

Issue At A Glance:

Blue Light Exposure

Exposure to artificial blue light has been increasing with rising electronic use. In light of October 10 being Blue Light Awareness Day in California, this brief reviews the health effects of artificial blue light and interventions to decrease exposure.

Introduction

Electronic usage has drastically increased globally, with the United Nations Trade and Development reporting 1.2 billion smart phone shipments in 2023—more than double that of 2010.¹ For Americans specifically, the most recent 2024 Pew Research Center Report revealed that 95% of adults use the internet, 90% own a smartphone, and 41% report being online almost constantly.² The pandemic also spurred an increase in daily screen time for U.S. teenagers on smartphones, with an average use of 5 hours per day.³ In fact, a similar Pew Research Report showed nearly half of teens say they are also online almost constantly, up from 24% a decade ago.⁴

Electronic devices—especially smartphones—use primarily LED lighting. LED lighting emits prominent blue light that peaks at 450 nm., which is double in intensity compared to other wavelengths.⁵ Most smartphone visible light display is around 12% of the blue light wavelength.⁶ As technology has advanced, more devices are used at home, leading to increased daily LED lighting. The most recent data in 2024 reported that teens now have access to a smartphone (95%), desktop or laptop computer (88%), gaming console (83%), or tablet computer (70%) at home.⁴ Given the data, it is safe to infer that teens and adults are exposed to more artificial blue light now than a decade prior.

Blue Light Filtered Glasses

- Glasses (both prescription and nonprescription) that offer blue light filters have a wide range of filtration, from **6 to 43% reduction of blue light**.⁷
- There currently appears to be **no standardized method or consensus for blue light filtration for glasses**.⁷
- **The lens tint, not the chemical coating over the lens, seems to offer the greatest impact on blue light reduction**, with red and orange tinted lenses only allowing 0.62 to 2.32% of blue light transmission.⁸
- **Orange tinted lenses seem to offer the best visual transmission** by blocking blue light but also allowing for more non-circadian-proficient light.⁸

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Effects On Circadian Rhythm and Sleep

Blue light is not inherently unhealthy. In fact, prior to the dawn of technological advancement, the majority of blue light exposure came from the sun, with daytime peaks that have continued to provide humanity with increased attention, improved reaction times, and positive effects on mood.⁹ Natural blue light also helps regulate and influence our circadian rhythm, which is the process by which we wake and sleep in a 24 hour period, as blue light levels drastically decrease at nighttime without sunlight.⁹ However, with the introduction of artificial blue light from LED use even at night, the natural circadian rhythm is disrupted.⁹

There is significant evidence from multiple studies that demonstrate light emitted from LEDs affects human cerebral functioning, with shorter wavelengths (e.g., blue light) specifically inducing an excitatory effect.^{10,11} Blue light also activates the retinal ganglion cells in the eyes, which directly affects the circadian rhythm.¹¹ As such, blue light affects our natural sleep-wake cycle, with evening exposure shortening the circadian rhythm.¹² Even more alarming, even at low light levels at night, this shortening of time was true regardless of whether or not the eyes were open.¹² As a result, the American Academy of Ophthalmology (AAO) has voiced significant concern regarding LED exposure 2 hours prior to bedtime due to negative effects of prolonged time to sleep (known as increased sleep latency), decreased melatonin secretion, and reduced next-morning alertness.^{10,12,13} Once the blue light exposure stops, however, melatonin production seems to resume back to normal levels, indicating the likelihood of sleep initiation difficulties possibly due to cerebral stimulation.¹⁴

One of many circadian rhythm sleep disorders is delayed sleep-wake phase disorder (DSWPD). DSWPD most commonly presents in teenage years with likely progression into adulthood.¹⁵ People with DSWPD tend to not get enough adequate restful sleep and, as a result, have difficulties getting to work or school on time, leading to disruptions in career or education while also being associated with depression and personality disorders.¹⁵

Risks of Teenage Sleep Deprivation

Motor vehicle crashes are a leading cause of death for those aged 15-20 years old, as fatalities among young drivers have increased by 25% since 2014.¹⁶ For teenagers and young adults under 24 years old, getting less than 6 hours of sleep per night has been associated with an increased risk for a crash.¹⁷ In fact, from 2017-2021, 17.6% of drivers that caused a fatal crash were drowsy, with drivers aged 16-20 years old making up the greatest proportion.¹⁸ Teenagers are most active on their phones from 8-10 pm, with minimal activity only during 2-5 am.³ Sleeping cannot occur when one is active, leading to the hypothesis that teenagers may only be getting 3 hours of restful sleep per night, indicating severe sleep deprivation.³



Interventions to Decrease Blue Light Exposure

Policy Interventions

Several bills targeting blue light exposure have been introduced in the California Assembly in the past.¹⁹ However, they did not progress through the legislative process to be enacted. Currently, at the time of this brief, there is no state law proposed or enacted regarding regulation of blue light exposure.

However, there is one state resolution currently in place regarding blue light exposure. California Senate Concurrent Resolution 73 (SCR 73) was sponsored by Senator Richard Pan in 2019 and passed unanimously. SCR 73 designated October 10th of each year as Blue Light Awareness Day. The resolution, which is not enforceable, voices concern about blue light exposure and the potential association with retinal damage. It also encourages Californians, especially children, to limit exposure to LED screens and consider protective measures.²⁰

Despite lack of state-level policy, many local jurisdictions have enacted policy to protect against blue light exposure at night. Such legislation focuses specifically on restricting LED color appearance and operational uses at night. LED color lighting is in units of Kelvin, which is a misnomer as it is not actually temperature but the hue of LED lighting. Warmer, yellow light is at or below 3000-K, while colder, blue light is at or above 5000-K.²¹ Goleta, Thousand Oaks, and Palo Alto all have policy ensuring LED lighting color stays at or below 2700-K.^{21,22,23} All three also focus on regulating outdoor lighting, shielding, glare, and operational hours of lighting at night.^{21,22,23}

Currently, federal policy is bare. HR 8800, known as the National Defense Authorization Act for Fiscal Year 2027, sets forthcoming policies, programs, and funding for the Department of Defense. HR 8800 was

passed by the House of Representatives on July 22, 2026, and currently remains subject to further Senate action. The House-passed version includes Section 763, which proposes a pilot program for blue light dissipating displays. However, this measure is only for military personnel, not the general public.²⁴ There is currently no other federal policy proposed at this time to address blue light exposure.

Technological Interventions

New technology has allowed for decreased blue light in LED displays. For example, Apple and Android have both incorporated built-in display controls that can automatically shift to warmer, darker colors at night.²⁵ In addition to modifying LED displays, Samsung has developed OLED technology that uses less light in general by activating individual pixels.²⁶ By requiring less LED light, blue light exposure is indirectly lessened. Besides light modifications, there have also been blocking or filtering advancements. Professional tinting of glass lenses has been developed to block or filter blue light (see gray box on page 1). However, without a standardization method across models, much variability exists in recorded blue light blocked by these lenses.^{7,8,25,26}

Individual Interventions

The CDC and AAO recommend evidence-based behavioral interventions to decrease blue light exposure at nighttime. Recommendations include having the bedroom as dark as possible by using blackout curtains, avoiding LED screens 1-2 hours prior to bedtime, and having a standard alarm clock in the bedroom instead of the phone. Also, it is important to have adequate natural sunlight exposure in the morning and daytime to facilitate normal circadian rhythm.^{27,28}

Conclusion

Blue light exposure through LED use is dramatically increasing globally. Research reveals blue light exposure at nighttime can significantly disrupt the circadian rhythm, leading to sleep deprivation. Currently, there is little state, federal, and local policy to combat this growing issue. Though technological advancements and behavioral interventions can be utilized, it is not enough. Further policy should be enacted to ensure safe use of LED devices to minimize negative health impacts.

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Did you know?

There have been two prior proposals to limit outdoor blue light from LEDs at nighttime in California. AB 2382 was introduced in 2021 and passed legislature in 2022; however, it was subsequently vetoed by Governor Newsom. AB 38 was introduced in 2022 but was never passed.¹⁹



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