

# THE CLIMATE CRISIS IS A HEALTH EMERGENCY



The effects on human and specifically ocular health.

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In 2022, heat exposure killed at least five workers in Texas, including a landscaping worker who experienced severe heat stroke symptoms and later died in the hospital.<sup>1</sup> Climate change was declared the biggest global health issue of the 21st century by *The Lancet*.<sup>2</sup> Although we ophthalmologists specialize in eye health, it is important to emphasize that we are also committed to caring for our patients' overall well-being. As such, it is critical that we understand how our rapidly changing environment is affecting human and planetary health. Extreme weather events, air pollution, rising sea levels and temperatures, and forced migration have an impact on all aspects of human health, including the eyes.

The Intergovernmental Panel on Climate Change unequivocally concluded that human activities, primarily through greenhouse gas emissions and land alteration from agriculture and deforestation, are the main drivers of global warming.<sup>3,4</sup> As average global temperatures rise,<sup>5</sup>

heat waves and drought are becoming more frequent. The increasing loss of ice from Antarctica and Greenland is accelerating the rate of sea level rise.<sup>6</sup> More intense rainfall is leading to flooding.<sup>7,8</sup> Extreme weather events and rising carbon dioxide levels are precipitating environmental changes that are ultimately detrimental to human health. More than 9 million premature deaths worldwide are attributed to indoor and outdoor air pollution, which is both a cause and effect of climate change.

## CLIMATE CHANGE AND HEALTH

Climate change affects various health outcomes across a broad spectrum (Figure).<sup>9</sup> A 2023 report from the Lancet Countdown emphasized that climate change is leading to irreversible human harm and endangering the survival of millions of people.<sup>10</sup> Extreme heat is linked to heat stroke, arrhythmias, and cardiovascular failure. In 2019, high temperatures contributed to 93,000 cardiovascular deaths globally. In the

United Kingdom, a study found that, for every 1 °C increase in temperature above 23.2 °C, there was a 1.5% rise in the risk of hospitalization for patients with chronic obstructive pulmonary disease.<sup>11</sup> In 2020, 9-year-old Ella Adoo-Kissi-Debrah became the first person in the United Kingdom to have air pollution listed as a cause of death, following a severe asthma attack in 2013 due to unsafe levels of nitrogen dioxide in her area.<sup>12</sup>

Warming temperatures increase pollen production and virulence, prolong allergy seasons, and worsen air pollution, exacerbating respiratory conditions and causing more cases of allergic conjunctivitis.<sup>13,14</sup> Studies have also shown an association between extreme heat exposure and a higher risk of emergency department visits related to kidney disease, including acute kidney injury, kidney stones, and urinary tract infections.<sup>15</sup> For those who are pregnant, the impact of rising temperatures includes preterm birth, stillbirth, low fetal weight, and other complications.<sup>16,17</sup>

As the intensity of storms increases, ozone in the stratosphere decreases, allowing more UV radiation to reach people. Heat and increased UV exposure can exacerbate ocular and periocular conditions such as skin cancers, herpetic infections, and eczema as well as systemic lupus erythematosus.<sup>18</sup>

More frequent and intense droughts are leading to food insecurity, famine, and forced migration. Malnutrition may result in ocular diseases such as xerophthalmia due to vitamin A deficiency. Heat and drought are making wildfires more frequent and intense, thereby generating more chemically toxic smoke and increasing groundwater pollution.<sup>19</sup> Heat-related changes in vector ecology are leading to a resurgence of previously eradicated diseases, such as dengue fever in the United States. Studies have suggested that higher temperatures linked to climate change can increase the incidence of trachoma infection. Additionally, climate change-induced factors such as migration, environmental degradation, and overcrowding, along with reduced sanitation, can hasten the spread of onchocerciasis.<sup>18,20</sup>

Environmental and climate changes are also affecting mental health. People directly harmed by climate change often develop posttraumatic stress disorder and depression, and there is a direct correlation between rising temperatures and interpersonal violence.<sup>21</sup> A recent study has shed light on the profound concern among Generation Z regarding climate change, with greater than 80% of respondents feeling anxious about its impact.<sup>22</sup>

Climate change threatens everyone's health but not equally. In the United States, the most severe harm disproportionately affects historically marginalized and underresourced communities who are least able to prepare for and recover from heat waves, poor air quality,

and flooding.<sup>23</sup> Other vulnerable groups include children, senior citizens, pregnant individuals, outdoor workers, individuals with chronic illnesses, and people living in island nations and developing countries.

### CLIMATE CHANGE AND OCULAR HEALTH

Maintaining homeostasis is crucial for optimal eye function. The following material on the associations between climate change and ocular health has all been taken from original research articles cited in a recently published scoping review of the topic.<sup>24</sup>

#### Cornea, Conjunctiva, and Ocular Surface

Elevated temperatures and decreased humidity have been linked to a shorter tear breakup time, dry eye disease (DED), and a heightened risk of conjunctivitis, including acute hemorrhagic conjunctivitis and allergic conjunctivitis. Areas experiencing increases in rainfall and flooding are at growing risk of parasitic infections, such as microsporidia or *Pythium* keratitis,

particularly during the monsoon season.

Exposure to sunlight or UV light increases the likelihood of developing pterygium and DED. Moreover, high ambient UV radiation exposure can reduce corneal resistance, increasing susceptibility to infection.

Airborne pollutants can increase the risks of conjunctivitis, conjunctivitis-related hospital visits, keratitis, and pterygium; the frequency of DED exacerbation, including DED related to Sjögren syndrome (due to its effect on chronic inflammatory pathways); and poor tear film quality.

#### Lens

Elevated temperature, UV radiation exposure, and airborne pollutants can hasten cataract development.

#### Refractive Error and Vision Impairment

Exposure to airborne pollutants can impair vision and cause myopia progression in children through oxidative stress and the reduced

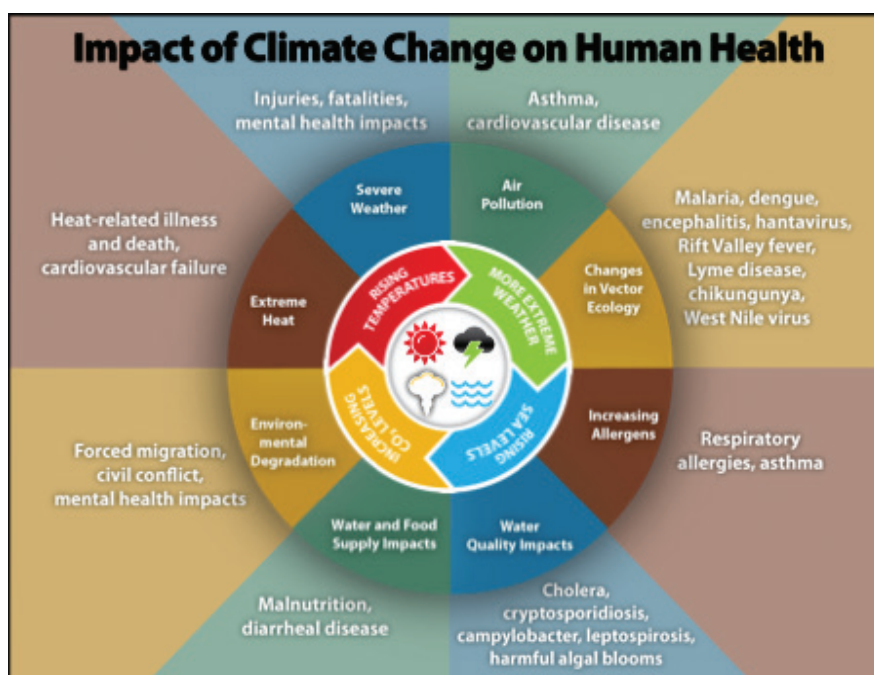


Figure. This presentation from the Centers for Disease Control and Prevention highlights the primary effects and impact on health of climate change.<sup>9</sup>

release of dopamine from retinal cells, which regulate axial growth. Although outdoor activities can slow myopia progression by providing higher solar illumination, the benefit may be mitigated in areas with high levels of air pollution and UV radiation.

### Glaucoma

Exposure to heat waves and cold spells—more common in our changing climate—has been found to raise the occurrence of both primary angle-closure glaucoma and primary open-angle glaucoma. Primary angle-closure attacks are more common during the monsoon season. The frequency of pseudoexfoliation syndrome has been associated with sun exposure and rising temperatures. Oxidative stress, neuroinflammation, and hypercoagulability induced by air pollutants contribute to retinal ganglion cell death and subsequent neuropathy. Other proposed mechanisms include damage to trabecular meshwork cells, leading to elevated IOP and the development of glaucoma.

### Lids and Ocular Adnexa

Lower temperatures and exposure to airborne pollutants have been associated with meibomian gland dysfunction and blockage and blepharitis, which increases the risks of evaporative DED and keratitis.

In addition to the risk of periocular tumors associated with exposure to UV radiation, climate change seems to increase the risk of periocular and orbital infections. In Japan, increased temperatures have been linked to periocular fungal sporotrichosis infections. A rise in rhino-orbital mucormycosis cases occurred following a month of widespread flooding in the Denver-Boulder metropolitan area.

### Retina and Ocular Inflammation

Elevated ambient temperature has been linked to higher rates of

rhegmatogenous retinal detachment, possibly due to alterations in chorioretinal adhesion and vitreous liquefaction. Elevated temperatures and temperature variability may correlate with the risk of uveitis, particularly the noninfectious form. Greater rainfall has been linked to the reactivation of toxoplasma retinitis, particularly during the second and fourth quarters of the year, notably during the El Niño phenomenon.

### CONCLUSION

Temperature fluctuations, exposure to UV radiation and airborne pollutants, and extreme weather events pose disproportionate yet significant threats to human health and biodiversity worldwide. The impact of climate change on general and ocular health demands comprehensive physician education (as declared by the American Medical Association)<sup>25</sup> and action. Health care generates 8.5% of US greenhouse gas emissions.<sup>26</sup> As physicians, we have a unique opportunity to reduce the carbon footprint of health care, call for policy change, educate our colleagues and community, and advocate for our patients. ■

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