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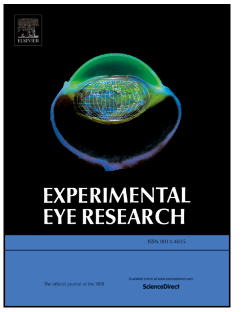

Solar ultraviolet radiation cataract

Stefan Lofgren

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Introduction

Ultraviolet radiation has long been known to cause disease in humans. When UV radiation was identified in the 19th century it was soon evident that UV radiation induces skin erythema. Widmark (1891) showed that a pig lens could protect the skin against UV erythema and that UV radiation damages lens tissue (1901). Lens transmittance studies have shown that the human lens transmits very little UV radiation to the retina, and that the protective efficiency vary with age and degree of lens yellowing (Boettner & Wolter 1962). With the advent of modern epidemiology many authors showed an association between solar UV radiation and cataract, especially UVB radiation and cortical cataract (Cruickshanks et al., 1992, Taylor et al., 1988). Action spectra for lens or cell damage from UV radiation have been presented for various models, such as rabbit (Pitts et al., 1977), rat (Merriam et al., 2000), and human lens epithelial cells (Andley & Weber 1995). Man-made UVR sources are of a less concern because of well-known regulations for personal protection in the workplace. The major UV absorbing molecules in the lens are aromatic amino acids and kynurenine (Taylor et al., 2002, van Heyningen, 1971) and advanced glycation end products (Ortwerth et al., 1997). Most UV studies cover UVB radiation but the potential action of UVA radiation in producing nuclear cataract has attracted increasing interest (Giblin et al., 2002).

Epidemiology

A lifetime high ambient UVR exposure in southern France was associated with an increased risk for cataract extraction (odds ratio 1.53; 95% confidence interval, 1.04–2.26; p= 0.03). The UVR data were extracted from the Eurosun UV database (Delcourt et al., 2014). Zhu et al. (2015) found that disability-adjusted life year (DALY) rates of cataract were higher in regions with higher ambient UVB radiation levels. In contrast to these two studies, Storey et al (2013) saw a discriminatory effect of solar UVB radiation on type of cataract, with a correlation between UVB radiation and cortical but not nuclear cataract. Yu et al. (2016) found a higher prevalence of cataract in a rural population at high altitude compared to those a lower altitude. Cortical cataract was most prevalent at low altitude while the mixed type dominated at high altitude. The prevalence of nuclear cataract was similar at both locations. In contrast, El Chehab et al. (2012) identified high altitude as a risk factor for anterior cortical cataract. The reason for the discrepancy between the two altitude studies is likely different albedo environment, causing a difference in ocular exposure that negates the effect of altitude. Glutathione S-transferase omega-2 polymorphism is associated with increased risk for cataract and enhanced susceptibility to oxidative stress. This group of patients can be identified by genotyping and might be subjected to individualized antioxidant treatment (Stamenkovic et al., 2014).

Lens UV radiation transmittance

There is a considerable variability in human lens transmittance in the UV radiation and visible light range, and the transmittance window around 320 nm previously showed by Boettner & Wolter (1962) does not disappear completely in some people (Artigas et al., 2012). Human lenses have a gradient in the UV absorption, with higher absorbance in the posterior parts of lens, as measured in cryosections (Pajer et al., 2013). A decreasing anterior-to-posterior gradient was found for