



**RANZCO**

The Royal Australian  
and New Zealand  
College of Ophthalmologists

# Blue Light and Digital Screens

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**Approved by:** RANZCO BOARD

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## **1. Purpose and scope**

This position statement was developed by The Royal Australian and New Zealand College of Ophthalmologists (RANZCO). The purpose of the statement is to improve public awareness about the effect of Blue Light and Digital Screens on the eyes.

## **2. What is blue light?**

The optical part of the electromagnetic spectrum includes radiation with a range of wavelengths. Very short wavelengths (100-400nm) are called ultraviolet, visible light has short wavelengths (blue light) of 400nm through to long wavelengths (red) 760nm. The longest wavelengths are known as infrared (760+nm). The shortest wavelengths have the highest energy and therefore potentially more likely to cause biochemical damage to tissue. Although people often associate blue light with computers and phones, the largest source of blue light is sunlight. Other sources include fluorescent light, compact fluorescent light bulbs and LED light.

## **3. How does the eye naturally protect itself from light damage?**

A number of factors will affect how much light is absorbed or scattered on its way through the eye and whether tissue is damaged. The cornea and lens absorb most UV light before it travels any further into the eye. However, a small amount does get through along with the visible spectrum (short wavelength blue light to long wavelength red light) and some infrared will travel through clear ocular media to the retina. The macular pigments (zeaxanthin, lutein, and meso-zeaxanthin) absorb 40% of the high energy (short wavelength) light to protect the retina.

## **4. What are the effects of blue light radiation on the eyes?**

There are some situations where environmental light damage to the retina is well-recognised, such as on sun-gazing during a solar eclipse and long-term UV exposure from sunlight has well-documented damaging effects on the eye (1-3). However, currently there are no documented studies to suggest normal environmental exposure specifically to blue light causes damage to eyesight. Animal studies have generally used intensities and durations of light exposure that would rarely occur in normal life although some experimental evidence is emerging that repeated exposure at lower intensities may be more harmful than a single brief exposure (4). For example, Moon et al showed that exposure of cultured retinal pigment epithelium cells to light equivalent to that emitted from mobile display devices causes free radical production and reduced cell viability (5). However, in life these cells are not directly exposed to blue light and extrapolation to real life exposure in humans may not be possible. In a further study Ratnayake et al showed that blue light-excited retinal can influence signalling in the plasma membrane of living retinal cells, which could significantly influence retinal cellular physiology. However, the study used HeLa cell line and very high intensity blue light so is likely not representative of what might occur during exposure to the much lower intensities of digital screens (6).

Shang et al showed damage occurred to the retina of albino rats exposed to long durations of white and blue LED lights placed at 20cm for 12-hour periods over durations 9-28 days (7). The damage was considerably less in rats exposed to compact fluorescent light, which have lower blue light emission. Again, it is unclear if this experimental animal data can be correlated to human light exposure.

## **5. What are digital screens?**

A digital screen uses light emitting diodes to display an image and filters govern the colour of light perceived from each pixel (pixel=picture element; a screen is divided into thousands of pixels). All computers, tablets, smartphones use digital screen technology. Many white LED products available use a blue LED pump with yellow phosphors, which leads to a distinct blue peak in their spectral power distribution (8).

## **6. How does using digital screens affect the eyes?**

The amount of radiation coming from a computer has never been demonstrated to cause any eye disease. Studies have found no measurable UVA or UVB radiation from computer monitors (9). It should be noted that UV radiation is the most harmful part of sunlight for eyes and skin. Recently there has been concern about the use of digital screens on the health of the eye and there is concern that the blue light (which is different to UV light see section 2 above) emitted from these screens may be harmful. Some authors have measured output from some of these devices to inform risk to the eye and found that computer screens and smart phones have a very low level blue light radiance being about <0.5% of the luminance level that the International Commission on Non-Ionizing Radiation Protection consider safe (10). Evidence obtained from different experimental models indicates that exposure to blue light in the 470–490 nm range may be less damaging to the eye compared to blue light in the 400–460 nm range. Thus, LEDs with a peak emission of around 470–490 nm may be relatively safe. (11).

## **7. What is “digital eye strain”?**

When concentrating for long periods whether at a printed page or computer screen we tend not to blink as often. This can lead to dryness of the ocular surface and make the eyes feel tired. Some people may also have trouble adjusting focus from near to far after spending a long time on near tasks. Regular breaks when reading and using digital devices can be helpful to reduce these symptoms.

If symptoms of digital eye strain do not settle with these simple measures it is important to get checked by an eye healthcare professional to ensure health of the eyes and that correct reading glasses are being worn if required.

## **8. What are the general health effects of light from digital screens?**

It is becoming increasingly apparent that blue light levels from screens can have an effect on circadian rhythms (sometimes known as the biological clock). There are specific cells in the retina of the eye that respond best to blue light and these cells contribute to signals controlling the biological clock. Evidence from animal models have linked altered ocular circadian rhythms to altered ocular growth rates and myopia development. In humans, nighttime exposure to light in the blue spectrum might have the most deleterious consequences, as it has maximal effects on the primary circadian photoreceptors, the ipRGCs (12,13).

Blue light is beneficial during daylight hours because it boosts attention, reaction times, and mood but is disruptive at night. Melatonin is a neurohormone that regulates sleep. Experiments comparing the effects of exposure to blue light with exposure to green light show that blue light suppresses melatonin for about twice as

long as the green light and shifts circadian rhythms by twice as much (3 hours vs. 1.5 hours) (14). Studies have also shown that blue light in the range of 470–490 nm is more effective compared to monochromatic light of 555 nm in phase-shifting the human circadian clock (15,16). A recent study reported that exposure to light-emitting e-readers at bedtime may negatively affect sleep and the circadian system. This study also showed that using a digital screen for 4 hours before bedtime suppressed evening levels of melatonin by  $55.12 \pm 20.12\%$ , whereas the print-book reading showed no suppression ( $-18.77 \pm 39.57\%$ ) as measured during the fifth night (16). Conversely experiments using blue-light blocking (amber) spectacles can impede the capacity of bright light to suppress melatonin production and might be helpful for shift workers (17).

## **9. What is the evidence to support use of blue light blocking filters to protect the eyes?**

A recent laboratory study has examined the effect of using blue light absorbing filters on the viability of retinal pigment epithelial cells. The results demonstrated evidence for the damage of white light to RPE cells and the protective effect of a blue light absorbing filter, after 3 light-darkness (12 hours/12 hours) cycles. In cells exposed to white LED light, the filter provided a reduction in light transmission of 22%, that resulted in an 89% decline in apoptotic cells, an 81% reduction in DNA damage and an 11% increase in cell viability (18). It is not possible to directly relate these results to what might happen in the human eye as there are natural protective mechanisms in the human eye not employed in this laboratory study.

A review of current literature has concluded there is little evidence with respect to using blue light blocking spectacles to improve visual performance (19). In addition, there are no studies showing such filters can conserve macular health. It should also be noted that avoiding all blue light may have unwanted effects as there is some weak evidence that blue light is useful in the daytime to improve concentration and mood (20). Blue-light blocking filters have been incorporated into some intraocular lenses used in cataract surgery. The merits or disadvantages of these is beyond the scope of this position statement but might form part of future statements.

## **10. Australian Standards**

There are currently no specific Australian standards for Blue Light filtering glasses or screen protectors.

## **11. Recommendations**

No evidence exists to suggest that normal environmental exposure to blue light, including those from digital screen technology, causes damage to eyesight. Filtering out the blue light from screens is not necessary in general use. There may be a benefit to reducing screen time in the evening or using night-time settings on screens in the few hours before bedtime to reduce interruption to circadian rhythms. General measures to reduce symptoms of eyestrain include taking regular breaks and focussing on distance objects from time to time as well as ensuring spectacles, if worn, are appropriate for the task. It is recommended to consult a health care professional if symptoms of eyestrain persist.

## 12. Position statement details

This position statement was developed RANZCO and published in October 2019.

## 13. References

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**14. Record of Amendments**

<b>Page</b>	<b>Details of amendment</b>	<b>Date approved</b>
Nil	Nil	Nil