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Perspective

Health effects of climate change in Africa: A call for an improved implementation of prevention measures

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ABSTRACT

The world's climate, particularly in Africa, has changed substantially during the past few decades, contributed by several human activities. Africa is one of the continents that is most vulnerable to climate change globally. Since the beginning of 2022, extreme weather events in Africa have affected about 19 million people and killed at least 4,000 individuals. Cyclones, floods, heatwaves, wildfires, droughts, and famine were among the severe weather occurrences. Natural disasters and extreme weather events brought on by climate change may compromise access to clean water, sanitation systems, and healthcare facilities, making people more vulnerable to a number of illnesses. Floods and drought can lead to both communicable and non-communicable diseases. The African population is more likely to experience more mental health disorders than before because of natural disasters, which result in the loss of property and sometimes loss of lives more frequently. We, therefore, call for an improved implementation of strategies to prevent the health effects of climate change so that the health of the people in Africa can be maintained.

1. Introduction

Climate change is perceived to be one of the greatest global health challenges of the 21st century. According to the International Panel on Climate Change (IPCC), the world's climate has been undergoing substantial changes over the past few decades, including in Africa. In 2017, human-caused global warming surpassed pre-industrial levels by roughly 1 °C. Because of these temperature changes, rainfall patterns have also changed [1]. Several human activities contribute to climate change. Fossil fuel combustion releases carbon dioxide, which depletes the ozone layer and causes global warming. Carbon dioxide levels in the atmosphere are also increased by bush burning and industrial plant smoke. With fewer trees absorbing carbon dioxide during photosynthesis, deforestation increases the amount of carbon dioxide in the atmosphere [2]. Chlorofluorocarbons, which are frequently released by air conditioners and refrigerators, also destroy the ozone layer, which shields the earth by blocking a large portion of the sun's ultraviolet rays. More ultraviolet rays enter the atmosphere as the ozone layer is depleted, raising the earth's surface temperature [3]. Climate change is also exacerbated by methane gas from waste, chemical reactions, nuclear fusion, and fission, as well as quarrying and mining [2]. Greenhouse gases contribute to global warming by forming a gas layer in the upper atmosphere, which reflects solar radiation to the earth's surface, thereby increasing the temperature on the earth's surface [4]. Climate change contributes to extreme weather events through its effect on global temperatures and precipitation patterns (Table 1). Climate change alters atmospheric circulation, making wet places wetter while dry places drier. Droughts and heat waves may become more common, severe, and prolonged as a result of extreme heat [5].

Despite being the most common source of income in Africa, agriculture also contributes to climate change. Greenhouse gases are released into the atmosphere as a result of clearing forests for agriculture, burning crop residues, immersing rice in water, keeping vast herds of cattle and other mammals, and applying fertilizers containing nitrogen. In 2016, land use change and forestry activities contributed 36% of Africa's greenhouse gas emissions, followed by the energy sector (35%), agriculture (21%), industrial activities (4%), and waste (4%) [6].

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Africa is one of the continents that is most vulnerable to climate change globally. Drought has affected Africa more than any other continent. Between 2000 and 2019, Africa had 134 droughts, 70 of which were in East Africa alone [7]. Although Asia experienced the highest number of extreme weather events between 2000 and 2019, of the top ten countries affected by extreme weather events by total affected/100,000 people, six were in Africa. The six countries were Somalia, Zimbabwe, Lesotho, Eswatini, Niger, and Mauritania [7]. Since the beginning of 2022, extreme weather events in Africa have affected about 19 million people and killed at least 4,000 individuals [8]. Cyclones, floods, heatwaves, wildfires, droughts, and famine were among the severe weather occurrences. Famine and drought have affected eight million people in Ethiopia and killed 2,500 people in Uganda [8]. Between 2000 and 2019, Kenya, South Africa, and Mozambique experienced around 75% of the flooding incidences in Africa [7]. The deadliest floods in Nigeria in a decade claimed more than 600 lives. In the South African provinces of KwaZulu Natal and the Eastern Cape in April 2022, landslides and floods resulted in the deaths of 459 persons and the displacement of an additional 40,000 [8]. Whilst flooding in urban areas in Africa is attributed to poor drainage systems [9], in rural areas, it is attributed to deforestation [10]. Six powerful storms that hit Southern African nations, including Madagascar and Mozambique, killed at least 890 people. In August and October 2022, flooding in Chad had a negative impact on around two million people. Temperatures in Tunisia in July 2022 hit 48 °C, fuelling extremely severe wildfires [8]. In 2019, heatwave hotspots were distinctly identified across western-coastal, north-western, southern, and equatorial Africa. Urban areas in Africa generally exhibit significantly higher air and surface temperatures compared to their surrounding rural areas [11]. Natural disasters and extreme weather events brought on by climate change may compromise access to clean water, sanitation systems, and healthcare facilities, making people more vulnerable to a number of illnesses [12]. In this review, we discuss the health effects, including the mental health effects of extreme weather events that commonly occur in Africa, as well as the strategies that can be used to reduce these health effects in the continent.

2. Health effects of extreme weather events

The nature of exposure, associated dangers, socioeconomic and environmental considerations for the population and individuals, and the ability of health systems to protect the population against current and future risks are just a few of the many variables that affect the health risks associated with climate change [13]. In central and southern Africa, the consequences of climate change on health are anticipated to be particularly severe. Climate change is anticipated to increase the death rate by between 60% and 80% in Africa in 2030, which is more than in any other region. Malaria and diarrhoea are predicted to be responsible for the biggest number of these deaths [14].

2.1. Drought

Malnutrition is the most obvious and well-known effect of drought on health. Ecosystems are impacted by drought, impairing agriculture and livestock productivity. The crop failures and shortage of grass and water for livestock result in food shortage and food insecurity [15]. The quantity and quality of food consumed are usually reduced, leading to malnutrition that increases the risk of mortality and makes people more susceptible to illnesses. Due to their greater dietary requirements, children, pregnant women, and the elderly are more at risk of malnutrition. Micronutrient deficiency may lead to a number of diseases like anaemia due to iron deficiency, night blindness due to vitamin A deficiency, and scurvy due to vitamin C deficiency [16].

Table 1
Deadliest extreme weather events in the last two decades.

Extreme weather event	Year of occurrence	Region/countries affected	Number of deaths
Earthquake and Tsunami	2004	Asian and African countries	226,408
Storm	2008	Myanmar	138,366
Heatwave	2008	Europe	72,210
Heatwave	2010	Russia	55,736
Drought	2010	Somalia	20,000

Source: CRED/UNDRR (2020) [7].

Drought-related water constraints may result in poor handwashing and personal hygiene, which makes it easy for diarrhoeal diseases like cholera and typhoid to spread [16]. Changes in the climate can impact cholera transmission pathways. An increase in cholera epidemics is linked to weather factors such as rising ambient temperatures [17]. Low rainfall has an impact on the levels of nutrients, salinity, and acidity in water bodies, all of which affect the survival of the *Vibrio cholerae* [18]. Reduced crop yields brought on by low rainfall also increase the risk of malnutrition. Stunted growth and underweight among children in Mali, Kenya, Ethiopia, and Ghana due to malnutrition have been associated with drought [19]. People who are malnourished, particularly young children, are more likely to develop cholera infection and tend to have a longer duration of diarrhoea [20]. High temperatures with low precipitation in dry weather are the ideal climatic condition for cholera infection [21]. High temperatures can accelerate the growth and proliferation of *V. cholerae* in raw food, water, or the environment. The spread of cholera outbreaks is accelerated by other climate change effects like an increase in carbon dioxide concentration, a decrease in oxygen concentration, acidification of water bodies, and water pollution. These factors all result in increased bacterial replication and shortened replication times [18].

Lack of personal hygiene may also lead to skin infections like scabies and impetigo. Dry soil makes it simple for dust to be blown from the ground and circulate in the air during droughts. Allergens and pathogens in the dust may cause respiratory illnesses. Households may keep a lot of water indoors during a drought, and the water containers may serve as mosquito breeding grounds, increasing the number of malaria cases [22].

2.2. Floods

The health effects of flooding can be divided into immediate, secondary, and long-term effects [23]. Drowning, physical harm, animal bites, gastroenteritis outbreaks, and respiratory illnesses are only a few of the immediate health implications of flooding. People getting washed away from their houses and vehicles may drown. People may sustain injuries when running away from danger or as a result of crumbling buildings and other infrastructure. Electrocution or electrical burns may occur if standing water is close to electrical lines. If the floodwater temperature is below a person's core body temperature, they may also experience hypothermia [24].

Secondary health effects of flooding include water contamination, chemical contamination, vector-borne diseases, and respiratory illnesses. Floods can result in the contamination of water bodies with bacteria, and this may lead to diseases such as cholera, shigellosis, and typhoid [25]. Floods may disrupt sewage systems, which may lead to the contamination of water bodies and the overflowing of human waste from the sewage system. The water systems may also be disrupted during floods, and this may result in people relying on untreated water for drinking, which will increase the spread of cholera [26]. Diarrhoeal diseases may spread easily after floods because people in affected areas may not have access to health services. As a result, mortality from diarrhoeal diseases like cholera may also be high in these situations [27]. Chemicals swept away from industries may contaminate flood water, resulting in skin diseases. Stagnant water that results from the floods may act as a breeding ground for mosquitoes leading to an increase in malaria cases. Respiratory illnesses resulting from moulds in people with impaired immunity may also increase during floods [28].

Long-term health consequences of floods include disability, poor mental health, and malnutrition. Disability usually results from injuries that would have been sustained during the flooding. People may have sustained fractures that may heal without proper treatment as a result of disruption of health services, thereby leading to permanent disability. Floods may also leave people without anything to eat, and without support from the government and well-wishers, these people may become malnourished because of a shortage of food [29].

2.3. Heat waves

Exposure to extreme temperatures can result in heat exhaustion, heat stroke, heat syncope, heat cramps, and even death. The most common heat-related illness is heat exhaustion, which can cause extreme thirst, excessive perspiration, weakness, fainting, headaches, nausea, and vomiting. Elderly people are more at risk of developing these problems [30]. Apart from Africa, heat waves are experienced in other continents too. Previous heat waves in European countries such as France, which has recorded several heat waves, have resulted in thousands of deaths among vulnerable populations, and an economic burden on the country's health system [31]. Heat waves are also associated with increased mortality, and the mortality is associated with a number of pre-existing chronic health conditions like cardiovascular diseases, cerebrovascular diseases, respiratory diseases, and other health disorders [30].

3. Mental health effects of extreme weather events

Loss and trauma are important features of natural disasters since affected people experience a personal injury, damage to or loss of personal property, or, in some scenarios, the loss of loved ones [32]. As natural disasters increase in frequency and severity due to climate change, it is increasingly likely that there will be more cases of anxiety, post-traumatic stress disorder (PTSD), and major depressive disorder (MDD) in Africa. Social, economic, and physical systems are important determinants of psychological well-being. By disrupting these systems, climate change is likely to worsen risk factors for mental health disorders [33]. An increase in temperature has been associated with aggressive behaviour in a study conducted among adolescents. It is possible that with the rise in global warming, the rate of aggression may increase [34]. Heat waves have been associated with mood disorders, anxiety disorders, and anxiety-related disorders, among other mental health disorders [35].

As a result of climate change, vulnerable communities usually experience disruptions in their social and economic lives, which can lead to mental health disorders. Psychological effects of climate change are usually gradual and cumulative, meaning that as climate change progresses, so does the effect on individuals' mental health disorders [32]. Climate change and its negative impact on the physical environment can worsen poverty, malnutrition, and disease, and each of these serves as independent risk factors for the development of mental health disorders. Climate change will also expose pre-existing vulnerabilities [18]. People with a pre-existing resilience deficit may fail to prepare adequately for extreme events due to climate change, developing mental health disorders out of despair and hopelessness. This is because such individuals may find it difficult to find strategies to rectify the detrimental effects of climate change [36].

Climate change is likely to lead to an increase in competition for scarce resources and add to already existing social inequalities in the continent. This is likely going to affect interpersonal and intergroup behaviour resulting in increased stress and worry, which will eventually cause mental health disorders. Even in the absence of direct impacts, the perception and fear of climate change may lead to anxiety and depression among the population [37]. Drought is predicted to become more frequent and severe in the coming years in Africa. This is expected to lead to hunger and displacement of the population, and loss of jobs in the agricultural sector. These issues will likely lead to anxiety and depression among farmers and other individuals who rely on agriculture for employment and income [38].

Mental health disorders are likely to be more prevalent among people living in small rural communities than in big cities. Failure of crops as a result of climate change can lead to economic hardships that may result in farmers going into debt, which may drive them into mental health disorders [39]. Worse still, they may also be unable to buy food for their families as a result of increases in the prices of agricultural produce. People may also migrate to other areas with better climatic conditions, resulting in the destruction of social cohesion. All these factors may tip a lot of people on the continent into mental health disorders [40].

4. Strategies to reduce the health effects of climate change

Climate change is a global phenomenon and challenge which cannot be mitigated by one continent in isolation. Therefore a global multinational participatory approach is required to effectively combat the multitude of negative consequences of climate change on the population. Africa, which is significantly vulnerable, will need to work closely with other continents. Strategies that Africa can use to reduce the health effects of climate change include improved surveillance, information dissemination, reducing poverty and health inequalities, and improving research on the health effects of climate change [41]. Human beings will also need to adapt to climate change through adjusting behaviour and migration. People can relocate to other regions that are less affected by climate change [13].

Surveillance and primary health information systems should be improved in the continent. Essential data collected should include region-specific projections of changes in health-related exposures, projections of health outcomes under different future emissions, and different adaptation scenarios. Surveillance should also gather data on changing patterns of diseases due to insect-borne infections. Reliable, relevant, and up-to-date data should be collected and processed into information that can inform various responses, such as vector control, development of new vaccines, or rapid and effective treatment and diagnosis of the diseases emanating from climate change [42]. There is a need to increase local and regional climate modelling, as this will allow for the creation of an effective early warning system. The early warning system will allow people to be moved or take precautionary measures early before extreme weather events. Since malaria epidemics in semi-arid areas are mainly associated with excessive rainfall, early warning systems may give outlooks with lead times before the onset of the epidemics, which provide opportunities for putting interventions in place to prevent excess morbidity and mortality during malaria epidemics [43]. More research should be carried out in Africa to determine the effects of climate change on health, as this will inform the development of strategies for health protection [41]. To reduce food shortages that cause malnutrition, biochemistry research can be utilized to develop drought- and pest-resistant cereals like maize, millet, rice, sorghum, and cassava, among other crops [44].

Once data is gathered concerning climate change and its health effects for a particular region, the knowledge gained, and the adaptation strategies formulated should be disseminated to local communities so that they can take preventive measures. However, the scientific findings should be disseminated with responsibility and care in order to reduce psychological effects on the population [19]. In addition, since poor people are more vulnerable to the health effects of climate change due to greater exposure and sensitivity, and reduced adaptive capacity, countries in Africa should provide social protection for vulnerable people. Social protection will ensure that vulnerable people have enough food, adequate safe drinking water, and sanitation to prevent malnutrition and diarrhoeal diseases [42]. Adaptive dietary diversity buffers populations from food shortages and malnutrition. The continent should also invest in food security through the application of existing technologies and the development of new ones to boost food output. The strengthening of information, technology, and scientific capacity will reduce the

vulnerability of populations in the continent and build the resilience of infrastructure at local, regional, and national levels [41].

Climate change adaptation costs in Africa were estimated to be about US$60 billion per annum. Most countries in the region are unlikely to have enough money for these adaptations due to competing priorities such as infectious diseases and feeding the poor. High-income countries can assist low-to-middle-income countries in Africa by increasing the funding they allocate to the region to cope with the ongoing climate change. This funding can be used to finance early warning systems and climate-resilient infrastructure [14].

5. Conclusion

Although climate change is affecting all continents in the world, Africa is being affected disproportionately. Some of the effects of climate change, like drought and floods, have health implications for the population. Floods and drought can lead to both communicable and non-communicable diseases. The African population is more likely to experience more mental health disorders than before because of experiencing natural disasters which result in the loss of property and sometimes loss of lives more frequently. Strategies that Africa can use to reduce the health effects of climate change include improved surveillance, information dissemination, reducing poverty and health inequalities, and improving research on the health effects of climate change. We, therefore, call for improved implementation of these strategies to prevent the health effects of climate change so that the health of the people of Africa can be maintained.

Author contributions

E. M. and P. M.–Conceptualization, Writing original draft; L. G. N. and G. M.–Writing-review and editing; T. D.–Conceptualization, supervision, writing review and editing.

Declaration of competing interest

The authors have declared no conflicts of interest.

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