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Editorial

CURRENT AND FUTURE IMPACTS OF CLIMATE CHANGE IN EYE AND VISION HEALTH

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Within the last quarter of the century, many peer-reviewed publications have been written on climate change, its impacts on the environment and human health, as well as mitigation strategies. Since its establishment in 1988, the Intergovernmental Panel on Climate Change (IPCC) has released 6 landmark reports (1990, 1995, 2001, 2007, 2014, and 2023) on the physical science behind climate change; impacts, adaptations and vulnerability; and mitigations. According to the 5th report, there is 95% certainty that anthropogenic activity is the main cause of global warming since the mid-20th century with devastating impact on health and there is more than 50% possibility that the rise in temperature around the world will either reach or surpass 1.5° C (2.7° F) between 2021 and 2040.¹

The latest report concluded that

- The rate of global warming since 1970 has been highest than in any other time frame in the last 2000 years.
- The concentrations of carbon dioxide, methane gas and nitrous oxide are at their highest in the last 800,000 to 2 million years.

- Sea levels will continue to rise for centuries as a result of deep ocean warming and melting of ice sheets, and over 3 billion people are vulnerable.
- Currently observed long-term impacts are grossly lower than projected and further warming will be complex and unmanageable.²

The human eye and vision health is reported as the one of the body systems that has been impacted by climate change and the trend is expected to continue^{3,4,5} or get worse.^{6,7} There are no empirical evidence directly linking climate change to the pathological changes in the crystalline lens, other refractive media, retina and surrounding tissues, but many reports suggest an association based on available knowledge.

The basic ocular conditions that have been linked with climate changes are cataracts, refractive errors, glaucoma, eyelid lesions, pterygium, squamous metaplasia, carcinoma, retinal damage, (age-related macular degeneration (ARMD), photokeratitis and uveal melanoma. Ultraviolet rays (UVR-B

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component) have been largely implicated as having a predominant role in these pathological developments followed by water changes, extreme weather and a drier climate.⁴ Different regions are expected to have varying levels of exposures to these environmental incidents and consequently there should be appropriate reflections in the geographic and seasonal spread of the diseases.

The eye care profession is faced with many preventable conditions that can only be avoided with patient education, adequate counseling and improved research methodologies. In order to appreciate the effects of climate change on the ocular and vision health, studies have to be instituted in line with the known changes that have been observed and longitudinal investigations taken and cross-referenced with similar work in different regions of the globe. Climate change has health impacts, and it is not expected to get better even if the total anthropogenic sources of global warming and pollution are stopped today. Bearing that in mind, it is only proper that fixation should be on how to counter and prepare for the fallouts of these impacts especially in the eye care industry.

Cataracts, pterygia, photokeratitis, melanomas and AMDs are expected to increase in incidence especially in the areas nearer the equator and studies have revealed that adults and children under 30 years of age and people with aphakic eyes have higher risks of retinal damage from UVR-B so it is recommended that sunglasses are worn around noon when insolation is highest and IOLs that absorb

UVR be used to protect the retina of aphakes.^{8,9} Wide-brimmed hats and other protective equipment will also help to shield the eyes and their use should be encouraged by eye care practitioners to reduce exposure. Most of the studies on climate change and ocular diseases have failed to produce firm evidence on these associations but the prospect of a remote link calls for preventive action to ameliorate the effects if any.

There are yet other eye diseases associated with climate change such as climate droplet keratopathy which is a degenerative condition where the corneal stroma accumulates materials and can lead to loss of vision. According to a WHO publication¹⁰, solar elevation, cloud cover, altitude, stratospheric ozone levels, reflective surfaces (e.g. water or snow) and regional pollution will affect the amount of ambient UVR-B that an individual is exposed to. In addition to that it is important to note that everyone is at risk. UVR-B-blocking eyewear should be made available for prescription glasses and younger children who spend a lot of time outdoors should also be protected. Antioxidants and phytonutrients counteract retinal phototoxicity just as certain antibiotics, non-steroidal anti-inflammatory drugs and psychotherapeutic agents may exacerbate retinal damage.¹¹

Climate change affects the availability of safe water supplies for drinking, cooking and basic hygiene. This in turn affects the transmission of water-borne eye diseases like trachoma and onchocerciasis. Increased temperature and reduced rainfall in some

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regions will lead to water shortages while increased rainfall and consequent flooding will increase the spread of water-related vectors.⁴ These neglected tropical diseases are still affecting millions of people in developing countries and climate change impacts will worsen the present scenario. It is necessary that eye care providers are ready to diagnose and treat especially in the event of an extreme event like a storm, heavy rainfall and flooding of low-lying coastal areas among others.

Mitigation efforts for the health impacts of climate change must embrace the expected changes in ocular health and vision due to climate change and adapt accordingly. Developed nations must carry the developing ones along and initiate programs that will benefit all. Coordination in all aspects of the planning and implementation will accelerate progress and lessen the negative impacts.

Climate change has grave impacts on the environment, human health, food supply and socio-economic order. The history of climate change and impacts on health has been dominated by other parts of the body and there is sparse literature on the effects on the eye and visual health. These observed effects are the results of studies that have been conducted over two centuries. The campaign to reduce emissions of greenhouse gases and turn to renewable energy has succeeded over the years through advocacy groups putting forward precise information, aided by severe weather events, media and elite cues to bring world leaders to sign agreements on curbing emissions. Eye care practitioners should initiate and participate in more research on climate change and the eye and visual

health. They should also join in the movement to limit the atmospheric levels of carbon dioxide and reduce emission of greenhouse gases, and this can be better accomplished with empirical published data from studies on the impacts of climate change on eye health.

Public health approaches to the impacts of climate change on eye and visual health is multidisciplinary and will involve a lot more than just the eye care providers. Clinical eye care practitioners are expected to be aware of the increased challenge posed by these climate-induced effects and suitable diagnostic and reporting procedures employed to quickly detect and treat them should the need arise. Electronic health records should not be limited to big and acute care hospitals only but should extend to private practices including optometry and ophthalmology offices to assure a more proficient, safer, and more excellent eye care delivery. Health information technology serves to rapidly recognize a trend in morbidity and is a veritable tool for health managers and epidemiologists in calculating prevalence and incidence of diseases in addition to other statistical indices.

The prevention of water-related eye diseases is a key public health initiative. In addition to sanitation, effort should be made to stop the spread of trachoma by educating the population on how it is spread with a view to making appropriate behavioral changes to avoid infection. The provision of accessible and quality water supply alone will not halt the transmission of trachoma, but effort must be made to deliver it and health promotions on sanitation and personal hygiene will guide the underserved

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communities to protect themselves. Climate change also affects the breeding grounds of the black fly responsible for transmitting the parasitic worm, *Onchocerca Volvulus* in parts of Africa and South America. In 1997, WHO listed onchocerciasis among others, as one of the parasitic diseases that can be eliminated in 10 years¹² and a vigorous Ivermectin distribution treated 18 million people in a 25% coverage that same year.¹³ Today, 27 years later, some pockets of communities mainly in Africa still suffer from the blinding disease. New methods of combating the breeding grounds of the black fly vector should be investigated alongside Ivermectin treatment. There is a possibility that variability in climate may introduce these vectors to areas where they were not originally endemic and further strain the ecosystems and human populations in the affected areas.¹⁰ Public health systems must be strengthened in populations at risk in order to tackle the possible fall out of climate change impacts in these communities. Preventive strategies, more than treatment, must be emphasized and more studies carried out on ways to limit the spread of diseases.

The practice of eye care delivery is a healthcare specialization that can only exist in harmony with other health and social care professionals, related disciplines tend to complement one another in the pursuit of wholesome wellness. Just like laboratory scientists and medical transcriptionists, eye care professionals can also benefit from collaborations with climatologists to investigate the impact of climate changes on the eye and visual health. Some of the literature on the relationship between these two parameters is based on assumptions calculated

from inferences on associations. There is need for establishment of concrete causal pathways and temporal associations based on research by eye care practitioners and climate scientists working as a team to unravel these uncertainties. More epidemiological studies are needed to understand these relationships with a focus on preventive approaches to their elimination.

The impact of global climate change on the eye and visual health should be included in the curriculum of eye care training schools appropriate for a working knowledge of the various associations between UVR and cataracts, pinguecula and photokeratitis as well as melanoma and retinal disease. More eye care professionals are needed to develop further in the field of environmental health to get a more robust understanding of the forces at play, region-specific training should see those in areas endemic to trachoma and onchocerciasis receiving adequate knowledge on the prevention and eradication strategies for these water-related eye morbidities and those in snowy areas to learn about the mitigation strategies to prevent snow blindness (photokeratitis) and treat it. Record keeping and coordination with other health and social workers is another skill that must be taught to all eye care professionals in order to achieve a balanced practice as a unit in the health care work force.

Exchange of knowledge also helps to cross-fertilize ideas, academic programs that exchange students in eye care profession, from maybe a temperate climate to a tropical one and vice versa for a period of time within their regular course course

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work, will succeed in breeding a dynamic set of eye care providers with a very robust knowledge of preventive and curative strategies and prepared for any shift in vector migration and endemicity if it happens. More training schools for eye health should be established to improve access to care and reduce disparities in health care especially among vulnerable groups, some developing countries still lack basic facilities for appropriate and well-rounded training of ophthalmologists, optometrists, ophthalmic nurses and opticians.

Conclusion

Eye care practitioners should expect more cases of cataracts and pingueculas in areas closer to the equator and at higher altitudes, more photokeratitis in persons exposed to frequent snow and all these and other discussed effects in people who spend a lot of time outdoors than the average. Cataract is correlated with age, smoking, diabetes, malnutrition, hypertension and alcohol consumption in addition to UVR exposure, if the latter can be reduced with the UVR blocking spectacles, contact lenses and wide brimmed hats, blindness will be averted in a fraction of people in developing countries and surgical costs saved in the developed ones. Public health strategies aimed at eliminating and eradicating diseases should integrate the projected increase in cataracts, pterygium, age related macular degeneration, trachoma and onchocerciasis from climate change impacts, in their long and short term plans. Eye care training facilities in developing regions should be assisted with equipment and personnel in order to achieve an aggregated workforce and cross fertilization of ideas through exchange programs for students which will prepare them for any shift in vector breeding grounds.