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Review Article

A review on effect of Blue-Light exposure before sleep on melatonin levels

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Abstract:

Melatonin is a vital hormone for maintaining the body's sleep state. Melatonin supplements can be taken by individuals who have difficulty maintaining a consistent sleep schedule. From the National Institute of Health, a 2017-2018 survey was conducted and found that 2.1% of adults take melatonin to help them. Good sleep practices must be committed before taking melatonin supplements, since supplements can be the last resort. One of the most important sleep practices is to limit screen time two hours before bedtime. The light from the phone screen is a technology called light-emitting diode (LED) that contains blue light. Excess exposure to blue light is very concerning for our eye health, such as eyestrain, and affects the sleep-wake cycle. This study reviews 35 articles about the effect of blue light from any sources, mainly mobile devices, on our melatonin secretion. It also tackles the hazardous factors of blue light and which type of people will be affected thoroughly by this problem. A wide variety of search engines and databases, such as PubMed and Google Scholar, were used to find certain articles that related to this study's aim.

Keywords: Light-Emitting Diodes; Melatonin; Mobile Devices; Screen Time; Sleep Hygiene.

Introduction

Melatonin is a vital neurohormone that regulates human circadian rhythms and the sleep-wake cycle, with its supplementary use rising in recent years [1]. Good sleep hygiene, such as limiting screen time before bedtime, is essential to promote natural melatonin production [2]. Smartphone screens and electronic devices rely heavily on light-emitting diode (LED) technology, which emits high-energy blue light that causes eye strain and disrupts natural sleep architecture [3]. Systematic reviews evaluating these physiological responses adhere to standardized reporting guidelines, such as the PRISMA statement, to assess how photic interventions impact human health [4]. Experimental studies consistently demonstrate that exposure to blue-enriched white LED lighting at night leads to significant melatonin suppression and altered sleepiness [5].

Light travels in electromagnetic waves that vary in length across a broad spectrum, ranging from long radio waves to short, high-energy gamma rays [3]. Within this spectrum, the human eye perceives a narrow band known as visible light [3]. Light energy is inversely proportional to its wavelength; thus, longer wavelengths transmit less energy, whereas shorter wavelengths carry higher energy [3]. Blue light is characterized by short wavelengths spanning 400 to 500 nm [3]. Artificial LED technology, household bulbs, and electronic screens serve as primary evening sources [3]. Although the cornea and crystalline lens filter

out damaging ultraviolet rays, they offer minimal protection against short-wavelength blue light [3].
Despite its potential for ocular strain, daytime blue light exposure is essential for maintaining circadian rhythmicity and coordinating 24-hour biological processes [1, 2]. Central to this system is the suprachiasmatic nucleus (SCN), located within the hypothalamus, which acts as the master circadian pacemaker [5]. The SCN uses photic cues to coordinate physiological rhythms and signal the pineal gland to release melatonin during darkness [1, 5]. Peak melatonin concentrations typically occur during the night to promote sleep initiation and quality [1, 2]. However, when blue light stimulates the eye prior to sleep, it signals daytime conditions to the SCN, acutely suppressing nocturnal melatonin secretion and disrupting normal sleep hygiene [2, 3, 5].

Methodology

Inclusion and exclusion criteria

The review included studies that measured human melatonin levels before sleep when participants were exposed to blue light. The review included only English-language studies published between January 2018 and November 2025. The review focused on quantitative studies that measured melatonin levels in picograms per milliliter (pg/mL) and Dim Light Melatonin Onset (DLMO).
The review excluded studies that used animal or cell samples through title and abstract screening. The review excluded studies from full-text screening if they failed to measure melatonin levels or presented incomplete results or lacked methodological transparency. The studies were also excluded for unclear designs and insufficient statistical methods. All duplicate studies were removed.

Source of databases

This review was conducted using database searches in PubMed, Cochrane, and additional search platforms, including Google Scholar and MDPI, to gather as many relevant articles as possible.

Search strategy

All related keywords discussing the impact of blue light on melatonin levels and sleep were included in the search. To discover pertinent research, the search method used the "OR" operator to mix blue light with related phrases. The "AND" operator was used to combine the three key terms to locate research that examined how blue light affects melatonin and sleep patterns.

Study selection

Eight duplicate studies were detected by Mendeley Reference Manager software and were subsequently eliminated from the study (Figure 2). After removing duplicates, the studies were assessed using predefined inclusion and exclusion criteria. The screening process consisted of two phases, which started with title and abstract evaluation, followed by complete text assessment for eligibility determination. The review process followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [4].

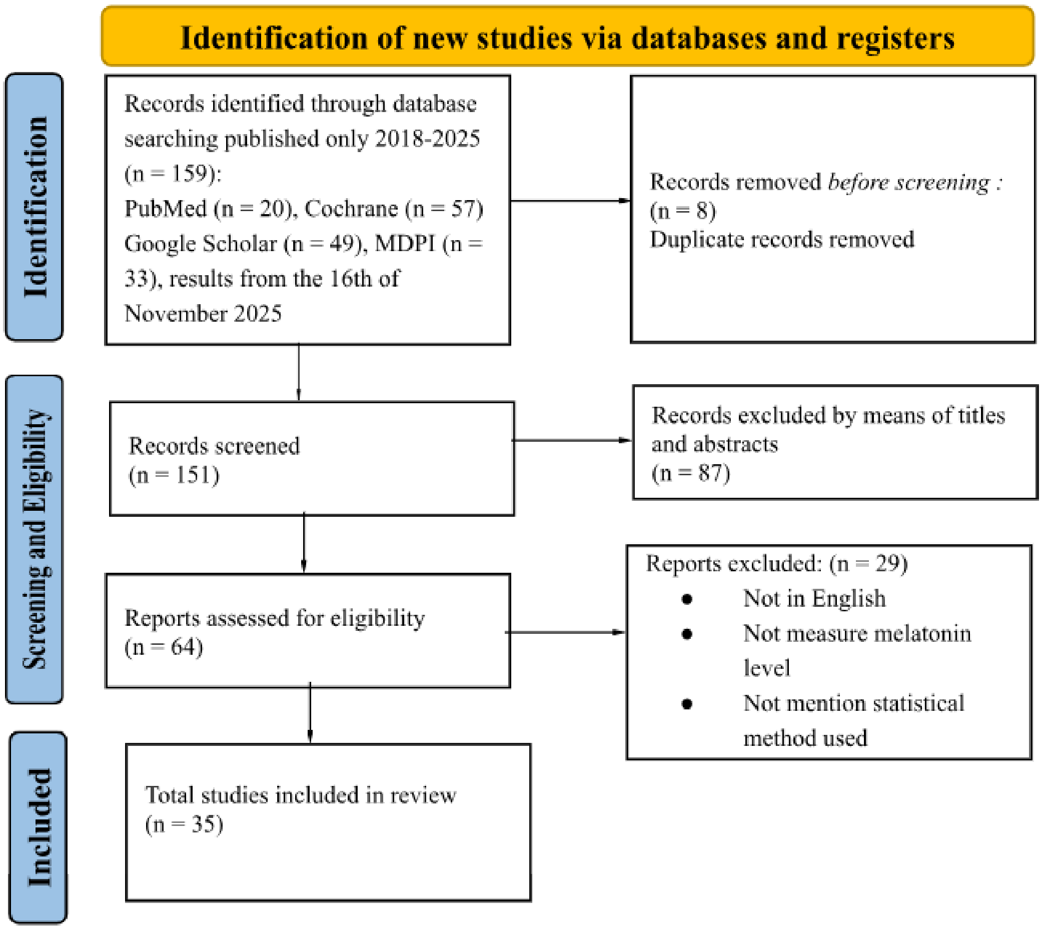

Figure 1. shows the step-by-step process from the identification of articles, screening, eligibility, to inclusion of articles as outlined in this PRISMA flow diagram [4].

Findings and Discussion

Neurobiological Mechanism of Light-Induced Melatonin Suppression

Melatonin is a primary neurohormone synthesized and secreted by the pineal gland in response to darkness [5, 13, 14]. It serves as a master physiological signal for regulating the human circadian system, sleep onset, and sleep-wake architecture [5, 13, 14]. Under normal physiological conditions, ambient light enters the eye and stimulates specialized photoreceptors known as intrinsically photosensitive retinal ganglion cells (ipRGCs), which express the photopigment melanopsin [6, 7, 13, 18]. These ipRGCs transmit photic signals directly to the suprachiasmatic nucleus (SCN)—the central circadian pacemaker in the hypothalamus via the retino-hypothalamic tract [6, 7, 13, 18].
Blue light, characterized by short wavelengths ranging from 400 to 500 nm [18, 32], falls directly within the peak spectral sensitivity zone of melanopsin (~480 nm) [32]. Consequently, exposure to short-wavelength light rapidly inhibits SCN signaling to the pineal gland, suppressing the production of nocturnal melatonin [6, 18]. Because modern light-emitting diode (LED) technologies and electronic screens (e.g., smartphones, tablets, laptops) emit high quantities of short-wavelength blue light, pre-sleep exposure artificially

signals daytime conditions to the circadian clock, leading to acute melatonin suppression, delayed Dim Light Melatonin Onset (DLMO), and elevated nighttime alertness [8, 10, 11, 18].

Impact of Light Sources, Wavelengths, and Intensity

The extent of nocturnal melatonin suppression is heavily dictated by the spectral composition, intensity (lux), and duration of the light source [9, 14, 15, 29].

LED vs. Alternative Light Sources

Studies evaluating continuous LED ceiling fixtures and electronic screens consistently report greater suppression of endogenous melatonin and phase delays compared to alternative sources such as Organic Light-Emitting Diodes (OLED) or violet-excitation LEDs, which exhibit reduced blue-peak emissions [20, 21, 23, 35].

Illuminance and Duration

Higher light intensity (e.g., bright light >50 lx up to 5,000 lx) significantly intensifies melatonin suppression [18, 29, 31]. Furthermore, exposure durations exceeding 30 to 60 minutes produce substantial decreases in circulating or salivary melatonin levels [6, 30], reaching maximum suppressive effects at exposure durations of 2 hours or more [9, 14, 15, 16].

Spectral Shift

Comparative trials confirm that high Correlated Color Temperature (CCT) lighting—rich in blue wavelengths—suppresses melatonin significantly more than low CCT warm lighting or longer red wavelengths (~620 nm) [9, 16, 19, 30, 32].

Susceptibility Across Vulnerable Populations

Sensitivity to blue-light-induced circadian disruption is not uniform across all demographics [5, 9, 13, 33].

Children and Adolescents

Pediatric and adolescent populations demonstrate significantly higher sensitivity to evening blue light compared to adults [5, 9, 29, 31, 32]. Children possess larger pupil diameters and clearer crystalline lenses, allowing greater transmission of short-wavelength light to the retina [5, 31]. Studies indicate that even low-to-moderate light intensities cause up to double the rate of melatonin suppression in children compared to adults, leading to pronounced delays in sleep onset [5, 29, 31].

Special Clinical Demographics

Pregnant Women

Shifted hormone profiles make circadian regularity crucial during pregnancy . Nighttime blue light suppression can disrupt maternal sleep quality, whereas targeted light interventions help preserve normal evening melatonin onset [13].

Circadian and Psychiatric Conditions

While individuals with mood disorders (such as euthymic bipolar I disorder) exhibit suppression patterns similar to healthy controls [33], individuals suffering from sleep disorders show significant sleep quality improvements and advanced DLMO when exposed to blue-depleted or pre-sleep dim light environments [39].

Efficacy of Blue-Light Mitigation Strategies

To counteract the adverse circadian effects of evening light, several optical and digital interventions have been evaluated [7, 10, 13, 18, 19, 24, 28].

Blue-Blocking Lenses

Wearing amber or blue-blocking glasses 2 to 3 hours before bedtime effectively blocks wavelengths <530 nm [7, 13, 18, 24]. This practice preserves nocturnal melatonin secretion, advances DLMO, and shortens subjective sleep latency [7, 13, 18, 24].

Software Filters and Dark Modes

Utilizing built-in digital night modes or blue-blocking software on smartphones and tablets reduces overall blue-peak intensity [10, 18, 19, 28]. While software filters reduce the severity of suppression compared to unfiltered screen exposure, complete restriction of screen usage remains the most effective approach for optimal sleep hygiene [10, 11, 25].

Circadian-Friendly Environmental Lighting

Transitioning to dim, low-CCT lighting or blue-depleted hospital and home environments in the late evening minimizes circadian disruption and promotes natural melatonin secretion prior to sleep [27, 38, 39].
Table 1 provides a synthesized overview of the empirical evidence evaluating the effects of blue-light exposure on evening melatonin levels and sleep metrics across diverse populations

Table 1. *Summary of included studies evaluating the effect of pre-sleep blue-light exposure on melatonin levels and sleep parameters.*

Study	Mean age ± SD (years) number of participants (n)	Intervention (bluelight source)	Study design	Statistical tool	Outcome
Lee et al, 2018 [5]	Adult: 41.7 ± 4.4 years Children: 8.9 ± 2.2 years n = 44	Light-emitting diode (LED) ceiling light	Randomised Controlled Trial (RCT) design	SPSS 23.0	Light-induced melatonin **suppression** in children is greater than in adults.
Tomoaki Kozaki, 2018 [6]	21.6 ± 1.5 years n = 11 (male)	Three conditions include dim light, 100-Hz flickering blue light, and non-flickering blue light	Experimental, within-subject (repeated measures) design	SPSS 22.0, ANOVA	Melatonin suppression was significant for both flickering and non-flickering blue light after 30 min, while non-flickering light caused faster suppression initially.
Knufinkeet al, 2018 [7]	23.27 ± 3.63 years n = 15 (male and female)	With light restriction condition (LR), wear amber-lens glasses, and no light restriction condition (nLR), wear non-vision-adjusting transparent glasses.	Within-subject crossover design	ANOVA	Blocking short-wavelength light in the evening can significantly shorten subjective sleep onset latency.
Chinoy et al, 2018 [8]	25.7 ± 3.0 years n = 9 (male and female)	Unrestricted LE-tablet computer use versus evening reading from printed materials	Randomized Controlled Trial (RCT) and crossover design	SAS version 9.3	Evening use of LE-tablets can induce delays in self-selected bedtimes and suppress melatonin secretion.
Nagare et al., 2018 [9]	Adults: 46 ± 5.2 years Adolescents: 16.5 ± 1.9 years n = 24	Overhead LED lighting (BeveLED2.0, 2200-6000 K)	Randomised Controlled Trial (RCT) design	ANOVA	Adolescents exhibit greater melatonin suppression after exposure to the 5600 K intervention compared to the 2700 K intervention, unlike adults.
Sarah R. Schmid, 2021 [10]	21.7 ± 1.91 years n = 33 (male)	Three conditions: smartphones without blue-light filter, smartphones with blue-light filter, and printed books.	Within-subject, cross-over design	SPSS 27.0	Evening melatonin levels increased after smartphone exposure (both with and without filter) compared to reading

		Device: Samsung Galaxy A50 enterprise edition			a book.
Höhn et al., 2021 [11]	21.93 ± 2.17 years n = 14 male	Three conditions: Smartphones without a blue light filter, smartphones with a blue light filter, and printed material	Within-subject, crossover design	SPSS 26.0, R-Studio 3.6.1, ANOVA	Higher melatonin levels when using No Filter compared to both the Filter and Book conditions after 30 minutes of light exposure. Before sleep, the melatonin level is higher in the Book condition than in the Filter condition.
He et al, 2022 [12]	25 ± 2.26 years n = 8 (male and female)	Four experimental lighting conditions [L2 (1440 lx, 3300 K), L3 (1440 lx, 5300 K), L4 (70 lx, 3300 K), L5 (70 lx, 5300 K)], plus the baseline (L1 -dark , 4 lx, 5300 K at eye level)	Within subjects design	Minitab 17	Higher illuminance was correlated with increased subjective work alertness and higher sleep efficiency.
Liset et al., 2022 [13]	30.5 ± 4.0 years n = 47 healthy nulliparous pregnant women	Intervention group: blue-blocking glasses (Uvex Skyper S1933X) blocking 99% of wavelengths < 530 nm. Control group: grey glasses (Uvex Skyper S1905) blocking ≈ 50% of wavelengths < 530 nm.	Randomized controlled trial (RCT) design	SPSS 25.0	Wearing blue-blocking glasses 3 hours before bedtime advanced melatonin onset and increased evening melatonin levels, indicating a positive effect on the circadian system.
Arrona-Palacios et al, 2023 [14]	64.30 ± 5.25 years n = 13 (male and female)	Self-selected lighting conditions for the first 4-6 h of the day and in dim light until their scheduled bedtime	Within subject design	MANOVA, paired t-test	Older people who are exposed to ordinary room light during melatonin phase assessment appeared to suppress melatonin.
Gou et al., 2024 [15]	23.58 ± 0.7 years n = 24 (12 male and 12 female)	four lighting conditions (m-EDI: EL1, 200 lux; EL2, 20 lux; EL3, 40 lux; EL4, 10 lux)	between-subject design	ANOVA, paired t-test	Higher m-EDI lighting exposure enhances the suppression of melatonin.
Sanchez-Cano et al, 2025 [16]	30.08 ± 12.91 years	Two selected LEDs (blue and red)	Randomized crossover design	SPSS 24.0	Blue light significantly suppresses melatonin

	n = 12 (male and female)				secretion after 2 h of exposure
Yang et al, 2018 [17]	20 ± 3.4 years n = 15 (male and female)	Three light conditions: intermittent bright lighting, continuous bright lighting, and continuous dim light.	Randomized crossover design	SPSS ver 20.0, ANOVA	Intermittent light was as effective as continuous bright light in its acute effects in negatively impacting subsequent sleep.
Mortazavi et al, 2018 [18]	23.58 ± 8.78 years n = 43 (male and female)	First night - no filter Other 2 nights - blue and amber filters	Randomized Controlled Trial (RCT)	ANOVA	Blue light suppresses the secretion of melatonin more than the longer wavelengths of the visible light spectrum.
Nagare et al, 2018 [19]	22.5 ± 3.7 years n = 12 (7 male and 5 female)	Four lighting conditions: Night shift high CCT (5997K) from iPad full brightness, Night shift low CCT (2837 K) from iPad full brightness, blue light goggles (40 lux at 470 nm), orange goggles (< 525 nm)	Within-subjects experimental study	Repeated measures ANOVA, two-tailed paired Student's t-test	Night Shift (both CCTs) caused significant melatonin suppression and did not differ between high vs low CCT. Blue Light Goggles caused the highest suppression.
Ishihara et al, 2021 [20]	25.7±0.65 years n = 10 (males)	3 conditions: LED (1000 lx), OLED (1000 lx), dim (10 lx) light conditions	Randomized crossover repeated-measures study	ANOVA	Total urinary 6-sulfatoxymelatonin (urinary metonin) did not differ between the light conditions (*p = 0.923)*
Mitsui et al, 2024 [21]	26.3 ± 5.9 years n = 15 (male)	Violet- and blue-excitation LEDs	Randomized Controlled Trial (RCT)	SPSS ver 27.0	Melatonin suppression exposed to violet-excitation LEDs was smaller than in those exposed to blue-excitation LEDs.
Hanifin et al, 2019 [22]	22.1 ± 1.8 years n = 20 (male and female)	Blue-enriched (17,000K) polychromatic fluorescent light and standard (4000K) polychromatic fluorescent light	Randomized Controlled Trial (RCT)	SAS 9.0, ANOVA	Blue-enriched light caused significantly greater suppression of melatonin than standard light.
Park et al, 2020 [23]	26.9 ± 5.7 years	Three different light conditions (OLED, LED,	Randomized crossover study	SPSS ver 18.0	Melatonin onset was significantly delayed under

	n = 24 (male and female)	and dim light)			LED compared to dim light, but did not differ under OLED.
Barrau et al, 2019 [24]	27.9 ± 5.8 years n = 56	Non-filtering lenses, selective filter, and dark-orange lenses	Cross-over randomized clinical study	MANOVA	Low levels of light at night (LAN) are sufficient to decrease melatonin production.
Kater et al, 2022 [25]	21.19 ± 1.42 years n = 79 (women)	Blue light exposure, blue light filter, and no use of smartphones in bed	Randomized within design	ANOVA	Regarding sleep, sleep quality was found to be lower when using blue light than in the control condition.
Constantino et al, 2025 [26]	Median age of 66.5 years n = 36 (male and female)	Blue-enriched light and control light	Randomized crossover design	SPSS ver 29.0, ANOVA	Evening light exposure was significantly reduced melatonin levels.
Vethe et al., 2020 [27]	23.0 ± 3.1 years n = 12 (5 male and 7 female)	3 light conditions: dim light, blue-depleted light environment (LE), standard light environment (LE),	Randomized crossover design	R statistical package (version 3.5.2), linear mixed model	Melatonin was less suppressed in the blue-depleted LE (15%) compared with the normal LE (45%; *p* = 0.011). Dim light melatonin onset was phase-advanced more after residing in the blue-depleted LE than after the normal LE (*p* = 0.008).
Makateb et al, 2023 [28]	n = 80	Blue-light filter software and sham treatment (placebo)	Randomized controlled trial (RCT)	SPSS ver 21.0	The amount of melatonin decreased significantly in the intervention group compared to the control.
Hartstein et al., 2022 [29]	4.2 ± 0.5 years n = 36	5 to 5,000 lux light	Within-subject experimental design	Paired t-test, independent t-test	Higher intensity (5,000 lux) resulted in more melatonin suppression (p = 0.046).
Hartstein et al., 2025 [30]	4.86 ± 0.9 years n = 10 (5 male and 5 female)	high CCT light (5000 K), low CCT light (2700 K), dim light (<10 lux)	within-subjects crossover design	Paired t-test	Low CCT and high CCT light at 20 lux resulted in significantly lower salivary melatonin levels after 30 and 50 minutes of

					exposure compared to dim light levels (<10 lux).
Akacem et al., 2018 [31]	4.3 ± 1.1 years n = 10	Bright light ~1000 lux containing blue light, dim light < 15 lux	Within-subject repeated measures experimental study	Paired t-test, SPSS	Bright light suppressed melatonin by 87.6 ± 10.0%. Suppression lasted ≥ 50 minutes after light exposure ended.
Najjar et al., 2024 [32]	7-14 years n = 19	Blue-enriched LED light (~480 nm peak), Red light (~620 nm)	within-subjects crossover design	Linear mixed-effects models (LMM)	Blue light suppressed melatonin significantly more than red light in children.
Ritter et al, 2020 [33]	39.6 ± 9.6 years (control) 43.3 ± 10.9 years (bipolar I disorder) n = 90 (57 controls, 33 bipolar I disorder)	Blue light, red light, dark condition		ANOVA, *t* tests,repeated-measures analyses of covariance ANCOVA, univariate ANCOVA	No differences in melatonin suppression between euthymic patients with bipolar I disorder and healthy controls.
Blume et al, 2022 [34]	23.2 ± 2.8 years n = 29	Two light conditions only differing in the melanopic effects (123 vs. 59 lx melanopic EDI)	Within-subject, randomized, crossover design	ANOVA	Suppression of melatonin by ≈14% in the high- compared to the low-melanopic condition.
Jo et al, 2021 [35]	27.5 ± 5.1 years n = 24 (male and female)	Three light conditions (OLED, LED, and dim light)	Randomized controlled trial (RCT)	SPSS ver 18.0, Friedman test, ANOVA	Exposure to light in the evening can suppress melatonin late at night and disrupt deep sleep, and worse when under LED.
Maeda-Nishino et al., 2025 [36]	10 - 12 years old n = 39 male school children	Partial blue-light blocking glasses JINS Screen Lens Heavy (40% blue-light cut), standard clear lenses	Randomized, crossover design	Two-way repeated measures ANOVA	No change between blue-light blocking glasses compared to standard clear lenses
Maeda-Nishino et al., 2025 [37]	24.2 ± 3.9 years n = 38	BLB group: blue-light–blocking (BLB) contact lenses reduced blue light by 90% Control group: regular, clear lens	Randomized controlled study	Repeated-measures ANOVA	Prolonged blue-light reduction for 4 weeks did not significantly alter melatonin levels or DLMO.
West et al., 2019 [38]	n = 43	2 lighting: naturalistic lighting (IU), standard indoor lighting (CU)	Quasi-randomized Control Trial	SAS	In the IU group, melatonin plasma levels were increased at discharge compared to inclusion (p =

					0.030) and evolved rhythmicity (p = 0.007). In the CU group, melatonin plasma levels were similar between discharge and inclusion, and no rhythmicity evolved.
Yoon et al., 2024 [39]	40.0 ± 10.2 years n = 40 who had a sleep disorder	Control: standard lighting LT group: dim warm-colored light minimizing blue light	randomized, open-label, two-arm clinical trial	Independent t-test, paired t-test, chi-squared test, R software version 4.1.1	The LT group exhibited significant improvements in an advanced Dim Light Melatonin Onset compared to the control group (approximately 30 minutes).

Discussion

After reviewing approximately 35 articles on the effect of blue-light exposure before sleep, it has been proven that it affects the circadian rhythm by suppressing melatonin levels, leading to increased alertness. This hypothesis has been accepted and proven across multiple studies that have tested it on various factors, including light conditions, duration of light exposure, age, and health conditions.

Melatonin is also known as a sleep hormone and plays a crucial role in regulating the sleep-wake cycle. It is released by the pineal gland in response to darkness [5,13,14]. The light will enter the retina, and melanopsin-containing intrinsically photosensitive retinal ganglion cells (ipRGCs) will deliver the environmental information to the suprachiasmatic nucleus (SCN) via the retinohypothalamic track [6,7,13,18].

Statistical methods that are often used among the studies to evaluate the melatonin concentration level are repeated-measures ANOVA [5-7,9-12,14-19,21-25,28-30,33-39]. In the studies, various factors contributed to the variability of melatonin data. For example, the duration of exposure, the light conditions, and the participant group. Generally, these studies that utilized this approach present their data in the form of mean ± SD, F-values, p-value, and a graph plot to visualize the changes in melatonin level [5-7,9-12,14-19,21-25,28-30,33-39]. Therefore, Repeated-measures ANOVA is the most suitable statistical approach as it allows researchers to evaluate the significant variation in melatonin levels across multiple conditions.

Furthermore, multiple studies have used the paired t-test as the primary statistical approach or conducted post-hoc after ANOVA and MANOVA. These studies utilized a paired t-test to analyze two variables of the same subject under different conditions [14,15,19,29,30,31,33,39]. Other than that, Independent t-tests were applied when comparing two different groups, as in research conducted by Hartstein et al. (2022), which evaluated melatonin suppression under different lux levels between separate participant groups [29].

Moreover, some of the studies where the data are not normally distributed, carried out non-parametric statistical approaches, such as the Friedman and Wilcoxon test [6,7,8,10,39]. Other than that, some studies used MANOVA when the dependent variable involved is more than one [14,24]. In addition, Welch's test was implemented by a study to evaluate and compare the melatonin levels and light conditions [5]. Several studies used Linear Mixed Models (LMM) where the data involved repeated measurement [10,16,27,32]. Pearson correlation was also used in the study to test the relationship between light intensity and melatonin suppression [10,16]. Additionally, a study by Ritter et al, (2020) used ANCOVA to compare the data on melatonin suppression between healthy individuals and bipolar disorder patients [33].

Nowadays, using electronic devices is a part of our daily life. Several studies reported that blue light or blue-enriched light can be emitted through electronic devices and lamps, for example, mobile phones, laptops, e-book devices, and LED screens or lamps. The study's findings reported that the usage of these devices that emit a bright light during the evening or near bedtime leads to a decrease in melatonin concentration level [8,10,11]. Thus, several studies suggested that wearing blue-blocking filter screens and blue-blocking glasses helps in reducing the probability of melatonin suppression [10,16].

Another point is regarding the light condition when the tests were carried out; the hypothesis remained consistent across multiple studies, stating that exposure to blue-enriched light (short wavelength) leads to significant suppression of melatonin [9,17-19]. A few studies reported that the intensity and brightness of light also play a vital role in affecting the melatonin suppression. Bright light above 50 lux has been proven to greatly reduce the level of melatonin of participants [18,29]. On top of that, duration of exposure is also one of the factors that are being considered in these studies, pointing out that the melatonin suppression was significant after 60 to 90 minutes and reached a plateau for durations above 2 hours [9,14,15].

Another notable findings from these studies were age factors, as children and adolescents show a higher suppression of melatonin than adults when subjected to the same light conditions [5,9]. Suppression of melatonin in children is said to be double the amount from adults, as the reason behind it is that children have an earlier melatonin onset. However, the study did not thoroughly explain the main reason behind the hypothesis and required further testing and reasoning [5]. Furthermore, in pregnant women, studies found that wearing blue-blocking glasses in the evening helps prevent nocturnal melatonin suppression [13]. These findings are valuable as they suggest reducing blue light exposure, therefore improving the health and sleep patterns of pregnant women. In contrast, a study tested on participants with bipolar disorder and the finding shows that the suppression of melatonin is the same as healthy people [33].

In conclusion, the data gathered from the articles clearly support the idea that blue light exposure suppresses melatonin, particularly in the evening and before bedtime. Thus, melatonin suppression causes wakefulness and disrupts the body's natural wake-sleep cycle. In order to maintain healthy sleep patterns and quality, it is advised to minimize the use of electronic devices and exposure to blue light.

Conclusion

All in all, the reviewed studies consistently exhibit similar findings, which evening exposure to blue light or short-wavelength light could suppress melatonin and elevate alertness. This review comprises studies that investigate various independent variables, including light intensities, exposure durations, age groups, device types, and the presence of illnesses such as bipolar disorder. This review also found that blue-blocking glasses and screen filters can reduce the effect of melatonin suppression. Additionally, appropriate and reliable statistical methods such as various versions of SPSS, ANOVA, and MANOVA are used to analyze their findings. One of the limitations of this study that could be improved is the variation in study designs, as reviewed articles used different methodologies and participants' conditions. Furthermore, many studies had small sample sizes, which may limit their reliability.

Conflict of interest

The authors declare no conflict of interest.

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