

14<sup>th</sup> World Congress on **Healthcare & Technologies**

July 22-23, 2019 | London, UK

**Climate change and health effects in Africa****Nuraine Mohammed**

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Africa is commonly described as a “climate-vulnerable” continent in which rainfall variability, hydrological extremes, and anthropogenic climate change have the potential to inflict significant harm on large populations. This description is grounded in the hard reality of modern history. Droughts have triggered massive economic loss, famine, displacement, and possibly armed conflict in regions across Africa. Floods exact a significant cost as well in river basins across the continent, leading to immediate loss of property and lives, and sometimes triggering crippling economic hardship and epidemics of waterborne and vector-borne disease. Meanwhile, a warming climate may be associated with changes in the range of infectious disease, loss of crop production and fisheries, associated under nutrition, increases in extreme events, and exposure to acute heat stress. At the same time, quantifying, predicting, and projecting the full impact that climate has on human health is a daunting challenge. In part, this is because of inadequate data over much of the continent. Climate-monitoring networks are sparse, economic and agricultural records can be inconsistent and incomplete, and health outcomes data are limited. But the challenge runs deeper than data. Understanding the impacts of climate on health is fundamentally difficult in any context because the connections are highly mediated by physical, ecological, and sociological factors. In Africa, rapid economic growth, demographic change, frequent political instability, and environmental changes independent of climate (e.g., overgrazing, deforestation) make it particularly difficult to trace climate impact to health outcome through these mediating dynamics. One way to conceptualize these processes is to distinguish between health impacts that are primarily physically mediated, those that depend on ecological as well as physical mediation, and those that are most strongly influenced by societal factors layered on physical and ecological conditions. This is an imperfect classification, as few health impacts fall neatly into one category and there is frequent interaction across mediating processes and health outcomes. Flood control infrastructure, for example, is part of the physical mediating environment, but its construction, maintenance, and operation are functions of societal factors.

Nutritional outcomes are affected by infectious disease burden, crossing ecological and social categories. Nevertheless, the classification provides an entry point for dealing with complex climate–health dynamics. The model shown in Figure 1 is similar to the models used by the Intergovernmental Panel on Climate Change (IPCC) and other climate and health reviews and assessments of Climate anomalies and trends mediated by physical, ecological, and societal processes can cause diverse health impacts, requiring a health system response. All categories of mediating process include natural and human systems. In Africa, each of the pathways linking climate to health has long been a study concern. Initially, this work was largely motivated by the tremendous health challenges faced by Europeans residing in the African colonies. Detailed records were kept of disease outbreaks along the Gold Coast (current Guinea Coast), for example. A connection was made between the seasons and disease occurrence. Medically, the tropical year was considered to have three divisions: Diarrheal/dysenteric, fevers/malaria, and congestive and pulmonary. The first coincided with the hottest months and was considered to be relatively healthy. Despite considerable physical adaptations of the body to the excessive heat, fever was generally rare. The second, coinciding with the rainy season, was considered the unhealthiest, although heavy rains could diminish the occurrence of malaria by disrupting the stagnation of surface waters where mosquitoes breed. The third division, which of the northeast Harmattan winds of the cold season, also brought healthy conditions as well as a frequent break from the heat. However, dust and cold lead to congestive and pulmonary problems. Modern study of climate and disease in Africa goes well beyond consideration of the seasonality of disease and physiological adaptations. Links between year-to-year frequency of certain diseases and changes in climate have been established, as have predictive models of disease. Africa is a

remarkably diverse continent. Rather than attempt a comprehensive inventory of all climate and health issues, more useful are overviews of salient examples of physically, ecologically, and socially mediated health challenges found in various regions. These examples include the most significant climate–health phenomena in developing countries of sub-Saharan Africa, several of which are being impacted by climate change. Neither the health examples nor the methods used to study them are unique to Africa, but the picture they compose is clear: The impact that climate variability and change have on food security is the single greatest climate–health issue facing Africa.

It affects the well-being of more people than any other climate-related health risk, and it either underlies or amplifies other health risks, ranging from disease susceptibility to violent conflict. Studies of food security do not fall clearly within the health field, as food production and prices are traditionally the domain of agricultural and economic research. But health is a primary outcome of interest in food security analysis, and any climate impact on nutrition via food security must be considered in studies of climate–health dynamics. Infectious disease is a second critical area of climate impact. Africa stands out both for a high burden of several pan-tropical diseases, including malaria and cholera, and for the diversity of neglected tropical diseases that affect significant populations. Finally, climate extremes exact a significant annual health toll and may increase under global warming. These extremes have physically mediated impacts—drowning, injuries, and heat stress—but they also have lasting ecologically and socially mediated impacts through disease dynamics and economic stability. As a starting point, a review of the basic characteristics of prevailing climate and climate variability across Africa is in order. The review then proceeds through climate–health examples, beginning with food security and other socially mediated processes, since they have the largest total burden, and continuing with infectious diseases, which are generally thought of as ecologically mediated phenomena, and the physically mediated impacts of climate extremes. Where possible and relevant, the impacts of climate variability and climate change are treated separately in order to distinguish between the existing and emerging climate-attributable health burden. These categories are also tied to different applications literatures, as climate variability is the basis for risk monitoring and early warning, while climate change projections connect to climate change adaptation activities. There is the strain on Africa health systems imposed by the high burden of life threatening communicable diseases coupled with increasing rates of non-communicable diseases such as hypertension and coronary heart disease. Basic sanitation needs only 58% of people living in sub-Saharan Africa have access to safe water diseases, such as hypertension, heart disease, diabetes and are on the rise and injuries remain among the top causes of death in the Region. The report stresses that Africa can move forward on recent progress only by strengthening its fragile health systems.

### Biography

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