

High-Energy Visible Light

It is well known that prolonged exposure to ultraviolet (UV) light can damage the eye and adnexa, but what about high-energy visible (HEV) light? Research¹⁻³ suggests that prolonged exposure to HEV light emitted by artificial light sources may be harmful to the eye.

HEV light is at the lower end of the visible light spectrum (380-780 nm) and ranges from 380-500 nm (blue light). Because the wavelengths are shorter in blue light it has higher energy compared to compared to green, yellow and red light.

HEV light is all around us and is almost impossible to avoid in today's technologically advanced society. Outdoors we are exposed to HEV light from the sun, with HEV light comprising 25-30% of the sun's rays. Indoors we are exposed to HEV light emitted from luminescent light sources such as fluorescent bulbs and light-emitting diode (LED) screens (e.g. LED TVs, iPhones, computer screens). HEV light emitted from luminescent light sources ranges from 35-50%, which is significantly higher when compared to incandescent bulbs that emit only 5% HEV light. With the development of smart technology and phasing out of incandescent light sources we have drastically increased our exposure to HEV light in the home and workplace in an attempt to be more energy efficient and environmentally friendly, but at what cost?

Chronic exposure to HEV blue-violet light (415-455 nm) has been shown to have damaging effects to the retina and underlying retinal pigment epithelium (RPE).¹⁻³ Briefly, prolonged exposure to HEV blue-violet light induces accumulation and oxidation of the protein all-trans-retinal (ATR) in photoreceptors discs. Discs containing oxidized ATR are shed and engulfed by the RPE; however, oxidized ATR is not completely digested by the RPE and remains as metabolic waste (lipofuscin). Buildup of lipofuscin impairs proper functioning of the RPE and ultimately leads to cell death. Although accumulation of lipofuscin in the RPE is considered a natural process of normal ocular senescence, it also occurs in the early stages of age-related maculopathy. Whether chronic exposure to HEV blue-violet light accelerates the aging process in the retina in humans or increases risk of age-related maculopathy is unknown.

Fortunately, all visible blue light is not harmful. Regular exposure to visible blue-turquoise light 460-500 nm range (longer wavelength = less energy) is important for entraining the Circadian sleep/wake cycle and is essential to our vision and pupillary reflex.⁴

The damaging effects of chronic exposure to HEV blue light can be

combated by eating a healthy diet rich in anti-oxidants; daily supplementation with Vitamin C and E; reducing time spent looking at cell phones, laptops, and TV screens; and coating spectacles with high-energy blue light filter (e.g. Crizal Prevencia).

References

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