

Climate change impacts on health in South Africa

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South Africa is vulnerable to the impacts of climate change given the projected increases in ambient temperature, and the changes in rainfall patterns and intensity. Scientific models and projections indicate that southern Africa will be particularly affected by climate change. Local temperatures are expected to increase, on average, by a rate that is double the projected average for the globe [1,2]. Widespread poverty and inequality that are amongst the worst in the world also contribute to South Africa being considered vulnerable to climate change [3]. Climate change heightens the pre-existing vulnerabilities of women, rural subsistence farmers and those living in informal settlements, among others.

Heat-health impacts

A time-series analysis was undertaken using daily temperature data and a national dataset of 8.8 million deaths between 1997 and 2013. A total of 3.4 % of deaths in South Africa were attributable to non-optimum temperatures during the 15-year period. Results showed relative risks for all-age, all-cause mortality on very cold and hot days (1st and 99th percentile of temperature distribution) were 1.14 (1.10-1.17) and 1.06 (1.03, 1.09) respectively, when compared to the minimum mortality temperature and showing a greater impact on mortality from cold relative to hot temperatures [4]. Strongest associations were in children aged under-5 years, in the elderly (>64 years), and for cardiorespiratory effects. Heat effects tended to occur immediately after exposure but diminished quickly, while cold effects were delayed but persistent. Another study pooling data from Cape Town, Durban and Johannesburg, calculated that for every 1 °C rise, overall **mortality** escalates by 1% and by 2% in those aged above 65 years [5].

There is anecdotal evidence of the impact of heatwaves on health in South Africa. Over a period of a few days in 2016 a heatwave with temperatures over 40 °C broke local temperature records and caused the deaths of at least 11 people in South Africa's North-West province, with the elderly being particularly vulnerable [6]. Indoor thermal conditions are an important determinant of **cardiovascular and respiratory** health problems [7]. Mean indoor dwelling temperatures were often higher than outdoor temperatures and frequently exceed international and national recommendations (21°C and 24 °C, respectively) for optimal thermal comfort [7,8]. Mean indoor summer temperatures also often exceed 27 °C; the minimum temperature above which optimal body functioning is detrimentally affected.

In schools in the City of Johannesburg, indoor classroom temperatures varied between -21 °C at night to 34 °C midday during late summer months [9]. Temperature inside a shipping container classroom exceeded 40 °C. Children working in classrooms with temperatures ≥ 32 °C reportedly felt **tired** and had **difficulty breathing**. Similarly, among environmentally-exposed road construction workers in Upington, Northern Cape, where temperatures regularly exceed 40°C, they reported a wide range of ill health effects that they perceived to be associated with heat-related effects including **sleeplessness, irritability and exhaustion** that prohibited productivity and output during hot weather [10].

Infectious diseases

Climate change has potential to change the distribution of infectious diseases. In a research collaboration between Japan and South Africa named the infectious Disease Early Warning System (iDEWS) a sophisticated infectious disease climate-based outbreak prediction model, incorporating environmental and climate parameters, was made to predict likelihood of outbreaks of **malaria** and **diarrheal diseases** with a lead time of around six months [11]. Such warnings of a high likelihood of a disease outbreak may be used by local health departments to conduct public awareness campaigns around the early signs and symptoms of diseases in high risk areas, ensure that enough staff are on duty and that there are adequate stocks of key medications.

Extreme weather events and other impacts

Extreme weather events are the most publicly noticeable impacts, especially recent droughts in the Western Cape [12,13]. Droughts and high precipitation worsen **water quality**, and hamper hand washing and other hygiene practices [14,15].

The mental health impacts of extreme weather events may compound the multiple health and social stressors that already beset South Africans. The country has amongst the highest levels of **mental illness** worldwide, much of which is linked to high levels of gender-based and other forms of violence, crime, poverty, inequality, HIV and political turmoil [16].

Climate change is also linked in several ways with outbreaks of **water- and food-borne diseases** in South Africa. A study in children under-five in Cape Town noted that a 5 °C rise in minimum weekly temperatures increased cases of diarrhoea by 40% one week after [17]. An increase in sea-surface temperature was linked to a cholera outbreak in 2000–2001 in KwaZulu-Natal [18]. Lastly, listeria monocytogenes, recently responsible for a major epidemic across South Africa, could be climate-sensitive too [19]. As the evidence suggest, climate change is and will have widespread, differing impacts on human health and ecosystems that support livelihoods, health and well-being in South Africa.

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