17.8	139	14	36.1
Latin America and Caribbean	265	12	54.1	298	59	30.7
South East Asia	242	54	850.5	286	458	427.4
Western Pacific	375	36	273.1	381	48	1,199.8
Developed	563	10	2.8	577	6	40.8
Total	1,848	692	1,336	2,078	601	1,851