Can natural light damage your eyes?

Yes it can!

Radiation emitted from the sun includes visible light, heat and ultraviolet (UV) radiation. The schematic below shows this range of the electromagnetic spectrum with the very small visible light range exploded to show the colours that we are able to see.

Even the colours of the rainbow sometimes hurt!

Visible light waves emitted by the sun are the only electromagnetic waves that we can see. We see these as the colours of the rainbow. Each colour has a different wavelength. Red has the longest wavelength and violet has the shortest wavelength. When all the waves are seen together, they make white light. When this radiant energy is light, at normal intensity levels, enters our eyes, and strikes the sensitive pigment cells on the retina - the light sensitive layer of cells at the back of our eyes - it causes a photochemical reaction in the specialised retinal cells known as photoreceptors, which manifests to us as the sensation of light or sight. Clearly a beneficial effect of the visible range of radiant energy to us is sight. However this visible range can also be damaging depending on its intensity. Too intense and it would result in potentially permanent damage of the retina's delicate photosensitive cells. Indeed this is exactly what happens when the sun is inadvertently gazed at directly, or an eclipse of the sun viewed directly without appropriate protection, causing a solar burn of the retina and often permanent damage to sight.

If your eyes are exposed to excessive amounts of UV radiation over a short period of time (acute exposure), you are likely to experience an effect called photokeratitis - “sunburn of the eye.”

So what exactly is Ultraviolet (UV)?

Ultra Violet means “beyond violet” since violet is the shortest wavelength of visible light and UV light is the next shortest. The UV region of the electromagnetic spectrum covers the wavelength range 100-400 nanometres (nm) (1 nm = 1x10⁻⁹ meter), and is divided into three bands: - UVA (315-400 nm), UVB (280-315 nm) and UVC (100-280 nm). Everyone is exposed to UV radiation from the sun. This radiation can affect our skin, eyes, and immune system, regardless of our skin colour. A small amount of UV however, is essential for the production of vitamin D, yet overexposure may result in detrimental acute and chronic health effects.

As sunlight passes through the atmosphere, all UVC and approximately 90% of UVB radiation is absorbed by the ozone gas which is found mostly in a region located in the stratosphere several miles above the surface of the Earth. Absorption of most UVB occurs due to atmospheric water vapour, oxygen and carbon dioxide. UVA radiation however is less affected by the atmosphere. Therefore, the UV radiation reaching the Earth’s surface is largely composed of UVA with a small UVB component.

Various factors in the environment affect levels of ambient UV light. Firstly, the higher the sun in the sky, the higher the ambient UV radiation level. Thus ambient UV radiation varies with time of day and time of year, with maximum levels occurring when the sun is at its maximum elevation, at around midday (solar noon) during the summer months. Secondly, the closer you are to the equator, the higher the ambient UV radiation levels. UV radiation levels are highest under cloudless skies. Even with cloud cover, ambient UV radiation levels can be high due to the scattering of UV radiation by water molecules and fine particles in the atmosphere. Thirdly, at higher altitudes, a thinner atmosphere filters less UV radiation. With every 1000 metres increase in altitude, ambient UV levels increase by about 10%. Although ozone absorbs some of the UV radiation that would otherwise reach the Earth’s surface, ozone levels do vary over the year and even across the day and thus may potentially affect levels of ambient UV. Finally, UV radiation is also reflected or scattered to varying extents by different surfaces, e.g. snow can reflect as much as 80% of UV radiation, dry beach sand about 15%, and sea foam about 25%.

Is there a simple measure of UV?

A gauge of ambient UV levels is given by the UV Index (see image below), which was established by the World Health Organization (WHO). The UV Index is a concise measure that factors in time of day and year, geographic location, weather conditions, and pollution. The UV Index is reported...
Therefore chronic UV exposure can change and damage cell structures and their content. Breaking bonds of protein molecules causes denaturation, resulting in opacification in the crystalline lens of the eye (i.e. causing cataract - a clouding of the eye's lens that can blur vision and will eventually require surgery to remove). Breaking bonds of protein (collagen) molecules in the skin, causes leatherness, and possible wrinkling. Alteration of specific molecules (e.g. DNA sequences) within cells can trigger irregular or abnormal cell replication and then the cells may become cancerous. Basal cell carcinoma is the most common type of skin cancer to affect the eyelids. These lesions most often occur on the lower lid, but they can occur anywhere on the eyelids, in the corners of the eye, under the eyebrows, and on adjacent areas of the face.

Excessive UV exposure also can suppress the immune system, thus making individuals more susceptible to infections. Additionally, UV exposure can trigger a re-activation of otherwise dormant conditions like cold sores.

Chronic exposure to environmental UV can lead to the development of Labrador keratopathy, which affects the cornea and can cause some loss of clarity. UV induced degenerations on the conjunctiva lead to the development of a pingoecula and eventually a Pterygium (an abnormal, but usually non-cancerous, growth in the corner of the eye emerging from the conjunctiva – this may require surgery to be removed if it affects vision). We know that patients taking certain medications which have a photosensitising side effect, including a whole range of widely used prescription medications, are at increased risk from UV radiation effects on the eye. These medicines make one more sensitive to UV and its effects. So check with your healthcare practitioner or pharmacist if you are taking any medications, regarding their photosensitising properties and take that into account when going out into the sunlight.

So what can you do to be safer when it comes to UV exposure?

Adopting some simple precautions as recommended by the World Health Organisation, can make the difference in terms of reducing the risk of damage from UV radiation. Shade, clothing and hats provide the best protection – applying sunscreen is necessary on those parts of the body that remain exposed like the face and hands. However sunscreen should never be used to prolong the duration of sun exposure.

- **Limit time in the midday sun.** The sun’s UV rays are the strongest between 10 a.m. and 4 p.m. So where possible, limit exposure to the sun during these hours.
- **Know the UV Index for the area you are in.** will help you plan your outdoor activities better to avoid overexposure to the sun’s rays and take special care to adopt sun safety practices when the UV Index predicts exposure levels of 2 or above.
- **Use the shade.** Shade when UV rays are the most intense, but keep in mind that shade structures such as trees, umbrellas or canopies do not offer complete sun protection. Remember the shadow rule: “Watch your shadow – Short UV, seek shade!”. 
- **Wear protective clothing and eyewear.** A hat with a wide rim offers good sun protection for your eyes, ears, face, and the back or your neck. Sunglasses that provide 99 to 100 per cent UV-A and UV-B protection, are distortion free and do not affect colour recognition will greatly reduce eye damage from sun exposure. UV not only enters the eye from the front of the lens by transmission through the spectacle lens, but also form the side, and by reflection from the back surface of the spectacle lens. Thus wrap-around frames with wide sides and special UV absorbing lens materials and UV blocking coatings on the lens surfaces are highly desirable. Some contact lenses also provide UV protection – so check with your contact lens practitioner and provider. High wave, loose fitting clothes will also provide better protection from the sun.
- **Use sunscreen.** Apply a broad-spectrum sunscreen of SPF 15+ liberally and re-apply every two hours, or after working, swimming, playing or exercising outdoors.

Most of the life-long UV exposure is accumulated in childhood when the risk of sunburn is greatest. Therefore protecting children against UV radiation is particularly important. Children and teenagers’ eyes are particularly susceptible to the sun’s damaging UV rays because the crystalline lenses of their eyes are more transparent than those of adults. Their more transparent crystalline lenses allow more UV radiation to reach the retina of the eye causing potential damage. The effects of UV radiation are cumulative, so it’s important to develop good UV protection habits early in life, such as wearing sunglasses with protection. Follow the simple recommendations about being safe in the sun detailed above, and choose UV blocking sunglasses that fit the child’s face and lifestyle that are large enough to shield the eyes from most angles. Make sure that the sunshades continue to fit well, are not damaged, and not out of shape and thus shrinking with use, and regularly adjusted to fit properly. A wide-brimmed hat for them to wear with the sunshades would be a good idea for greater protection.

Finally visit your eye care practitioner regularly for comprehensive eye examinations and for advice on all your eye care needs.