

# Eyes on the Storm: How Climate Change is Affecting Our Vision and What We Can Do About It

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Climate change refers to significant, long-term shifts in seasonal patterns and weather that occur over extended periods, even spanning millions of years.<sup>1</sup>Natural and human factors both significantly contribute to climate change. Natural factors include volcanic activity and ultraviolet radiation, while human factors encompass industrial and vehicular emissions, increasing solid waste generation, deforestation, unplanned urbanization, and population influx into large cities.

Although climate change has a global impact, certain countries are more vulnerable and Pakistan is among the most significantly affected, due to its geographical location, economic issues, and environmental factors. Recent floods, heat waves, cold spells, and glacier melts observed over the last decade highlight the evident impact of climate change in Pakistan. These events have not only resulted in increased mortality and morbidity but have also led to the proliferation of water and vector-borne diseases, as well as malnutrition, particularly in already vulnerable communities.

Eye is among the organs most vulnerable to the effects of climate change due to its constant exposure to environment. We find a significant increase in research articles examining the relationship between climate change and ocular health, particularly since 2019.<sup>2</sup> However, studies from Pakistan are relatively scarce, likely due to limited available resources. This editorial provides a concise overview of the detrimental effects of climate change on ocular health and explores potential mitigation strategies.

Literature indicates that hazardous air quality caused by ozone (O<sub>3</sub>), particulate matter (PM), gases like nitrogen dioxide (NO<sub>2</sub>), nitric oxide (NO), carbon monoxide (CO), methane (CH<sub>4</sub>) and sulfur dioxide

(SO<sub>2</sub>) have deleterious effects on eyes.<sup>3</sup>According to a report, Bangladesh, Pakistan and India are identified as the world's top three smoggiest countries during the year 2023.<sup>4</sup> In Pakistan, the average concentration of PM<sub>2.5</sub> reached 73.7 micrograms, significantly surpassing the World Health Organization's recommended level of 5 micrograms, with Lahore ranking as the fifth-most polluted city.<sup>5</sup>This has led to increased number of eye allergies, infectious conjunctivitis, blepharitis and dry eye diseases (DED). Allergic conjunctivitis may range from mild seasonal and perennial allergic conjunctivitis to chronic conditions like atopic and vernal keratoconjunctivitis which are on the rise during the last decade.

Long term exposure to air borne hydrocarbons especially volatile organic substances have been linked to increased chances of Retinal vein occlusion too.<sup>6</sup> These substances also adversely affect immune system, leading to an increased number of uveitis cases.<sup>6</sup>

As the global climate has been experiencing extreme temperature variations over the past decade, it has increased the susceptibility to microbial keratitis, notably fungal infections, and also DED. Toxoplasmosis, tuberculosis, chlamydia, ocular herpes simplex (VHS), and zoster are among the infections that are either directly or indirectly exacerbated by high temperatures. Additionally, prolonged exposure to high average temperatures and arid climates has been linked to allergic eye diseases. Conversely, regions characterized by hot and humid climates are associated with hemorrhagic conjunctivitis.

The shifting climate patterns have led to a rise in the frequency of floods, posing numerous hazards including microbial eye infections, waterborne diseases, and rhino-orbital mucormycosis. In Pakistan,

a series of cases of microsporidia keratitis were reported following exposure to water pools during the monsoon season and floods.<sup>7</sup> Moreover, nutritional deficiencies are also on the rise in flood-affected areas, leading to night blindness and deficiency diseases.

Ozone depletion represents another significant contributing factor to climate change, resulting in dangerously high levels of ultraviolet (UV) radiation. The effective dose of UV radiation is increased by 2% for every degree centigrade rise in temperature.<sup>8</sup> Prolonged exposure to direct sunlight containing high UV radiation is associated with an increased risk of Age-Related Macular Degeneration, cataracts, pterygium, herpes simplex keratitis, herpes zoster and periocular skin cancers including basal cell carcinoma and squamous cell carcinoma.<sup>9</sup> Moreover, increased ambient UV exposure appears to impact the biomechanical characteristics of the cornea and elevating the risk of keratitis.

The impact of climate change on intraocular pressure (IOP) and glaucoma is multifaceted. Factors such as pollutant-induced oxidative stress, neuroinflammation, and hypercoagulability are implicated in elevating the risk of glaucoma, irrespective of IOP elevation. Furthermore, research suggests that damage to trabecular meshwork cells and subsequent elevation of IOP may result from mechanical and oxidative stress induced by PM, thereby contributing to the glaucoma progression.<sup>10</sup>

We need to take general as well as specific measures to prevent our eyes from the adverse effects of climate change. Mitigating global warming should be among the priorities of policy makers as it represents a significant international challenge. Short term and longterm steps need to be taken at local and international levels. At the local level, individuals can contribute by reducing greenhouse gas emissions, promoting tree plantation and reforestation efforts, and implementing changes in crop management practices, notably by refraining from crop burning prior to new cultivation. Forests serve as crucial carbon sinks and play a pivotal role in preventing the adverse effects of climate change. Additionally, support from media outlets, organizing seminars, and implementing public awareness campaigns all serve as valuable contributions towards addressing this pressing issue.

At national level, new buildings should incorporate solar protection, efficient ventilation systems, and insulated facades to regulate internal

temperatures effectively. Implementing policies to prohibit smoking in public spaces is imperative. Additionally, measures such as phasing out the use of leaded gasoline, removing vehicles with deteriorated engines emitting harmful gases from circulation, adopting carpooling practices akin to those prevalent in the Western world, and ceasing open-air incineration are essential steps towards minimizing environmental degradation and fostering sustainable development.

Raising public awareness about the benefits of using sunscreen and protective eyewear, avoiding dusty environments, using humidifiers, staying well-hydrated in dry weather, and keeping plants indoors can have significant positive effects.

This write-up highlights the importance of research in this area in Pakistan. Further investigation is required to understand how climate is affecting the pattern of ocular diseases in our socioeconomic context. Such research has important implications for public health in Pakistan. Effects of extremes of temperatures, heavy rainfall, strong winds, and air pollution are among the factors that need to be addressed by the policy makers. Global warming precipitates a cascade effect that impacts ocular health. However, interdisciplinary efforts, fostering collaboration between ophthalmologists and environmental specialists, are imperative to address this pressing issue effectively.

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## REFERENCES

1. **Luber G, Prudent N.** Climate change and human health. *Trans Am Clin Climatol Assoc.* 2009;**120**:113-117. PMID: 19768168; PMCID: PMC2744549.
2. **Alryalat SA, Toubasi AA, Patnaik JL, Kahook MY.** The impact of air pollution and climate change on eye health: a global review. *Rev Environ Health.* 2022;**39**(2):291-303. Doi: 10.1515/reveh-2022-0209.
3. **Heilenbach N, Hu G, Lamrani R, Prasad J, Ogunsola T, Iskander M, et al.** Environmental influences on ophthalmic conditions: A scoping review. *Clin Exp Ophthalmol.* 2023;**51**(6):516-545.
4. **Stanway D.** Which countries had the worst air quality in 2023? Reuters [Internet]. 2024 Mar 19. Available from: <https://www.reuters.com/business/environment/bangladesh-pakistan-india-bottom-air-quality-rankings-2023-data-shows-2024-03-19/>. Accessed June 11, 2024.

5. How Pakistan got unenviable second spot among countries with worst air quality. The Express Tribune. Available from: <https://tribune.com.pk/story/2463069/how-pakistan-got-unenviable-second-spot-among-countries-with-worst-air-quality>. Accessed June 11, 2024.
6. **Zhang HW, Lin CW, Kok VC, Tseng CH, Lin YP, Li TC, et al.** Incidence of retinal vein occlusion with long-term exposure to ambient air pollution. *PLoS One*. 2019;**14(9)**:e0222895.  
Doi: 10.29271/jcsp.2022.Supp0.SS165.
7. **Malik S, Ishaq M, Nayyar S, Humayun S.** Microsporidial Keratitis - First Case Series of a Rare Pathogen in the Wake of Flood Disasters of 2022 in Pakistan. *J Coll Physicians Surg Pak*. 2022;**32(12)**:SS165-SS167.  
Doi: 10.29271/jcsp.2022.Supp0.SS165.
8. **Furdova A, Kapitanova K, Kollarova A, Sekac J.** Periocular basal cell carcinoma - clinical perspectives. *Oncol Rev*. 2020;**14(1)**:420.  
Doi: 10.4081/oncol.2020.420.
9. **Hatsusaka N, Yamamoto N, Miyashita H, Shibuya E, Mita N, Yamazaki M, et al.** Association among pterygium, cataracts, and cumulative ocular ultraviolet exposure: A cross-sectional study in Han people in China and Taiwan. *PLoS One*. 2021;**16(6)**:e0253093.  
Doi: 10.1371/journal.pone.0253093.
10. **Min KB, Min JY.** Association of Ambient Particulate Matter Exposure with the Incidence of Glaucoma in Childhood. *Am J Ophthalmol*. 2020;**211**:176-182.  
Doi: 10.1016/j.ajo.2019.11.013.

