

CLIMATE CHANGE AND POPULATION HEALTH

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It is generally accepted that climate change will have important consequences for the health and wellbeing of our world's population. In 2017 the World Bank stated that climate change was a risk multiplier, which threatened to unravel decades of development gains throughout the world. From heat waves to food insecurity resulting from droughts, from a possible resurgence of vector-borne infections, the range of potential health issues sensitive to climate change is enormous.

The links between human health and climate are not new. Human health has always been influenced by climate and weather. Hippocrates in the 5th century BC remarked on the fact that the distribution of many diseases were closely linked to changes in temperature or season. Some years later Aristotle wrote a major study of the links between weather and human health, which remained a standard text for centuries. Today, "feeling under the weather" has become an accepted and common expression hinting at the close relationship that exists between weather patterns and our health and wellbeing. There is little doubt that many fundamental body processes seem to be linked to changes in the weather, for example during the passage of a cold front when air pressure and temperatures fall. Just before a cold front, blood-clotting time changes markedly joint mobility decreases and our blood pressure rises. As temperatures fall, our blood vessels dilate and nerve endings cease to conduct sensations. As a cold front passes, blood volume decreases (the converse is true during heat stress) and after a steep barometric fall, white blood cells increase. It is also true that some weather patterns are closely linked to asthma attacks, arthritis, stroke and heart attacks.

Climate Change

Climate change is not new. It has been a feature of our planet's history and there are examples of cooling followed by warming temperatures. Prior to the Industrial Revolution all this was triggered by the earth's natural system. Today, we are in another phase of global warming, this time triggered by human behaviour through the release of greenhouse gases such as carbon dioxide into the atmosphere, mainly from fossil fuel combustion and the burning of forestland. Over the last 150 years or so, global concentrations of carbon dioxide, methane and nitrous oxide have all increased substantially. These emitted gases have a long lifespan and cause major

global warming. The Intergovernmental Panel on Climate Change (IPCC) noted in 2013 that the previous three decades had been warmer at the earth's surface than in any preceding decade since 1850 (5th IPCC Assessment Report, 2013). But the fact remains that predicting what might happen in the future is difficult because of the dynamics of our biophysical environment and the vagaries of human behaviour.

How will climate change impact upon our health?

The effects of climate change on our health will be both direct and indirect. Direct effects will include heat stress due to warming temperatures as well as the impact of extreme weather events. Indirect effects will involve the impact that climate and weather patterns may have on the lifecycle and distribution of disease vectors such as mosquitoes, fleas and ticks as well as aeroallergens such as fungal spores, pollens and dust mites.

There is evidence that climate change will impact on our health and wellbeing in the following ways.

1. Climate change will increase the likelihood of extreme climate events, particularly high temperatures, heat waves, droughts, hurricanes and floods with considerable implications for our health especially for older people and those dependent upon a daily routine of medication.
2. Climate change may influence the life cycle and geographical distribution of a number of vector-borne diseases.
3. Climate change will increase the production and geographic distribution of aero-allergens such as pollens with considerable implications for people suffering from respiratory diseases such as asthma.
4. Climate change will also impact upon food security around the world.
5. Climate change will play an important role in helping determine human migration and displacement.

1. Extreme Weather Events

The relationship between climate change and human health is perhaps best seen with reference to temperature extremes. In Australia, mortality is higher during the winter months and hot summers, and low during mild winters and cool summers. Global warming will have mixed outcomes with fewer deaths from exposure to cold temperatures but more deaths due to high temperatures. These outcomes will vary across the world. Urban populations will be particularly at risk due to what is called the urban heat island effect. As well as frequent and intense heatwaves, climate change will also produce other extreme weather events such as hurricanes, cyclones, floods, droughts; these are likely to result in deaths and illnesses related to human exposure as well as food shortages and population displacement. Such events can also produce acute gastro-intestinal illness caused by water pollution and acute respiratory infections. Over the last three years two of the world's major cities, Sao Paulo and Cape Town have suffered severe droughts where water availability and management has become critical with daily restrictions.

2. Climate Change and Vector-Borne Diseases

Increasing temperatures and changing rainfall patterns may also have important effects on the lifecycle and geographic distribution of vector-borne diseases such as Dengue, Malaria, Ross River Virus, Yellow Fever and Encephalitis. Vector-borne diseases are those transmitted by vectors such as mosquitos, fleas and ticks. These vectors carry infective pathogens such as viruses and bacteria. Australia is no stranger to such diseases with Dengue, Ross River Virus and Barmah Forest Virus accounting for an important number of illnesses every year.

Number of Cases Vector-Borne Disease in Australia 2016 and 2017		
	2016	2017
Dengue	2237	1071
Ross River Virus	3735	6915
Barmah Forest Virus	329	448
Chikungunya Virus	114	98

Table 1. Source: Australian Government Department of Health.

As Table 1 shows, there is a long history of major Dengue epidemics in Queensland but which on occasions extends into New South Wales. The 1925-26 epidemic was by far the greatest mosquito-borne epidemic in Australian history resulting in more than 550,000 cases (Table 2).

Major Dengue outbreaks in Australia		
Year	Number of Cases	Location
1897-98	40,000	Qld/ Nth NSW
1904-05	20,000	Qld/Nth NSW
1909-10	10,000	NW Australia
1925-26	560,000	Qld/NSW
1941-43	40,000	Nth Territory/ Qld
1953-55	20,000	Nth Qld
1992-93	25,000	Nth Qld

Table 2. Source: Author.

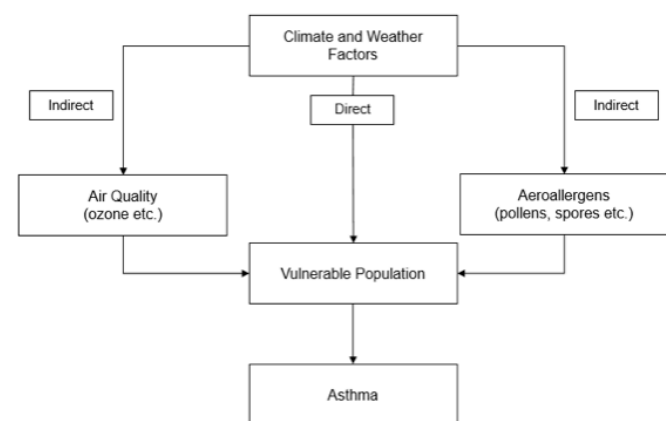
The geographical distribution, seasonality and prevalence of vector-borne diseases are influenced by climate factors such as high and low temperatures extremes, rainfall and humidity. It is argued that climate change will increase the risk of vector-borne diseases like Dengue by allowing mosquitoes to breed more prolifically and colonise new parts of Australia. Predicting the effects of climate change is, however, not simple as vector-borne diseases are permanently maintained in nature in a complex relationship with zoonotic or animal hosts as well as influenced by human activity and behaviour.

3. Air Quality and Climate Change

Changes in climate affect air quality in a number of important ways. Firstly, climate change has modified weather patterns influencing the level and distribution of outdoor air pollutants. Secondly, increasing levels of carbon dioxide can also promote the growth of plants that release airborne allergens which can affect indoor and outdoor air quality.

Chronic respiratory diseases such as asthma, emphysema and chronic bronchitis remain important health issues throughout the world, including Australia. The prevalence of such diseases are closely linked to the biophysical environment, particularly climate and weather patterns as well as to human behaviour. Asthma in particular is among the most sensitive of human diseases to weather and climate although the relationship is far from simple and in many ways still poorly understood. Climate would seem to affect the human respiratory tract in a variety of ways including the effect of cold and dry air on human airways. There are a broad series of seasonal effects that can influence our physiological and biochemical processes. Temperature and humidity can influence our airways: rapid falls in temperature, low temperatures and cyclonic and frontal activity can directly affect respiratory sensitivity and stimulate airways. People suffering from asthma seem to be highly sensitive to such changes in temperature and humidity. A sudden

fall in temperature or the passage of a cold front can directly bring about attacks of asthma. It is possible that people with asthma differ physiologically and in their biochemistry from non-asthmatics. Asthma attacks can also be introduced by winds and the movement of air which affect the composition of our atmosphere and the production and diffusion of some air pollutants such as ozone as well as a number of aeroallergens such as mould and fungal spores, pollens and dust mites (Figure 1). Currently around 2.5 million Australians suffer from asthma and in 2016 the disease killed 455 people, the majority aged over 75 years.



Source: After Beggs and Curson, 1997

Figure 1. Direct and Indirect Links between Climate and Asthma.
Source: After Beggs and Curson, 1997.

4. Climate Change and Food Security

Extreme weather events such as cyclones, hurricanes, floods and droughts are likely to become more frequent and another factor influencing the global burden of hunger in addition to poverty, poor governance and conflict. Strategies to increase food production are themselves an influence on climate change. In agriculture, the production of greenhouse gases originating from fertilisers, fuel use and the digestion and excretion habits of farmed animals, will greatly contribute to climate change. Deforestation and land clearing will also contribute. All this will have considerable implications for food security particularly in the poorer parts of the world. During extreme weather events, the failure of local water infrastructure, and its capacity to cope, causes sewer overflows, backups and/or localised flooding; this results in water contamination from human and animal waste as well as from agricultural activities including the use of fertilisers. A number of waterborne diseases may result from such circumstances.

5. Climate Change and Human Displacement and Migration

Although political, social and economic factors are the chief drivers of population displacement and migration,

climate change is already having a detectable effect. Natural disasters continue to be an important instigator of human movement. As climate change increases the frequency of natural disasters, such as hurricanes, cyclones, floods and droughts, the outcome can impact upon people and force many to move or flee as they struggle to adapt to environmental change. Sea and river level rise can also produce a major hazard affecting agriculture and coastal populations threatening to render people homeless.

Climate Change and Human Vulnerability

While there is little doubt that our health and wellbeing will be influenced by climate change the real impact will depend upon the social, economic and geographic situation of the affected population. Human vulnerability to climate and weather is often heightened by poverty, marginality, human neglect, home and job location, oversight and mismanagement (Figure 2).

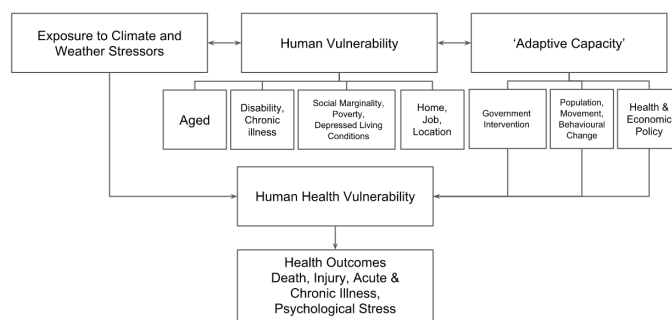


Figure 2. Climate Change and Human Vulnerability

Prolonged exposure to heat waves and high temperatures which can cause a wave of illness and premature death, particularly among the elderly is a case in point. Like excessively cold temperatures, susceptibility to high temperatures and heat waves conditions are closely related to human vulnerability, particularly to such things as old age, disability, social marginality and depressed living conditions. The severe heat wave which affected Western Europe in 2003 is a good example; more than 70,000 people died as a result in France, Spain and Italy. Most of those who died were elderly, either living alone and/or living in poorly funded, overcrowded and under-staffed rest homes. Australia's current health and demographic situation will make a large proportion of people increasingly vulnerable to any change in the physical environment. Australia's population is rapidly ageing. Today approximately 3.7 million Australians are aged over 65, 15% of the total population, and it is projected that by 2046 there will be more than seven million Australians or 22% of the population aged over 65 years. The fastest growing sector of the population over the next 25 years will be the old old. Today, 1.7 million Australians are aged over

75; within 25 years this number will increase to more than three million. Levels of chronic illness and disability are currently high in Australia particularly among the elderly and are likely to substantially increase over the next few decades; 87 percent of all Australians aged over 65 suffer from some form of chronic condition the majority from asthma, arthritis, hypertension, diabetes and circulatory disease, while more than four million or one in five Australians suffer from some form of disability. It is a sobering thought that Australia's current and future demographic situation will make a large proportion of the population more vulnerable to the impacts of climate change.

Conclusion

Climate change has the potential to affect many aspects of our health and wellbeing in many ways that are not direct but complex and synergistic. The ultimate outcome will depend upon a variety of factors including the rate of environmental change and the increasing vulnerability of sectors of the population. There is strong evidence of our increasing vulnerability to climate change. This is closely linked to a variety of social, economic and demographic factors the most important of which is age, living longer and putting up with disability, chronic illness and social marginality. Other trends will also contribute to our vulnerability to climate change. In particular the resurgence of infectious disease, the importance of vector-borne infections and increasing environmental degradation will all play a part.

Student Activities:

1. Explain the meaning of the term 'risk multiplier'; support your answer with examples from the article.
2. Read the following webpage http://ar5-syr.ipcc.ch/topic_futurechanges.php
 - a) Outline the current projections of how climate might change in the future.
 - b) Suggest reasons why there is uncertainty regarding the changes that might occur to the climate.
3. Using the information in the article, outline the impact of the passage of a cold front on human health.
4.
 - a) Using the following website and other research, investigate the impacts of heat stress on human health. <http://www.australasianscience.com.au/article/issue-december-2010/heat-stress-warming-world.html>
 - b) Suggest adaptation strategies that individuals or societies could apply to address the impact of heat stress on human health.
 - c) Choose ONE adaptation strategy to evaluate. You should consider social, economic and environmental factors in your analysis.
5. Draw a concept map to show the direct and indirect effects of climate change on human health that are outlined in this article.
6. Explain the link between climate change and human displacement and migration.
7. The impact of climate change on human health and wellbeing is closely linked to a variety of social, economic and demographic factors. Using your own knowledge and information from the article:
 - a) Create a table of these factors.
 - b) Choose one factor and outline how it influences vulnerability to climate change.
8. Investigate the predicted impact that climate change will have on the region of Australia where you live.

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