

Blue Light Introduction

Light has been around since the beginning of time and is often overlooked as a necessity to life, especially in today's modern society. However, light is far more complex than the average person may suspect. It is comprised from the electromagnetic spectrum, which is made up of different wavelengths, each giving off its own amount of energy. The lower on the spectrum, the shorter and more abrupt the wavelengths of the light and, in correlation, the more energy that light has. Sunlight, for example, includes both visible light and ultraviolet (UV) light. UV rays have the shortest wavelengths and highest energy of the spectrum, and it has been well documented that these high-energy wavelengths can be damaging to the body. Some visible light can cause damage, as well. Visible light ranges from red, orange, yellow, green, blue and violet, and there has been more and more information emerging about the potential damages of a specific range of the visible spectrum: blue light.

What is blue light?

Visible light starts at 380 nm (violet light) and reaches up to 780 nm (red light). Blue light is at the lower end of the spectrum, meaning it has shorter wavelengths and more energy than most of the visible spectrum. Blue light, just as the electromagnetic spectrum, includes variations and ranges from blue-violet light (415 nm to 455 nm) to blue-turquoise light (465 nm to 495 nm). Research conducted by Essilor and Paris Vision Institute in 2008 found that blue-violet light causes the most damage, specifically to the eye, whereas blue-turquoise light is beneficial to human health in moderation.

Where does harmful blue light come from?

In the past, blue light could only be found in sunlight, but with the increase in technology, it's more prevalent than ever before. "Blue light is something we're getting exponentially more exposed to because of our transition to a digital lifestyle," noted David Friess, OD. Blue light can be found in energy efficient lighting like compact fluorescent lightbulbs (CFLs) and LEDs, flat screen TVs, smartphones, laptops, tablets and e-readers.

On top of the endless ways to be exposed to blue light, the duration of society's exposure has increased, too. Studies show that:

- 90% of the country uses digital devices for 2+ hours a day, while 60% use them for 5 or more
- 76% checks devices before going to sleep
- 56% uses a digital device to read instead of a paper book, magazine or newspaper
- On average, Americans spend 4.5 hours a day watching TV
- About 90% of all lighting will switch to LED by 2020

The amount of blue light prevalent in daily life will continue to grow exponentially. Thomas Gosling, O.D., worries about the constant exposure in the new digital era, saying, "Now there's nowhere to hide from blue light. We're surrounded by high-energy light bulbs all over our homes... We're staring at our computers and our smartphones. Practically the only way to get away from it is to be in the dark."

What does this increase in blue light mean?

Blue light continues to be studied to find its cumulative effect, and it has been discovered that it affects many different aspects of the body, including circadian rhythm, mood and cognition. Research has shown that eye health is one of the areas of the body most directly affected. One study suggests that exposure to blue light releases chemicals that cause oxidative stress in the retina. Oxidative stress can lead to retinal pigment epithelium (RPE) being damaged and/or dying, which can eventually lead to photoreceptors, like rods and cones, misfiring and dying as well. Reflecting on the seriousness of this cell death, Geoffrey Goodfellow, OD stresses, "These are irreparable, permanent, visually debilitating problems that cause people to lose vision."

The body has a natural filter of blue light called macular pigment, found in the center of the retina. This pigment absorbs blue light and helps protect the rods and cones, as well as a third type of photoreceptor called intrinsically photosensitive retinal ganglion cells (ipRGCs). These ipRGCs cells have been linked with non-visual functions like melatonin regulation, cognitive performance and body temperature, and they contain melanopsin, a photopigment that is specifically blue light sensitive. But the more exposure to blue light a person receives, the more this protective pigment breaks down. A breakdown can lead to the previously mentioned cell damage, leading to age-related macular degeneration (AMD) and, potentially, blindness. The number of those affected with AMD is expected to double and reach over 5 million by 2050, and advanced AMD is a leading cause of irreversible blindness and visual impairment throughout the world.

Along with diseases like AMD, blue light has also been shown to cause more overall eye strain. Blue light scatters more easily than the rest of the visible spectrum, causing it to be more difficult to concentrate. This causes digital screens and other sources of blue light to be more difficult to focus on, especially for long periods of time, and causes eye strain. VSP Global's survey of the group's eye care providers found that 82% reported an increase in patients experiencing eye strain and other effects of blue light exposure, proving that this range of light has already begun to affect the population. "Think of children," pleads Dr. Gosling, "with their pristine lenses, huge pupils and short arms. I wonder what the long-term effect is to them."

How can we avoid the harmful effects of blue light?

There are many different options available in the marketplace today that can help diminish the effects of blue light:

- Screen protectors
- Amber-tinted glasses
- Special filters/coatings for corrective lenses
- Special blue light protective lenses
- Drug-eluting lenses (type of contact lens)
- Supplementation

There are steps that can be taken as eye care professionals as well. Start the conversation with patients, asking about their lifestyles, their occupational demands and their risk for AMD. You can then suggest any of the above-mentioned solutions to reduce the effects of blue light. There are several lifestyle changes that can also help reduce the effects:

- Take frequent breaks from digital screens
- Change display settings on devices to include more yellow light
- Increase working distance
- Limit screen exposure 2-3 hours before bed

For patients who rely on digital screens throughout the day, the 20-20-20 rule is a great option: take a 20 second break every 20 minutes and look at something 20 feet away.

Recent science has proven that blue light can negatively affect many different aspects of a patient's life. As society continues to adopt new technologies and devices, furthering both practice and patient awareness of the potential dangers of overexposure is essential in providing the best vision care possible. Taking precautionary action will enable eye care professionals to prevent the damage caused by blue light; while informed patients will help doctors to more successfully identify eye strain caused by blue light and devise plans best-suited to each patient's lifestyle needs.

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