Climate change and the growing epidemic of rheumatic autoimmune diseases in Africa

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Extreme weather phenomena have been on the rise in Africa. From flooding in East and North Africa to heatwaves in coastal West Africa and droughts in Southern Africa, these events have been attributed to the global climate change phenomenon. These extreme climate events have not only disrupted lives, socioeconomic activities and infrastructure. They have also imposed significant health risks especially upon vulnerable populations. With Africa warming faster than the global average, the continent faces unprecedented challenges in adapting to and mitigating the effects of climate change. This particularly means a risk in the rise of autoimmune diseases especially autoimmune rheumatic diseases. Research reports linking an increase in their incidence to climate change.

Patients with rheumatic autoimmune diseases, such as Systemic Lupus Erythematosus (SLE), Rheumatoid Arthritis (RA), and Psoriatic Arthritis (PsA), are particularly susceptible to the adverse health impacts of climate change. These diseases, characterized by immune system dysfunction and inflammation, pose unique challenges in the face of new environmental stressors. Studies have shown that exposure to air pollution, extreme weather events, and climate variability can increase the incidence of autoimmune diseases, exacerbate disease flares and influence the response to treatment of autoimmune diseases.

Recent published research have highlighted an association between long-term exposure to air pollution - a component of climate change - and immune-mediated diseases[1]. Extreme weather conditions such as drought, storms, and sandstorms release large amounts of fine Particulate Matter (PM) into the atmosphere, which may include silicates, clay, minerals, quartz, silicon dioxide, and heavy metals and can carry them for thousands of miles. Particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), small enough to enter the blood circulation, cause systemic inflammation. Thus exposure to PM over the long-term has been associated with a greater risk of autoimmune diseases such as rheumatoid arthritis, connective tissue diseases, inflammatory bowel disease, and SLE. Populations with chronic exposure to $PM_{2.5}$ at levels higher than 20 $\mu g/m^3$ are noted to have higher than 13% higher risk of developing autoimmune diseases such as rheumatoid arthritis and multiple sclerosis[2].

Most of Africa is exposed to concentrations of $PM_{2.5}$ that exceed the WHO guideline of 10 $\mu g/m^3$[3]. This trend puts Africa at a growing risk for autoimmune diseases in addition to the other health burden of climate change.

The impact of climate change is also seen with respect to therapeutic response of autoimmune diseases. The impact of climate factors and gene interactions on SLE patients' response to glucocorticoid therapy has been postulated. It underscores the complex interplay between environmental and genetic factors in disease management[1,2,4]. Evidence for other autoimmune diseases are lacking in this regard at this moment. But given that glucocorticoids are used often on the continent as part of the management of autoimmune diseases, more data in this regard will be most important.

Other proposed mechanisms hypothesised to be responsible for the effect of extreme weather events on autoimmune disease, include the loss of biodiversity with resultant reduced exposure to microbial biodiversity, driven by climate change. This loss of biodiversity contributes to immune dysregulation and the development of autoimmune diseases[5].

Heat stress is one of the climate change effects. A result of the rising global temperatures, it increases the severity and frequency of heatwaves and the associated morbidity and mortality[6]. Heat stress releases high levels of Reactive Oxygen Species (ROS) which in turn induce oxidative damage and degradation of biomolecules such as proteins, lipids, carbohydrates, and DNA, leading to cellular death. Heat stress also increases the production of heat shock proteins (HSPs)[6] which influence the immune system, mediating both anti-inflammatory and pro-inflammatory processes, thus

inducing the release of pro-inflammatory cytokines such as IL-6 and IL-1[2].

The link between climate change and the increase in autoimmune diseases is an indication of the urgent need for collaborative research and multidisciplinary approaches to address this growing challenge. Efforts are needed to understand the specific adverse health impacts of climate change on patients with rheumatic diseases in Africa. This will offer guidance to policy decisions, and lead to the implementation of risk mitigating strategies at clinical practice, institutional, national, regional and continental levels. Research specifically in the areas of biomarkers, response to treatment and data science evidence of association between climate change events and rheumatic diseases have been identified as areas of need.

Biomarkers need to be discovered and validated to provide evidence of exposure to pollutants and their association with autoimmune diseases. They will provide necessary data to inform personalised rheumatology care, management guidelines, public health and policy decisions. Some studies have shown the value of urinary metabolites in this regard. A study discovered the increase in 4-hydroxy-phenanthrene urinary concentration to be marginally associated with exposure to $PM_{2.5}$ and significantly associated with levoglucosan, a marker of wild land fire or vegetative biomass smoke[7]. C-reactive protein (CRP) has been correlated with air pollution, suggesting that low-grade inflammation may be a causative factor for the adverse health effects associated with exposure to air pollution[2].

Data science is crucial in generating important evidence that can be translated to patient care and policy interventions. Real-time analysis of integrated geospatial, environmental, and health data and the application of machine-learning techniques to better understand environmental-human interactions are currently some of the most important challenges in understanding the impact of global climate change on human health and disease. Big data analysis and artificial intelligence can be utilized to decipher the complex, multidimensional relationships between diverse parameters in the cause of diseases, particularly among vulnerable populations. Important data of interests also include chronicity of cumulative effects over a lifetime, and multiple simultaneous exposures. The results of these studies are instrumental for the development of health resilience measures such as forecasting, adaptation of disease management, and prevention of non-communicable diseases to manage climate change scenarios[2].

Other key actions, besides research include advocacy as Rheumatologists in the context of justice, equity, diversity, and inclusion considerations to address disparities in the impact of climate change on vulnerable populations such as in Africa[8].

As we confront the intertwined challenges of climate change and the growing epidemic of rheumatic autoimmune diseases in Africa, multisectoral, multidisciplinary, and trans-border efforts based on Planetary Health and One Health approaches are imperative[9,10]. By prioritizing research, policy interventions, and public health measures, we can strive to protect the health and well-being of individuals living with rheumatic diseases in the face of a change climate in Africa.

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