



Impact of Blue Light on Sleep

Lakshmi Aniruddh Mukkamala



Abstract

Wellbeing for a person overall is key to growth both physically and mentally, and sleep is one of the main sources of energy to keep a person's wellbeing consistent. A person's physical and mental development depends substantially from their teen to young-adult years. Furthermore, sleep is universally agreed upon to be beneficial no matter the person. One reason for this might be the belief that a good night's sleep is the foundation for good performance (Silvani et al., 2022). Blue light is far more accessible in today's world than before, and because of that, it is a versatile tool, and may be used for many different purposes.

The surge of device usage in the modern world has led to multiple differences in human function, mainly being sleep. The media and many other sources consider the negative outcomes of blue light, yet the positive outcomes are usually left behind. The goal of this study investigated how prolonged exposure to blue light impacts sleep quality in teenagers and young adults.

Google Scholar and PubMed were the two main search engines used to research through a boolean search of “((blue light) AND (sleep) AND (high school))” and “OR ((college) AND (young adults))”, giving 18,728 results. After screening and eligibility, ten articles were selected.

Ten articles were selected after general search and screening. The majority of selected articles indicated that both sleep quality and duration increase with lower amounts of blue light. Similarly, literature review indicated that greater amounts of blue light increased alertness, sleep latency, and cognitive functioning.

Blue light has rewarding benefits as evinced by positive effects on cognitive function. However, there appears to be a tradeoff, as blue light exposure can have negative effects on sleep quality, duration, and sleep efficacy.

1 Introduction

In the 21st century, personal computers and smartphones have become widely used in modern society (Ishizawa et al., 2021). The everlasting rise of technology has brought in the exposure of blue light. Over the years, multiple studies have been conducted, the majority representing a darker outcome of human activity, mainly sleep. Blue light is a powerful environmental stimulus that can produce significant phase shifts in the circadian rhythm of melatonin and sleep propensity, as well as acute effects on alertness of neurobehavioral performance (Killgore et al., 2022). While humans have interacted with multiple devices over the course of more recent years, it soon led to prolonged exposure of blue light, and overtime gathered a negative reputation. Furthermore, the human body has various mechanisms that demonstrate how exposure of blue light affects sleep quality (Abdulazeem et al., 2024). Blue light exposure is a subject that hasn't managed to capture as much attention compared to other subjects, due to holding the negative reputation upon multiple researchers across the world. The many negative effects of prolonged blue light exposure have been shown through other articles, but few have investigated the brighter outlooks that blue light may offer. The main question I tackled was how frequent exposure to blue light can affect teenagers and young adults through their sleep. Many studies have hypothesized that blue light comes with negative effects, but this study aims to understand specific ways that blue light impacts sleep-related health. This study hypothesized

that prolonged exposure of blue light to teenagers and young adults have negative effects when it comes to quality of sleep.

2 Methods

The main parameters that determined eligibility were publication dates from 2000-2025 and the removal of abstracts for the given domain.

The two domains that were used to locate articles were by PubMed and Google Scholar. From PubMed, we considered the two main criteria in order to find articles to conduct the study, and then searched for the first few articles. One factor that PubMed offered that was heavily useful was a boolean search. When searching for research articles, PubMed has an advanced search engine, and when using this engine, it uses both AND and OR functions for what we wanted to search. The two main groups that were used in the boolean search consisted of the main effects of blue light, “((blue light) AND (sleep) AND (high school))”, and the age group, “OR ((college) AND (young adults))”. The reason that “high school” is part of the first group and not the other is because it is the primary age group for this research. In total, PubMed offered 228 results, and Google Scholar offered 18,500 results.

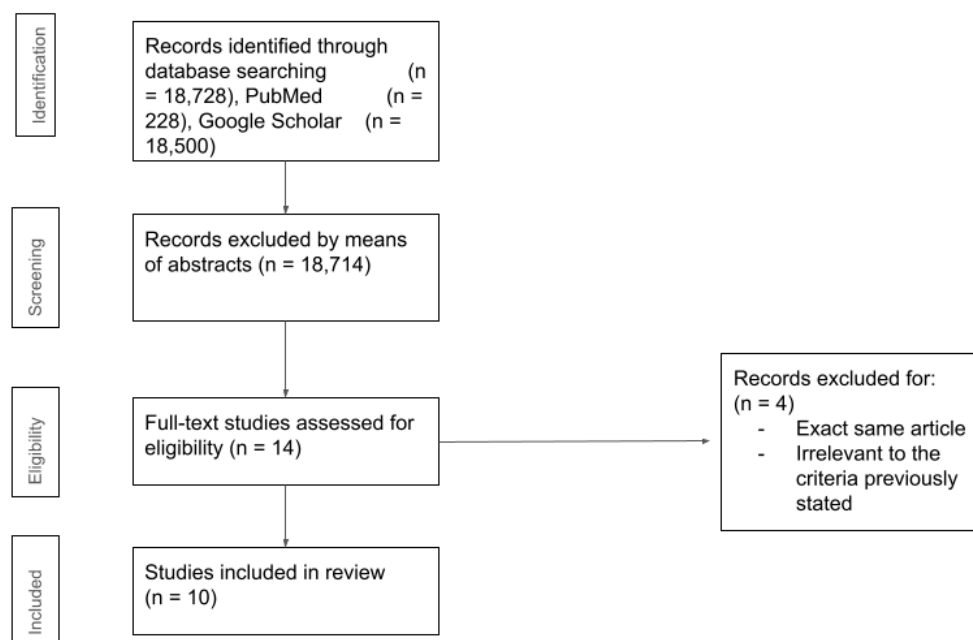


Figure 1. (Flowchart of data collection)

3 Results

After searching for articles in both PubMed and Google Scholar, the initial total was 18,728. From skimming through both titles and abstracts, a total of 14 articles were used for the case of this study based on reviews and other studies revolving around the same subject. The last screening step through the texts of each article resulted in 10 articles to skim through, crossing off articles that were identical and spoke of the same thing or a subject that was out of range from the main goal. Google Scholar resulted in a total of 6 articles and then PubMed with a total

of 4. From reading through all 10 articles, 5 key findings were highlighted for each (Table 1). Most held recurring themes, helping to elucidate the key findings regarding blue light exposure.

Table 1.

Article	Country	Mean age of participants	Study objective	Design	Key findings
Silvani et al. (2022)	Switzerland	26 (SD not reported), n = 458	Look at how blue light influences sleep in the general population	Systematic review	<ul style="list-style-type: none">• Blue light is associated with more tiredness• Sleep quality increased in areas with less blue light and decreased in areas with more blue light• Sleep duration increased with early exposure and decreased with late exposure• Sleep efficacy decreased with exposure• Sleep latency increased when exposure occurred in later hours
Killgore et al. (2022)	United States	22, SD 2.8, n = 29	Determine whether blue light exposure increases connectivity between the dorsolateral prefrontal cortex (DLPFC) and areas linked to alertness	Experimental	<ul style="list-style-type: none">• Blue light exposure increased alertness• Prolonged exposure affected resting-state brain activity• Mood was affected, mostly in a positive direction• Retention and working memory increased with exposure• Resting heart rate increased more under blue light than under amber light

Article	Country	Mean age of participants	Study objective	Design	Key findings
Studer et al. (2019)	Germany	15 (SD not reported), n = 28	Study how blue light usage affects sleep quality in adolescents	Experimental	<ul style="list-style-type: none">• Blue light exposure produced longer sleep latency than red light• Body movements during sleep were more frequent than under red light• Blue light held attention more effectively than red light• Sleep latency was reduced when exposure occurred later in the day• The effects of blue light were stronger in the morning
Ishizawa et al. (2021)	Japan	21, SD 1, n = 11	Study whether blue light alters sleep time, sleep quality, light sleep, deep sleep, body movement, and temperature	Experimental	<ul style="list-style-type: none">• The ratio of deep sleep to total sleep time was reduced by blue light exposure• Overall sleep quality declined with exposure• Body movements during sleep were more frequent after exposure• Deep sleep duration was shortened• The study reported three separate measures, each tied to a single sleep variable
Choi et al. (2019)	South Korea	24, SD 0.87, n = 15	Test whether blue light and other light types affect melatonin levels and the circadian system	Experimental	<ul style="list-style-type: none">• Blue light can counter drowsiness during the day• Repeated exposure increased alertness over time• Blue light reduced salivary melatonin,

Article	Country	Mean age of participants	Study objective	Design	Key findings
					<p>measured through saliva samples</p> <ul style="list-style-type: none"> • Blue light reduced drowsiness in low-sunlight settings • Exposure decreased melatonin production regardless of time of day
Randjelovic et al. (2023)	Serbia	21 (SD and n not reported)	Investigate how blue light affects sleep quality in students	Experimental	<ul style="list-style-type: none"> • Reducing use of devices that emit blue light improved sleep quality • Morning blue light exposure from devices improved daytime functioning • After the intervention, the same group shifted toward better sleep quality • Backlit device use was linked to increased sleep latency • Sleep quality decreased with exposure to artificial light at night (ALAN)
Jniene et al. (2019)	Morocco	Not reported	Study whether late night-time blue light exposure is as detrimental as exposure earlier in the day	Not reported	<ul style="list-style-type: none"> • Blue light exposure was linked to a worse overall sleep schedule • Nighttime device users with a light source present reported different outcomes than those without • Blue light exposure was linked to increased fatigue and headaches • Sleep disturbances were more frequent following blue light exposure

Article	Country	Mean age of participants	Study objective	Design	Key findings
					<ul style="list-style-type: none">• Poor sleep quality was linked to nighttime device use
Abdulazee m et al. (2024)	Saudi Arabia	19, n = 485 (SD not reported)	Assess how blue light-emitting devices (BLEDs) used at bedtime relate to sleep quality in medical students	Experimental	<ul style="list-style-type: none">• Blue light exposure that lowered sleep quality also disrupted everyday routines, such as morning schedules• Increased exposure was linked to more irritability from lost sleep, along with headaches• Poor sleep was linked to increased anxiety• Late-night social media use on blue-light devices was linked to a lower chance of falling asleep• Blue light device use in dark rooms was linked to less sleep and longer sleep latency
Souissi et al. (2025)	Tunisia	15.1, SD 0.92, n = 16	Clarify the timing relationship between nighttime blue light exposure and sleep quality	Experimental	<ul style="list-style-type: none">• Nighttime blue light exposure affected sleep patterns and circadian rhythm• Exposure was linked to changes in working memory• Blue light exposure was linked to faster cognitive processing• Nighttime exposure was linked to weakness over time• More exposure was linked to longer sleep latency

Article	Country	Mean age of participants	Study objective	Design	Key findings
Viola et al. (2008)	United Kingdom	36.4, SD 10.2, n = 94	Report how blue light exposure affects alertness, performance, and related measures	Experimental	<ul style="list-style-type: none">• Blue light exposure later in the day was linked to headaches• Daytime exposure was linked to reduced drowsiness• Increased exposure was linked to more eye strain• Daytime blue light was linked to better attention and alertness• Daytime exposure was linked to better nocturnal sleep than nighttime exposure

Sleep quality

After reviewing through all articles, the first study showed how the recession of blue light usage overall leads to a higher quality of sleep (Randjelovic et al., 2023). Another study noted the usage of blue light in different geographic areas, where non-blue light areas showed an increase in resident sleep quality compared to higher blue light areas (Silvani et al., 2022). One other study showed how the overall exposure of blue light not only resulted in a negatively impacted sleep schedule, but also indirectly impacted regular everyday actions (Abdulazeem et al., 2024). Results from three of the ten studies suggested that overall exposure of blue light negatively changed the quality of sleep, as well as impacted everyday actions.

Sleep duration

One study reported that blue light exposure in the early hours of the day resulted in a longer sleep duration compared to exposure in later hours, which resulted in a shorter duration (Silvani et al. 2022). One study reported that exposure from daylight hours resulted in better sleep (Viola et al. 2008), whereas another study reported that exposure in a room with no light resulted in less sleep (Abdulazeem et al. 2024). Another study reported that deep sleep is not only shortened, but the ratio of deep sleep to total sleep time is cut short due to exposure of blue light (Ishizawa et al. 2021). From these four studies, the everyday exposure of blue light held a negative impact during the later hours of a usual day, but when used in earlier hours, held a more positive result.

Alertness

Two studies reported that the overtime exposure of blue light developed an increase of alertness overall (Killgore et al. 2022, Choi et al. 2019). Another study reported the increased alertness through the daytime, as well as reducing drowsiness during the daytime (Viola et al. 2008).

Overall, three of the ten studies found that exposure of blue light as a whole resulted in overtime development of alertness, as well as overtime drowsiness reduction.

Sleep Efficacy & Latency

Two studies showed that a person's sleep efficacy decreased due to exposure of blue light, resulting in increased latency due to prolonged exposure (Silvani et al. 2022, Souissi et al. 2025). Another study showed a comparison of blue light and red light exposure, which resulted in blue light having a longer sleep latency, but showed blue light having decreased latency in the day (Studer et al. 2019). The prolonged exposure of blue light resulted in longer sleep latency and decreased sleep efficacy, but also showed stronger effects compared to exposure of red light.

Cognitive Functioning (memory, information processing, etc.).

Three studies reported that exposure of blue light resulted in an increase of long term memory retention and faster information processing (Killgore et al. 2022, Studer et al. 2019, Souissi et al. 2025). Another three studies, however, reported that prolonged exposure of blue light resulted in cognitive problems, such as headaches, eye problems, etc. (Abdulazeem et al. 2024, Viola et al. 2008, Jniene et al. 2019). Two more studies reported that exposure of blue light also can affect psychological mood, with increased anxiety, however the majority resulted in improvement (Killgore et al. 2022, Abdulazeem et al. 2024). In summary, six of the ten studies showed multiple reports of change in cognitive functioning within a person, where most showed increases in memory and information processing, however also showed effects to the wellbeing of a person.

4 Discussion

This review highlighted several main characteristics of sleep that are affected through the use of blue light. Over half of these studies reported on one or more of these main characteristics, and the most common was cognitive functioning. Some articles also noted the similar characteristics of sleep efficacy to cognitive function to more, which showed a recurring theme overall.

Sleep is a necessary requirement for the entire human body and thus remains a focal point in the span of one's life. Sleep is a term that is interpreted in many different ways, with factors like sleep quality, sleep latency, etc. being useful metrics for assessing overall sleep health. Sleep is a topic that has been covered by many researchers and articles in the past, however the majority of those articles were experimental studies. In total, one of ten articles used for this paper were systematic reviews, compared to the other nine that were experimental studies.

From researching these ten studies, the majority indicated a negative standpoint on the usage of blue light, most specifically during the time of the day, and a few also stated the setting. The most negatively viewed perspective of blue light exposure came from usage in later hours and with no additional light if setting is included. Blue light exposure manages to hold a negative standpoint for young people in general because it may indirectly affect the growth of a person during their developing years, being their teen to young adult years. While it may boost a person's cognitive function during the day, it would still be diminished due to quality of sleep and duration and the other factors that were also diminished at the same time. Thus, it is of unique interest to teenagers and young adults to build an evidence base investigating the influence of

blue light exposure on sleep, especially as the use of electronic devices has become a permanent feature of our everyday life (Silvani et al., 2022).

Among all ten of the articles for gathering data, the countries from the publishers of these articles were vastly different. Thus, the location may also change one's viewpoint on the subject as a whole. For example, the writer from Saudi Arabia had a more negative standpoint on blue light exposure, whereas the more western countries seem to have a more positive viewpoint on blue light exposure. Future research can be done to investigate whether blue light usage in select countries varies and to investigate the extent of exposure variability and its possible influences. Furthermore, more research can be done in the United States in particular, as the results of this investigation were from several different countries which likely differ in their respective populations.

Because blue light is far more accessible in today's world than before, this article was meant to examine both the advantages and disadvantages of blue light, showing how to use it in a way where sleep isn't diminished from these parameters.

Despite these findings, there were limitations in this study. This is a retrospective review article. Future studies that have experimental, double-blinded forms may be advantageous for more formal conclusions. Due to this study being driven by searches on PubMed and Google Scholar, it is possible that other applicable articles that are not shown on these databases may have been missed. Additionally, the papers selected in this study may also inherently have bias.

5 Conclusion

This review was to further explore perspectives of blue light exposure. The most common observed findings were that increased amounts of blue light exposure led to many negative effects, namely increased sleep latency and decreased sleep quality and duration, which all came from the exposure of blue light in the later hours of the day, as well as exposure in a setting with no additional light. The most common positive effects, being the increase of alertness and overall cognitive function, were through exposure in the earlier hours of the day and kept people more awake. The field of blue light is a very broad subject and varies, and despite the negative reputation it holds from the media, further research should be done to explore this relationship to provide further clarity in future studies.

References

Alzaher, Eman Abdulazeem¹; Alhadrami, Leenah Maher¹; Alselami, Alya Ibrahim¹; Alghamdi, Joud Khalid¹; Baawad, Reem Adnan¹; Shouk, Rawan Magboul¹; Aldealij, Refaal Saad¹; Wali, Siraj Omar². Impact of bedtime use of blue light-emitting devices on sleep quality among college students: A single university experience. *Saudi Journal of Internal Medicine* 13(2):p 53-60, Jul–Dec 2024. | DOI: 10.4103/SJIM.SJIM_11_24

Choi K, Shin C, Kim T, Chung HJ, Suk HJ. Awakening effects of blue-enriched morning light exposure on university students' physiological and subjective responses. *Sci Rep.* 2019 Jan 23;9(1):345. doi: 10.1038/s41598-018-36791-5. PMID: 30674951; PMCID: PMC6344573.

Ishizawa M, Uchiumi T, Takahata M, Yamaki M, Sato T. Effects of pre-bedtime blue-light exposure on ratio of deep sleep in healthy young men. *Sleep Med.* 2021 Aug;84:303-307. doi: 10.1016/j.sleep.2021.05.046. Epub 2021 Jun 8. PMID: 34217920.

Jniene, A., Errguig, L., Hangouche, A. J. E., Rkain, H., Aboudrar, S., Ftouh, M. E., & Dakka, T. (2019). Perception of Sleep Disturbances due to Bedtime Use of Blue Light-Emitting Devices and Its Impact on Habits and Sleep Quality among Young Medical Students. *BioMed Research International*, 2019, 1–8. <https://doi.org/10.1155/2019/7012350>

Killgore WDS, Alkozei A, Vanuk JR, Reign D, Grandner MA, Dailey NS. Blue light exposure increases functional connectivity between dorsolateral prefrontal cortex and multiple cortical regions. *Neuroreport.* 2022 Mar 23;33(5):236-241. doi: 10.1097/WNR.0000000000001774. PMID: 35287149; PMCID: PMC8966738.

Randjelović, P., Stojanović, N., Ilić, I., & Vučković, D. (2023b). The effect of reducing blue light from smartphone screen on subjective quality of sleep among students. *Chronobiology International*, 40(3), 335–342. <https://doi.org/10.1080/07420528.2023.2173606>

Silvani MI, Werder R, Perret C. The influence of blue light on sleep, performance and wellbeing in young adults: A systematic review. *Front Physiol.* 2022 Aug 16;13:943108. doi: 10.3389/fphys.2022.943108. PMID: 36051910; PMCID: PMC9424753.

Souissi, M. A., Gouasmia, C., Dergaa, I., Faleh, J., Trabelsi, O., Weiss, K., Rosemann, T., Dhahbi, W., Souissi, N., & Knechtle, B. (2025). Impact of evening blue light exposure timing on sleep, motor, and cognitive performance in young athletes with intermediate chronotype. *Biology of Sport*. <https://doi.org/10.5114/biolsport.2025.146787>

Studer P, Brucker JM, Haag C, Van Doren J, Moll GH, Heinrich H, Kratz O. Effects of blue- and red-enriched light on attention and sleep in typically developing adolescents. *Physiol Behav.* 2019 Feb 1;199:11-19. doi: 10.1016/j.physbeh.2018.10.015. Epub 2018 Oct 28. PMID: 30381244.



Viola, Antoine U, Lynette M James, Luc JM Schlangen, and Derk-Jan Dijk. "Blue-Enriched White Light in the Workplace Improves Self-Reported Alertness, Performance and Sleep Quality." *Scandinavian Journal of Work, Environment & Health* 34, no. 4 (2008): 297–306. <http://www.jstor.org/stable/40967721>.