

## **EDITORIAL BACKGROUND**

### **ENVIRONMENTAL FACTORS AFFECTING HEALTHY SIGHT**

Green house gas emissions contribute to global warming and are at the greatest levels ever experienced and continue to increase.<sup>1</sup> The threat of global climate change is clear and increasing,<sup>2</sup> and is predicted to have a strong and adverse impact on human health.<sup>3</sup> Climate change already contributes to the global burden of disease, and this contribution is expected to grow in the future.<sup>4</sup> Coupled with the depletion of the ozone layer and associated increase in **ultraviolet radiation (UVR)**, there are expected increases in some particular risks to health. These include **effects on the skin:** melanoma, skin cancer, sunburn; **effects on the eye:** photokeratitis, cataract, pterygia, cancer of the cornea and conjunctiva, macular degeneration; **effects on immunity and infection:** increased susceptibility to infection, impairment of immunization and **other effects:** food supply, air pollution and infectious diseases.<sup>5</sup> These changes will affect overall health and wellness.

Varying physiological factors can affect healthy sight, ranging from a person's genetic makeup to systemic diseases – such as diabetes – and lead to a higher risk of developing ocular manifestations. Healthy sight is also impacted by environmental factors, which are a result of an ever-evolving world.

An individual's vision-related quality of life is a function of his or her environment. Eyes are in constant interaction with environmental factors, both outdoor and indoor, and are impacted by light and air quality.

### **Outdoor Environmental Factors and Potential Ocular Effects**

Sunlight is everywhere, and is necessary for sight, but with it comes the damaging effects of **UVR**. With the depletion of the ozone layer, and therefore an increase in the amount of sunlight and UVR reaching the earth's surface, the dangers to human health are even greater, with eye sight at particular risk.

UVR contributes to eye disease, by triggering pathological processes within the eye. As sunlight passes through the atmosphere, most forms of UVR are absorbed by ozone, water vapor, oxygen and carbon dioxide. Of the radiation that reaches the eye, most ultraviolet B (UVB) is absorbed by the cornea. Only small amounts of ultraviolet A (UVA) and UVB reach the inner eye, but the high sensitivity of the tissues that reside there can make these amounts damaging over time. UVR, comprised of UVA and UVB rays, occupies the wavelengths from 280-380 nanometers. Depending on their wavelengths, these rays can

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<sup>1</sup> National Oceanic and Atmospheric Administration, 2008.

<sup>2</sup> "Global warming is a 'clear and increasing threat.'" NewScientist, June 2005.

<sup>3</sup> "The Health Effects of Global Warming." UN Chronicle Online Edition, 2006.

<sup>4</sup> World Health Organization, 2008.

<sup>5</sup> World Health Organization. Climate change and human health - risks and responses. Summary, 2003.

cause molecular fragmentation and the generation of free radicals in various parts of the body, including the eyes.

Molecular fragmentation occurs when UVR causes proteins in the eye to break, resulting in inflammation, transformed cells, or an effect on the immune system. Light damage to ocular tissue resulting from free radicals occurs when pigmented molecules absorb UVR of a specific wavelength, changing the energy level of the molecule and causing it to create a free radical. Free radicals can disrupt cell membranes and destroy tissue. Prolonged exposure to UVR can cause both of these processes in the eye, aiding in the development of various eye diseases.

A cause and effect relationship exists because as stratospheric ozone decreases during the spring and summer months, the UVR dose increases. Research shows that eyes become more sensitive with increased exposure to UVR. A 1 percent decrease in stratospheric ozone may result in 100,000 to 150,000 additional cases of blindness due to eye cataracts worldwide.<sup>6</sup>

Exposure to UVR can result in short-term damage – what is essentially a *sunburn* of the eye's surface, a condition known as photokeratitis, which is the most common form of damage to the cornea. Two other common types of damage to the eye's surface from UVR exposure are benign yellowish growths known as pingueculae and pterygia. UVR can also contribute to the development of melanoma and nonmelanoma cancers on the eyelid.

More permanent conditions, which result from cumulative exposure to UVB, such as cataracts, are becoming more common as our population ages.<sup>7</sup> With increased UVB exposure due to ozone depletion, this trend is likely to not only continue, but increase in pace. Another serious condition related to UVR overexposure is age-related macular degeneration. Similarly, glaucoma can make the eyes more susceptible to damage from UVR and can increase sensitivity to glare.

When considering geographic locations and their proximity to the ozone layer, those at higher risk include the tropics and equatorial zones, as well as higher altitudes. In the tropics, UVR is strongest as the ozone layer is thinner and less absorbent, with the sun directly overhead allowing for rays to travel a short distance through the atmosphere. Likewise, when moving up in altitude, risk of overexposure increases as there is less atmosphere to absorb damaging rays.<sup>8</sup> Australia, for example, is exposed to 15 percent more UVR than Europeans, as the earth's orbit brings the continent closer to the sun in the summer, resulting in an additional 7 percent solar UVR intensity.<sup>9</sup>

In addition to UVR, **glare** is another side effect of sunlight that can be both distracting and dangerous. Glare is the loss of visual performance or visibility produced by a luminance in the visual field greater than that to which the eyes are adapted. It can be prevalent in regions near water or snow where extreme reflected glare is a concern. For instance, in certain coastal areas and other locales that receive higher-than-average rainfall, the issue of distracting glare during night driving becomes an important concern. In urban

<sup>6</sup> Enviropedia. [http://www.enviropedia.org.uk/Ozone\\_Depletion/Eye\\_Disorders.php](http://www.enviropedia.org.uk/Ozone_Depletion/Eye_Disorders.php). Accessed 10/24/2008.

<sup>7</sup> Longstreth, Janice. "Anticipated Global Health Consequences of Global Climate Change." *Environmental Health Perspectives*. Vol. 96, pp. 139-144, 1991.

<sup>8</sup> Environment, Health and Safety Online. <http://www.ehso.com/ehshome/uvIndexInfo.htm>. Accessed 10/24/2008.

<sup>9</sup> The Ozone Hole. <http://www.theozonehole.com/consequences.htm>. Accessed 10/24/2008.

environments, distracting glare reflected off glass and metal buildings and other broad surfaces can interfere with vision. Glare is not specific to these locations, as light is everywhere – outdoors and indoors – and so is the possibility of glare.

**Air quality** is another notable environmental factor impacting healthy sight, as high levels of airborne irritants, allergens, or pollutants can lead to ocular irritation, manifested by diverse symptoms varying from epiphora, which is excessive tear production resulting from irritation, to a dry eye state. In many climates and geographic zones, seasonal allergies and their ocular symptoms are an impediment to enjoying healthy sight. For example, ragweed is the number one fall and late summer weed in most areas of the U.S. that causes fall allergies. In fact, one ragweed plant can produce one billion pollen grains that can travel from 300 to 700 miles in the air. Global warming is likely one of the reasons that record pollen levels are being measured, which affect an individual's chances of developing allergies.<sup>10</sup>

Furthermore, some common **medications** used to treat allergies, including antihistamines and decongestants, can lead to ocular (dryness) and systemic (drowsiness) side effects that hamper visual function and comfort.

Environmental factors, such as global warming, drought, increased solar radiation and unsanitary or insufficient drinking water, can contribute to **dry eye**. Although it is not as serious as a sight-stealing disease, dry eye is a hindrance to seeing well. Nearly five million Americans 50 years of age and older are estimated to have dry eye.<sup>11</sup> As these issues worsen, individuals will have to find ways to incorporate hindrances to visual quality into everyday life.

### **Indoor Environmental Factors and Potential Ocular Effects**

Many people spend more time indoors than outdoors, and indoor environments can have ramifications on healthy sight, just as outdoor environments can. In indoor workplace environments, variables such as the type and level of indoor lighting, office ventilation, and computer use can lead to eye strain, ocular fatigue and visual headaches. Additionally, indoor air quality affects eye health. An inadequate supply of fresh air and poor ventilation, micro-organismal contaminants, and pollutants given off by building materials and processes within the building all lend to poor air quality.<sup>12</sup> Immediate effects to the eyes show up in the form of irritation, with potential permanent damage to eyesight for extended periods of exposure.<sup>13</sup>

The list below is inclusive of common indoor environmental factors that have potentially negative side effects to the eyes.

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<sup>10</sup> Warner, Jennifer. "Taking the itch out of fall allergies." MedicineNet.com. Aug. 20, 2004.

<sup>11</sup> AZFamily.com. Accessed 10/24/2008.

<sup>12</sup> Brown, Nellie J. and Bruyere, Susanne M. "Causes of Poor Indoor Air Quality and What You Can Do About It." Employment and Disability Institute. Cornell University, 2002.

<sup>13</sup> "The Inside Story: A Guide to Indoor Air Quality."

U.S. Environmental Protection Agency Office of Radiation and Indoor Air, 2008.

- **Dust, mold, and allergies:** Individuals who spend time in damp and or dusty indoor environments, such as basements, attics, or warehouses, may experience ocular irritative symptoms such as itching, burning, dryness or tearing.
- **Airborne irritants in the home:** Many commonly used household cleaning products contain chemical agents that can irritate the eyes, producing burning, stinging and tearing. Some are caustic and can lead to harmful chemical injuries to the lids, conjunctiva, or cornea if accidentally splashed or sprayed into the eyes. Allergies to pet dander are a particular concern when pets are kept indoors.
- **Dry air conditions:** Dry indoor air and inadequate ventilation can exacerbate ocular allergy symptoms and dry eye states. A special case is the *sick office syndrome* or *sick building syndrome* where a combination of dry, poorly circulated air, improper ventilation due to closed windows or a lack of adequate ventilation, and airborne irritants from cleaning products, carpeting, or industrial solvents lead to both ocular and systemic problems in the office worker.
- **Overhead lighting and the potential for distracting glare indoors:** Inadequate or poorly directed indoor lighting can impair comfortable visual function and lead to asthenopia or eye strain which manifests itself through symptoms such as fatigue, red eyes, pain in or around the eyes, blurred vision, headache and occasional double vision. Fluorescent lighting is a common culprit in this regard. On the other hand, excessive or misdirected light from overhead lighting, windows, or other light sources can produce distracting glare. This distracting glare has the potential to create eyestrain, fatigue and headaches.

Eye disorders like computer vision syndrome can be further aggravated by indoor environmental factors such as improper lighting conditions or air moving past the eyes.<sup>14</sup> Inconsistent lighting can also impact an individual's ability to see well.

Attention to lighting and ergonomic factors can aid in eradicating glare and consequential ocular effects. The impact of these factors can be minimized through protective and sight enhancing eyewear as provided through an eyecare professional, in addition to controlling the visual environment.<sup>15</sup>

### **Varying Situations Worldwide**

Global footprints have been given much fodder in recent times, as it is estimated that it now takes the Earth one year and four months to regenerate what we use in a year.<sup>16</sup> Assessing the pressure being placed on the planet is done by measuring the global footprint of a population – an individual, city, business, nation or all of humanity. By doing so, it aids in managing ecological assets more wisely and allows for personal and collective action to be taken. On a global scale, it can be overwhelming to determine how a global community as a whole can impact the planet's delicate balance. More directly, we impact the environment immediately around us. Choices like where an individual lives and works, and even what

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<sup>14</sup> Rosenberg, Robert. "Lighting and the aging eye." Lighthouse International, Winter/Spring 1994.

<sup>15</sup> Rosenberg, Robert. "Lighting and the aging eye." Lighthouse International, Winter/Spring 1994.

<sup>16</sup> Global Footprint Network, 2008.

products are used in the home, affect the environment, and therefore contribute to the global footprint.

In industrialized countries the visually impaired may have greater access to basic or comprehensive eye care, and therefore may be more encouraged to seek treatment. Populations of developing countries lacking access to even the most basic medical care may limit the ability for individuals with ocular problems to have a lifetime of healthy sight. In cases where the environment is adversely contributing to eye health outside of an individual's control, it's even more important to offer education and support.

Certain countries often lack the same regulations by governing bodies that are imposed on industries in counterpart nations. For example, China's boom in coal production has equated to rapidly climbing cancer rates due to the pollution, which is thought to cause roughly 400,000 premature deaths annually.<sup>17</sup> It is in these particular situations that education about protection and ocular treatment should be offered.

Environmental factors, found both outdoors and indoors, heavily impact an individual's quality of vision. In this rapidly growing world, an individual's geographic location may prove to determine an individual's overall and eye health.

### **About the Healthy Sight Institute**

The Healthy Sight Institute is an educational and learning resource for health and vision care professionals worldwide. Supported by Transitions Optical, the Healthy Sight Institute is dedicated to the protection and preservation of healthy sight for all people.

As a dynamic knowledge center for professionals, the Healthy Sight Institute makes available a range of information and resources, including clinical papers, professional education courses and public education tools. Drawing on the expertise of its geographically diverse and multidisciplinary steering committee, the Healthy Sight Institute also provides a forum to educate and collaborate with health and vision care professionals, optical industry leaders, policy makers, and the public for a wider understanding of proactive and preventive eye care choices.

The depth of the Healthy Sight Institute's resources can be accessed through its official Web site at [www.healthysightinstitute.org](http://www.healthysightinstitute.org).

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<sup>17</sup> Kage, Ben. "Coal emissions blanket China with pollution." NaturalNews.com. Jan. 4, 2007.