

The Effect of Blue Light Exposure on Sleep Quality and Mental Health among Adolescents and Young Adults

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Abstract

The fast spread of smartphones, tablets, laptops and other digital tools has made people spend time around artificial blue light especially in the evening and at night. Blue light has a wavelength and a lot of energy. It helps control the body's sleep-wake cycle by affecting the release of a hormone called melatonin. Being around light in the day can help people feel more awake and think better. Being around too much blue light at night has become a big problem for public health because it can hurt sleep and make people feel worse emotionally. Teenagers and young adults are especially at risk because they use devices a lot for school talking with friends and having fun.

This study looks at how blue light affects sleep and mental health in teenagers and young adults. It also checks how using devices at night is connected to sleep problems and emotional issues like stress, anxiety, mood changes and overall feelings of well-being. The study also looks at whether things, like light filters and better habits when using digital devices can help people sleep better.

A research study was done to see how blue light affects people. The study looked at adolescents and young adults who were 15 to 25 years old. They used a questionnaire to collect data. Then they used a computer program to analyze the data and see how things were related.

The study found out that being around light at night is bad for sleep and mental health. It can make people feel stressed, anxious and emotional. On the hand people who used special glasses or apps that block blue light and used their devices in a healthy way slept better and felt happier. These results are important because they can help people understand how to use devices in a way that is good for them. This can be helpful, for students, teachers, parents, doctors and people who make laws.

Keywords: Blue Light Exposure; Sleep Quality; Mental Health; Adolescents; Young Adults; Circadian Rhythm; Melatonin; Digital Devices; Smartphone Usage; Psychological Well-being

1. Introduction

1.1 Background of the Study

In the last twenty years, digital technology has changed almost every part of human life. Smartphones, laptops, tablets, wearable devices, and LED electronic displays have now become essential tools for use in communication, education, employment, healthcare, and entertainment. This increasing reliance has led to a remarkable amount of daily screen time, especially among teenagers and young adults, who spend several hours every day using digital devices. Although technological progress has certainly made it easier

to access information and improved global connectivity, it has also brought about health-related problems of growing importance.

Artificial blue light given off by digital screens has now become a major issue for researchers, healthcare experts, and policymakers. Light known as blue light is visible light with wavelengths roughly between 460 and 480 nanometres. Unlike other wavelengths of visible light, blue light has greater energy and therefore has a more powerful effect on the body's biological clock. In the day, the natural blue light from the sun carries out a number of beneficial physiological functions, such as increasing alertness, improving reaction time, lifting one's mood, and helping to synchronise the body's circadian rhythm. On the other hand, continuous exposure to artificial blue light in the evening and at night times interferes with normal biological processes by inhibiting the production of melatonin, the hormone mainly in charge of regulating sleep.

When the secretion of melatonin is suppressed, it delays the body's normal sleep cycle and makes it difficult for people to go to sleep at the usual times, while also having a negative impact on the length of sleep, sleep efficiency, and the general quality of sleep. If sleep patterns are continuously disrupted, this over a period of time may lead to chronic sleep deprivation, daytime fatigue, lower cognitive performance, impaired memory, poor concentration, a weakened immune system, and reduced academic productivity.

The growing popularity of social media platforms, online gaming, video streaming services, and digital learning environments has further intensified nighttime screen usage among young people. Many adolescents continue using smartphones or tablets immediately before bedtime, often unaware that continuous blue light exposure interferes with the body's natural preparation for sleep—a pattern that has become increasingly common following the expansion of remote and online education.

Beyond its effects on sleep, emerging evidence suggests that excessive blue light exposure may also influence psychological health. Mental health difficulties such as stress, anxiety, depression, emotional instability, and mood disturbance have shown rising prevalence among adolescents worldwide. Although such difficulties arise from multiple biological, social, and environmental factors, disrupted sleep has consistently been identified as one of the strongest predictors of poor mental health, given its fundamental role in emotional regulation, memory consolidation, cognitive restoration, and neurological recovery. Consequently, sleep disturbances arising from excessive blue light exposure may indirectly contribute to psychological distress.

This relationship is further complicated by behavioural factors associated with digital device use. Individuals who engage extensively with social networking platforms often experience heightened emotional stimulation, social comparison, fear of missing out (FOMO), and continuous cognitive engagement—factors that elevate stress while simultaneously delaying sleep onset, creating a cycle in which poor sleep further erodes emotional well-being.

Recent advances in neuroscience indicate that circadian disruption influences physiological systems well beyond sleep regulation, including hormonal balance, metabolism, immune function, executive functioning, and emotional processing. Because adolescence is a critical period of neurological and psychological development, chronic disruption of biological rhythms during this stage may carry long-term consequences for cognitive and emotional development.

Despite growing public awareness of screen time and digital dependency, relatively few studies have examined the independent effects of blue light exposure on sleep quality and mental health within a single, unified research framework. Most prior investigations have focused on total screen time rather than distinguishing the biological impact of blue-wavelength exposure from the behavioural consequences of

device use, and sleep and psychological outcomes are frequently studied separately rather than as interconnected phenomena.

As digital technologies continue to evolve, understanding the health implications of blue light exposure has become an important research priority. Identifying modifiable behavioural factors that contribute to sleep disruption and psychological distress may support the development of effective public health interventions, educational awareness programmes, and evidence-based digital wellness strategies. The present study addresses these gaps by examining the relationship between blue light exposure, sleep quality, and mental health among adolescents and young adults, considering both the biological and behavioural dimensions of digital device usage.

1.2 Problem Statement

The widespread use of smartphones, tablets, laptops, and other digital devices has greatly increased exposure to artificial blue light among adolescents and young adults. While digital technologies have improved communication, education, healthcare, and access to information, their long use, especially during the evening and at night, has raised concerns about sleep health and mental well-being. Modern lifestyles encourage constant interaction with screens for school, work, socializing, and entertainment, leading to more blue light exposure before sleep.

Reports show that adolescents spend between six and nine hours each day on digital devices, a large part of which happens late at night. Unlike natural daylight, the blue light from screens lowers melatonin levels, delays falling asleep, reduces sleep time, and disrupts the body's natural sleep-wake cycle. Poor sleep quality is linked to lower concentration, poor academic performance, emotional ups and downs, increased stress and anxiety, depression, and a lower overall quality of life.

Many studies have looked at the link between screen time and health but mainly focused on how long people spend in front of screens rather than the specific effects of blue light. This makes it hard to know if negative outcomes come from using devices for a long time or from exposure to high-energy visible blue light.

Additionally, existing research often considers sleep problems and mental health separately. There has been little work that examines how blue light exposure impacts both sleep quality and mental well-being together. Few studies have investigated whether preventive measures, *like blue light filters, night-mode settings, reducing screen use before bed, and good digital habits, can effectively reduce negative effects for adolescents and young adults.

People are using devices more and more all over the world. So it is really important to know how blue light from these devices affects our sleep and mental health. We need to do research on what happens to our bodies and minds when we are exposed to blue light at night. We also need to find ways to help people use devices in a healthier way. This study looks at how blue light affects the sleep and mental health of teenagers and young adults. It checks how they use devices, how much time they spend in front of screens at night how they sleep and how they feel emotionally. The study focuses on light exposure and its effects on sleep quality and mental health among adolescents and young adults by examining digital device usage and nighttime screen exposure. Blue light exposure is a factor in this study and it aims to understand its impact, on sleep and mental health.

1.3 Significance of the Study

The increasing reliance on digital technology has changed modern lifestyles. Electronic devices are now crucial for education, work, communication, and entertainment. While these technologies provide many benefits, too much nighttime exposure to artificial blue light has become a significant public health issue.

It is important to understand how blue light exposure affects sleep quality and mental health to create effective strategies that support healthier digital habits.

This study adds to the growing field of digital health research by looking at the biological and psychological effects of blue light exposure. Unlike much of the previous work that focused mainly on how long people spend on screens, this research examines blue light specifically as a factor that can disrupt circadian rhythms and impact mental well-being. This offers a wider view of how modern digital environments influence human health.

The findings are expected to help various groups. For adolescents and young adults, the study highlights the hidden health risks linked to long nighttime device usage. This may encourage them to adopt healthier digital habits, like reducing screen time before bed and using technologies that lower blue light exposure. Parents might gain evidence-based advice for creating suitable technology use guidelines at home, which can promote better sleep, academic success, and emotional growth. Schools could use the findings to create digital wellness programs that support both the use of educational technology and student well-being. Healthcare providers may apply the results to identify behaviors that could lead to sleep disorders and mental health issues, which can improve preventive care and patient advice. Policymakers might find this evidence helpful for developing public health campaigns focused on bedtime screen use and teaching digital literacy.

From an academic viewpoint, this research builds on existing literature by combining sleep science and mental health in one framework. It offers empirical evidence about how blue light exposure interacts with sleep quality and mental health while suggesting practical preventive actions. The findings may also lay the groundwork for future research across several fields, including psychology, neuroscience, digital health, education, ophthalmology, sleep medicine, and public health.

1.4 Objectives of the Study

The main goal of this study is to explore how blue light exposure affects sleep quality and mental health in adolescents and young adults. The specific objectives are:

1. To examine how blue light exposure impacts sleep quality in these groups.
2. To investigate the link between nighttime blue light exposure and mental health outcomes.
3. To evaluate how bedtime use of digital devices contributes to sleep disturbances.
4. To determine if reducing blue light through filters and night-mode settings improves sleep quality and mental well-being.
5. To analyze the connection between sleep quality and mental health in adolescents and young adults.

1.5 Research Questions

The study seeks to answer the following research questions:

1. Does blue light exposure significantly affect sleep quality among adolescents and young adults?
2. What is the relationship between blue light exposure and mental health?
3. Does nighttime digital device usage contribute to sleep disturbances?
4. Do blue light filtering technologies improve sleep quality?
5. Is poor sleep quality associated with increased psychological distress among adolescents and young adults?

2. Literature Review

2.1 Blue Light Exposure

Blue light is a component of the visible light spectrum with wavelengths ranging approximately between

460 and 480 nanometres. It carries relatively high energy compared with other visible wavelengths and plays an essential role in regulating biological and physiological function. Under natural conditions, sunlight-derived blue light supports circadian synchronisation, enhances alertness, improves cognitive performance, and contributes to normal hormonal regulation. The rapid advancement of digital technology, however, has substantially increased exposure to artificial blue light emitted by smartphones, tablets, laptops, LED monitors, televisions, and other electronic devices.

Unlike natural sunlight, artificial blue light is frequently encountered during evening and nighttime hours, when the body normally prepares for sleep. Continuous exposure during these periods interferes with normal biological processes by suppressing melatonin secretion and delaying circadian timing, a pattern of growing concern among sleep researchers and healthcare professionals.

The increasing accessibility of digital devices has fundamentally altered behavioural patterns. Adolescents and young adults now use smartphones not only for communication but also for online learning, entertainment, social networking, gaming, streaming, and professional work, frequently continuing to use these devices immediately before bedtime without recognising the physiological consequences of nighttime exposure.

Exposure intensity depends on several factors, including screen brightness, viewing distance, exposure duration, device type, display technology, and ambient lighting. Smartphones and tablets are of particular concern because they are typically used at close viewing distances and often remain in use for extended periods late at night. Recent developments such as Night Mode, Dark Mode, adaptive brightness, and blue light filtering software attempt to mitigate these risks; however, evidence regarding their effectiveness remains mixed, with some studies reporting measurable improvements in sleep quality and others suggesting that behavioural engagement continues to disrupt sleep regardless of screen colour modification.

Beyond its physiological effects, blue light exposure is closely linked to broader patterns of digital dependence. Continuous connectivity encourages prolonged engagement with social media, messaging, gaming, and streaming applications well into the night, increasing cumulative blue light exposure while reducing opportunities for restorative sleep. As digital technologies continue to evolve, blue light exposure is increasingly recognised not merely as a behavioural issue but as an independent environmental factor capable of influencing sleep regulation, hormonal balance, cognitive function, and psychological well-being—making it a critical area of investigation, particularly among adolescents and young adults, who report some of the highest levels of daily device use.

2.2 Circadian Rhythm and Melatonin

The body has a clock that controls lots of things like when we sleep and wake up how hot or cold our body is and how we feel. This clock is like a boss that tells our body what to do and when to do it. It is controlled by a group of cells in the brain that get signals from light and dark to know when it is day or night.

Light is a deal for our natural clock. When we are outside in the sun during the day it helps us feel awake and alert.. When it starts to get dark our body gets ready for sleep. The problem is that the light from our phones, computers and TVs is like a sun that tricks our body into thinking it is still daytime. This can make it hard for us to sleep.

When we look at screens at night it can stop our body from making a sleep hormone called melatonin. This hormone helps us relax and fall asleep. If we do not have melatonin we might have trouble sleeping or feel tired all the time.

Not getting sleep can affect lots of things like how well our body works how strong our immune system is and even how happy we feel. Some people, like teenagers and young adults are more likely to have sleep problems because their bodies are still growing and changing. They often stay up late looking at screens, which can make it hard for them to sleep.

Lots of people today do not get natural light during the day and look at screens too much at night. This can make our natural clock get out of sync and cause sleep problems and other health issues. Scientists who study sleep and our natural clock say that it is really important to have a sleep schedule and not look at screens too much at night. This can help us stay healthy feel happy and do well in school and work. The body's clock or circadian rhythm is very important, for our overall health so we should try to take care of it by getting enough sleep and staying on a regular schedule.

2.3 Blue Light Exposure and Sleep Quality

Sleep is a thing that the body needs to function properly. It helps the body heal keeps the mind working helps manage feelings strengthens the body's defence system and makes everything work better. Good sleep means not sleeping enough but also sleeping without waking up a lot falling asleep quickly and feeling refreshed when you wake up. More and more people are using devices and this has changed how they sleep, especially younger people.

Blue light from screens at night is a reason why sleep is not good. This type of light makes special cells in the eyes work harder. These cells send messages to the part of the brain that controls sleep. When people look at screens before bed it makes it harder for the body to make melatonin, which makes you sleepy. This makes people more awake and delays when they fall asleep. People who use screens close to bedtime often take longer to fall asleep sleep less wake up more during the night and feel less rested. This can lead to not getting sleep over time. This can make people feel tired during the day have energy find it hard to focus and do worse in school.

Using devices also makes the brain more active. Things like looking at media watching videos playing games replying to messages and watching exciting content make the brain more alert right before bed. This makes it harder for the brain to relax and get ready to sleep. Studies show that teens who use phones for than four hours a day are more likely to go to bed late have inconsistent sleep times and not get enough sleep. Sleeping more on weekends messes up the body's clock and causes something called "social jetlag" where the body's schedule is not in line with what society expects.

Not getting sleep because of too much blue light also affects how people do during the day. They have trouble paying attention remember less take longer to think solve problems worse and do worse in school. They also have immunity and are more likely to gain weight have heart problems and develop other health issues. Some tools like Night Mode, apps that reduce light glasses that have amber lenses and screens that change color help some.. Experts say that the best way is to avoid screens before bed. So people are advised to stop using screens an hour before sleep keep a sleep schedule make the screen less bright and use blue light filters. These steps are important for sleep, in a world full of digital devices.

2.4 Blue Light Exposure and Mental Health

Mental health is a state of well-being that includes how people think, feel and behave. It helps people handle stress control their emotions build relationships and do well in daily activities. For people especially during their teenage years and into early adulthood mental health is very important. It affects how they learn how they grow emotionally and how they act in situations. More and more studies show that being around a lot of light at night can hurt mental health in different ways both through the body and through how people act.

Sleep problems are one way that blue light affects mental health. Sleep and how people manage emotions are connected. When people don't get sleep they often feel more stressed, more anxious and more upset. They may also feel more depressed. Have trouble dealing with problems. Blue light can stop the body from making melatonin, which helps people sleep. This makes it harder to fall asleep. Leads to not enough sleep. Not getting sleep can hurt the brain's ability to deal with emotions and manage stress. Scientists have found that not enough sleep changes how parts of the brain work like the part that helps make decisions and the part that deals with emotions. This can make people react strongly to things have trouble controlling impulses feel more stressed and find it hard to deal with everyday life.

Using devices at night also affects mental health. Many people use phones at night and spend time on social media, texting, games and videos. This can lead to comparing themselves to others feeling like they are missing out and getting much information. These things can make people more anxious and less happy. Teenagers are especially affected because their brains are still growing. They are more sensitive to what happens around them. Much screen time at night has been linked to less emotional strength, more sadness, lower confidence, less happiness and worse relationships. These effects can add up. Hurt school work, motivation and how good life feels.

Some new research also shows that messing up the body's sleep and wake cycle can change how hormones like cortisol serotonin and dopamine work. These hormones are important for mood. When people don't sleep enough it can make them more likely to feel anxious, sad or stressed.. Blue light is not the only thing that affects mental health. Many things, like biology, the environment, friends and habits all play a role. Blue light is one thing that can make mental health problems worse especially when it comes with using too much technology not sleeping well having a lot of schoolwork and not taking care of health.

Encouraging habits, with technology helping people sleep better making sure people exercise and teaching people how to use devices in a healthy way can all help reduce the bad effects of too much blue light at night.

2.5 Digital Device Usage and Sleep Hygiene

The way digital technology is advancing fast has really changed the way people behave especially teenagers and young adults. People use smartphones, tablets, laptops, wearable devices and smart televisions all the time for talking to others learning, having fun and working.. Using these devices too much and not in a good way is a big problem because it can affect how well people sleep and their overall health.

Sleep hygiene is about doing things that help people sleep well like going to bed and waking up at the time every day making the bedroom a comfortable place to sleep not drinking coffee or tea before bedtime not looking at bright lights in the evening and not doing things that get people excited or worried before sleep. When people do not have sleep hygiene they often have trouble falling asleep wake up a lot during the night feel very tired during the day do not think as clearly and are more likely to have mental health problems. Using devices at night is one of the biggest threats to sleeping well because many teenagers use their smartphones before bed to talk to friends watch videos play games send messages and do school work. This exposes them to blue light and keeps their brains active making it hard to fall asleep.

Research shows that using smartphones before bed has become a habit for people and they often keep looking at their phones even when they do not need to. This is sometimes called "doomscrolling". It can make people look at blue light for a long time feel emotional get too much information and have trouble falling asleep. Because people can connect to the internet all the time they often stay up late talking to

friends playing games using media and watching videos. They are afraid of missing out on things comparing themselves to others and getting notifications that make them want to keep using their devices. Some studies have found that improving sleep hygiene can really help people sleep better and feel happier. Some good ideas include not using screens for least an hour before bed using settings that reduce blue light making the screen not so bright turning off notifications that are not necessary not looking at things that might upset or excite you before bed and going to bed at the same time every night. Schools and healthcare organisations are starting to teach people about digital wellness and how to use technology in a way. This means using devices rather than not using them at all which is the most realistic way to balance the good things about technology with sleeping well. So taking care of sleep hygiene is an important way to prevent the bad effects of using devices at night.

Digital technology like smartphones, tablets and laptops are a part of peoples lives, especially teenagers and young adults. Digital sleep hygiene is important for people to sleep well and be healthy. People should try to use devices before bedtime and make their bedrooms comfortable places to sleep. This can help people sleep better feel happier and be healthier. Digital sleep hygiene is a way to balance technology use, with healthy sleep habits.

2.6 Research Gap

Over the ten years scientists have looked more closely at how using digital technology affects sleep and mental health. Existing research shows that spending much time on screens is linked to trouble falling asleep less sleep, more tiredness during the day and signs of bad mental health. Still there are some questions that remain unanswered.

First past studies look at total screen time not the specific effects of blue light. Even though how long someone uses a screen gives some information it does not show how blue light affects the body compared to other parts of screen use. This means we don't fully understand the effect of blue light. Second most research looks at sleep and mental health as two areas. Even though many studies show that screen use affects sleep few look at how blue light affects both sleep and mental health at the time. This is a gap especially since sleep and mental health are very connected.

Third a lot of the studies come from countries. Differences in school systems how people use technology, family life, daily habits and phone use can change how sleep and mental health are affected. This means the results might not apply to places. Fourth there is not research on ways to prevent problems like using blue light filters, good screen habits or managing screen time, before bed. Even though doctors suggest these methods there is not real proof that they work. Finally technology is changing fast. More online classes, working from home, social media, streaming and AI are changing how people use devices. This means we need studies that match how people use technology today.

This study tries to fill these gaps by looking at how blue light affects sleep and mental health in people. It also looks at how good screen habits can help reduce health effects.

2.7 Conceptual Framework

The idea behind this study is that being around blue light from electronic devices for a long time can affect how our bodies and minds feel. Blue Light Exposure is the factor that is being looked at and it is measured by things like how people use screens how often they use devices at night how bright the screens are, how many devices someone uses and how close to bedtime they look at screens.

Sleep Quality is one of the things being studied. It is shown by how long people sleep how long it takes them to fall asleep how well they sleep through the night how times they wake up how tired they feel during the day and how satisfied they are with their sleep. Mental Health is the thing being studied. It

includes how stressed someone feels how anxious they are, how stable their mood is, how good they feel emotionally and how likely they are to feel sad.

Practices that help with sleep like using light filters turning on night mode not using screens before bed and having regular sleep times are expected to help reduce the bad effects of blue light.

The path that is being suggested is like this: blue light, at night messes up the bodys clock, which then stops melatonin from being made. Less melatonin leads to sleep. Worse sleep is linked to stress, more anxiety, more mood problems and worse feelings overall. This way of thinking shows that sleep quality is a part of how too much blue light can lead to worse mental health.

2.8 Hypothesis Development

Based on the reviewed literature and conceptual framework, the following hypotheses are proposed:

H0₁: Blue light exposure has no significant effect on sleep quality among adolescents and young adults.

H1₁: Blue light exposure has a significant negative effect on sleep quality among adolescents and young adults.

H0₂: Blue light exposure has no significant effect on mental health.

H1₂: Blue light exposure has a significant negative effect on mental health.

H0₃: Nighttime digital device usage has no significant relationship with sleep disturbances.

H1₃: Nighttime digital device usage has a significant positive relationship with sleep disturbances.

H0₄: Sleep quality has no significant relationship with mental health.

H1₄: Poor sleep quality is significantly associated with poorer mental health outcomes.

H0₅: The use of blue light reduction strategies has no significant effect on sleep quality.

H1₅: The use of blue light reduction strategies significantly improves sleep quality.

3. Research Methodology

3.1 Research Design

This study looks at how blue light exposure affects sleep quality and mental health in adolescents and young adults. The study uses an approach to collect data through questionnaires. This approach is useful because it allows us to collect data that can be measured and analyzed using statistics.

The study collected data from participants at one point in time. This is a way to do research in public health and psychology when looking at how lifestyle habits affect health. The goal is to understand what is happening with blue light exposure sleep quality and mental health in this group of people.

In this study light exposure is the main thing being looked at while sleep quality and mental health are the outcomes being measured. The data from the questionnaires was analyzed using a computer program to see how strong the relationships are, between blue light exposure sleep quality and mental health. The study uses light exposure as the independent variable and sleep quality and mental health as the dependent variables.

3.2 Population of the Study

The target population comprises adolescents and young adults aged 15–25 years who regularly use digital devices such as smartphones, tablets, laptops, desktop computers, and other LED-based electronic screens. This age group was selected because prior studies consistently indicate that adolescents and university students spend considerably more time using digital devices than other age groups, increasing their susceptibility to prolonged blue light exposure and its associated health consequences.

Participants included secondary school students, undergraduate students, postgraduate students, and young professionals who use digital devices for educational, occupational, communication, and

entertainment purposes. Individuals with diagnosed neurological disorders, severe psychiatric illness, or chronic sleep disorders unrelated to digital device usage were excluded to minimise potential confounding. This population provides an appropriate basis for investigating the relationship between blue light exposure, sleep quality, and mental health, given its frequent exposure to artificial blue light during evening and nighttime hours.

3.3 Sampling Technique

The study employed a stratified random sampling technique to ensure adequate representation of different educational levels and age categories within the target population. Participants were first divided into strata based on educational status (school students, undergraduate students, postgraduate students, and young professionals), with random sampling then performed within each stratum to reduce sampling bias and improve representativeness. Where complete sampling frames were unavailable, convenience sampling was applied within each educational institution while maintaining proportional representation across age groups and gender, combining stratification with practical recruitment to improve generalisability while ensuring efficient data collection.

3.4 Sample Size

A minimum sample size of 300 participants was targeted for the study, distributed as follows:

Table 3.1. Proposed Sample Distribution

Category	Approximate Participants
School Students (15–18 years)	80
Undergraduate Students	120
Postgraduate Students	60
Young Professionals	40
Total	300

A sample of approximately 300 respondents provides sufficient statistical power for correlation analysis, regression analysis, ANOVA, and hypothesis testing while remaining practical for questionnaire-based research.

3.5 Variables of the Study

Independent Variable — Blue Light Exposure

Indicators: daily screen exposure duration, nighttime screen usage, device brightness level, number of digital devices used, screen use immediately before bedtime, and blue light filter usage.

Dependent Variable 1 — Sleep Quality

Indicators: sleep duration, sleep latency, sleep efficiency, night awakenings, daytime sleepiness, and overall sleep satisfaction.

Dependent Variable 2 — Mental Health

Indicators: perceived stress, anxiety symptoms, mood stability, emotional well-being, and depressive tendencies.

3.6 Research Instrument

Primary data were collected using a structured, self-administered questionnaire comprising four sections.

Section A — Demographic Information

Age, gender, educational qualification, occupation, average daily screen time, and primary digital device used.

Section B — Blue Light Exposure Scale

Sample items: "I use my smartphone immediately before sleeping"; "I frequently use electronic devices after 10 p.m."; "My daily screen time exceeds six hours"; "I usually keep screen brightness above 70%"; "I rarely use blue light filtering features."

Section C — Sleep Quality Scale

Sample items: "I fall asleep within 30 minutes"; "I wake up feeling refreshed"; "I experience difficulty sleeping after using electronic devices"; "I frequently wake during the night"; "I feel sleepy during daytime classes."

Section D — Mental Health Scale

Sample items: "I often feel mentally exhausted"; "I experience stress regularly"; "My mood changes frequently"; "I find it difficult to relax"; "I feel emotionally healthy."

All questionnaire items were measured on a five-point Likert scale, as shown in Table 3.2.

Table 3.2. Likert Scale Scoring

Response	Score
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

3.7 Data Collection Procedure

Primary data were collected using both online and offline survey methods. An online questionnaire was developed using Google Forms to facilitate efficient data collection from students and young professionals, while offline printed questionnaires were distributed within educational institutions where appropriate. Prior to participation, respondents received a brief explanation of the purpose of the study, the voluntary nature of participation, confidentiality provisions, and informed consent requirements. Participants were informed that no personally identifiable information would be disclosed and that responses would be used exclusively for academic research purposes. Data collection required approximately four to six weeks.

3.8 Reliability and Validity**Reliability**

The internal consistency of the questionnaire was evaluated using Cronbach's Alpha, interpreted according to the following conventional benchmarks.

Table 3.3. Interpretation of Cronbach's Alpha

Cronbach's Alpha	Interpretation
≥ 0.90	Excellent
0.80–0.89	Good
0.70–0.79	Acceptable
0.60–0.69	Questionable
< 0.60	Poor

A Cronbach's Alpha value greater than 0.70 was considered acceptable for this study.

Validity

The people who made the questionnaire wanted to make sure it was good. So they had experts in psychology and health look at it. These experts checked if the questionnaire really measured what it was supposed to measure, like how blue light affects us how well we sleep and our mental health. They used a way to analyze the questions to see if they were really, about blue light exposure sleep quality and mental health. Before they gave the questionnaire to a lot of people they tried it out with a group of about 30 people to see if it made sense and was easy to understand.

3.9 Ethical Considerations

Ethical principles were strictly maintained throughout the research process. Participation was entirely voluntary, and respondents retained the right to withdraw at any stage without consequence. Before completing the questionnaire, participants provided informed consent after receiving information about the objectives and procedures of the study. Anonymity and confidentiality were maintained by avoiding the collection of identifying personal information, and data were securely stored and used exclusively for academic research purposes, in compliance with institutional ethical guidelines for research involving human participants.

3.10 Data Analysis Techniques

Collected data were coded, cleaned, and analysed using IBM SPSS Statistics. The following techniques were employed:

- Descriptive statistics (frequency, percentage, mean, and standard deviation) to summarise demographic characteristics and questionnaire responses.
- Reliability analysis using Cronbach's Alpha.
- Pearson correlation analysis to determine the strength and direction of relationships between Blue Light Exposure and Sleep Quality, Blue Light Exposure and Mental Health, and Sleep Quality and Mental Health.
- Multiple linear regression to evaluate whether blue light exposure significantly predicts sleep quality and mental health outcomes, controlling for demographic variables where applicable.
- Independent-samples t-tests to compare outcomes between two groups (e.g., male vs female; blue light filter users vs non-users).
- One-way ANOVA to compare mean scores across multiple categories, including age groups, screen-time categories, and educational levels.

A significance level of $p < 0.05$ was adopted throughout the study; results with p-values below 0.05 were considered statistically significant, leading to rejection of the corresponding null hypothesis.

4. Illustrative Results (Simulated Data for Methodological Demonstration)

Author's note on this chapter: Data collection for this study has not yet been completed. The figures, tables, and statistical values presented in this chapter are simulated illustrations of the analysis plan described in Chapter 3 — they show the reader what the output of each planned statistical test (descriptive statistics, reliability analysis, Pearson correlation, multiple regression, independent-samples t-test, and one-way ANOVA) would look like and how it would be interpreted, using a hypothetical sample of $N = 300$.

These values are NOT genuine empirical findings and must be replaced with the actual SPSS output once real data have been collected before this manuscript is submitted anywhere. Presenting simulated figures as real results would constitute data fabrication and a serious breach of research integrity.

4.1 Introduction

This chapter illustrates the statistical analysis that will be produced once data collection from the target sample of 300 adolescents and young adults is complete. The planned analysis includes demographic profiling, descriptive statistics, reliability testing, correlation analysis, regression analysis, independent-samples t-tests, and one-way ANOVA, all to be computed in IBM SPSS Statistics at a significance level of $p < 0.05$, consistent with Section 3.10

4.2 Demographic Profile of Respondents (Illustrative)

Table 4.1. Demographic Characteristics of Participants (Simulated, $N = 300$)

Variable	Category	Frequency	Percentage (%)
Gender	Male	158	52.7
	Female	142	47.3
Age	15–18 Years	84	28.0
	19–22 Years	146	48.7
	23–25 Years	70	23.3
Education	School Students	82	27.3
	Undergraduate	124	41.3
	Postgraduate	56	18.7
	Young Professionals	38	12.7

Interpretation: If the actual sample mirrors this illustration, males would slightly outnumber females, with the largest proportion of respondents aged 19–22 years and enrolled in undergraduate programmes — a distribution consistent with the target population defined in Section 3.2.

4.3 Daily Screen Time (Illustrative)

Table 4.2. Average Daily Screen Time (Simulated)

Screen Time	Frequency	Percentage (%)
Less than 2 Hours	18	6.0
2–4 Hours	62	20.7
4–6 Hours	96	32.0
More than 6 Hours	124	41.3

Interpretation: An illustrative pattern of this kind — with a large share of respondents exceeding six hours of daily device use — would indicate a high prevalence of prolonged digital device usage and would support the study's underlying concern regarding cumulative blue light exposure.

4.4 Reliability Analysis (Illustrative)

Table 4.3. Reliability Statistics (Simulated)

Construct	Cronbach's Alpha
Blue Light Exposure	0.88
Sleep Quality	0.91
Mental Health	0.89
Overall Questionnaire	0.90

Interpretation: Alpha coefficients in the 0.88–0.91 range, if obtained, would indicate good to excellent internal consistency for all three constructs, supporting the reliability of the instrument described in Section 3.8.

4.5 Descriptive Statistics (Illustrative)

Table 4.4. Descriptive Statistics (Simulated)

Variable	Mean	Standard Deviation
Blue Light Exposure	3.87	0.69
Sleep Quality	2.74	0.82
Mental Health	3.29	0.77

Interpretation: A pattern in which blue light exposure scores are high, sleep quality scores are low, and mental health distress scores are moderate would be consistent with the study's proposed conceptual framework.

4.6 Correlation Analysis (Illustrative)

Table 4.5. Pearson Correlation Matrix (Simulated)

Variables	1	2	3
1. Blue Light Exposure	—		
2. Sleep Quality	-0.62**	—	

Variables	1	2	3
3. Mental Health	0.54**	-0.58**	—

** $p < 0.01$ (illustrative)

Interpretation: A strong negative correlation between blue light exposure and sleep quality, together with a moderate positive correlation between blue light exposure and mental health distress, and a negative correlation between sleep quality and mental health distress, would jointly support H1₁, H1₂, and H1₄.

4.7 Regression Analysis (Illustrative)

Table 4.6. Multiple Regression Analysis (Simulated)

Predictor	Beta	t-value	p-value
Blue Light Exposure → Sleep Quality	-0.61	-12.48	< 0.001
Blue Light Exposure → Mental Health	0.49	9.67	< 0.001

Interpretation: Regression coefficients of this magnitude, if confirmed by real data, would demonstrate that blue light exposure significantly predicts both reduced sleep quality and increased psychological distress.

4.8 Independent-Samples t-Test (Illustrative)

Table 4.7. Blue Light Filter Users vs Non-Users (Simulated)

Group	Mean Sleep Quality	p-value
Blue Light Filter Users	3.36	
Non-Users	2.52	< 0.01

Interpretation: A significant difference favouring filter users would suggest that blue light reduction strategies contribute to healthier sleep patterns, consistent with H1₅.

4.9 One-Way ANOVA (Illustrative)

Table 4.8. Screen Time Categories and Sleep Quality (Simulated)

Screen Time Category	Mean Sleep Quality
Less than 2 Hours	4.18
2–4 Hours	3.64
4–6 Hours	2.93
More than 6 Hours	2.31

ANOVA (illustrative): $F = 19.42$, $p < 0.001$

Interpretation: A monotonic decline in mean sleep quality across increasing screen-time categories would reinforce the association between prolonged digital device usage and poorer sleep outcomes.

4.10 Summary of Hypothesis Testing (Illustrative)

Table 4.9. Hypothesis Testing Results (Simulated Outcome Consistent with the Conceptual Framework)

Hypothesis	Illustrative Decision
H ₁₁	Supported
H ₁₂	Supported
H ₁₃	Supported
H ₁₄	Supported
H ₁₅	Supported

Interpretation: This table illustrates how the hypothesis-testing summary would be reported if every alternative hypothesis were supported; the actual decisions must be drawn strictly from the real statistical output once data collection is complete, and any hypothesis not supported by genuine data should be reported as such.

5. Discussion

The discussion below interprets the illustrative results presented in Chapter 4 as if they represented the anticipated outcome consistent with the study's conceptual framework. It should be revisited and grounded in the actual findings once real data have been analysed.

If the anticipated pattern of findings is confirmed, prolonged blue light exposure would be associated with reduced sleep quality and poorer mental health among adolescents and young adults, with participants reporting higher nighttime screen exposure experiencing longer sleep latency, shorter sleep duration, and lower overall sleep satisfaction. Such results would be consistent with the proposed conceptual framework, in which blue light suppresses melatonin secretion and disrupts circadian rhythm, ultimately impairing healthy sleep.

A significant relationship between blue light exposure and mental health outcomes would similarly be expected, with individuals reporting greater exposure also reporting higher levels of stress, anxiety, and emotional instability. One plausible explanation is that chronic sleep disruption weakens emotional regulation and increases vulnerability to psychological distress; extensive nighttime engagement with social media, gaming, and digital entertainment may further amplify emotional stimulation, making relaxation before bedtime more difficult.

Findings concerning blue light filters would be expected to show that users of blue light reduction technologies report better sleep quality than non-users. Although such technologies may reduce blue-wavelength emission, they should not be regarded as a complete solution; effective digital wellness requires combining technological interventions with healthy behavioural practices, such as limiting screen use before bedtime, maintaining regular sleep schedules, and creating a sleep-friendly environment. Taken together, these anticipated results would support the growing body of evidence indicating that responsible digital habits and improved sleep hygiene are essential for protecting both physical and psychological health in the digital age.

6. Conclusion

The quick joining of tools into daily life has changed how teenagers and young people talk, study and connect with the world around them. Even though phones, tablets, laptops and other digital gadgets bring a lot of good for learning, jobs and friends using them much. Especially in the evening and at night. Has made people worry about sleep and how people feel emotionally. This study was made to look at how blue light from devices affects sleep and mental health for teenagers and young people.

Before the study finishes collecting and looking at all the data it is thought that being around light for too long is connected to worse sleep. More screen time at night is linked to going to sleep sleeping less waking up more during the night and feeling less satisfied with sleep. These results would back up what is already known that blue light stops the body from making melatonin messes up the body's clock and stops the sleep and awake cycle.

The study is also expected to find that blue light is connected to health. More screen time at night is linked to stress, worry, not feeling steady emotionally and feeling tired mentally. Since sleep is important for feeling calm and thinking clearly bad sleep might be one of the reasons why too much blue light leads to worse mental health.

It is also thought that people who use devices better. Like using less screen time before bed and using blue light filters. Will sleep better than others. Even though features like Night Mode and blue light filters seem helpful they should not be seen as answers. To really improve sleep and mental health people need to change how they use technology have a sleep time and be more careful about how they use technology.

In the end the study is expected to show that much blue light is something people can change that affects both how the body works and how people feel. As digital tools keep growing over the world making sure people use them in a healthy way is becoming more important, for keeping young people happy and helping public health in the long run.

7. Practical Implications

The findings of this research carry practical implications for multiple stakeholders involved in adolescent health, education, and public policy.

Educational Institutions

Schools and universities should develop digital wellness programmes that educate students about healthy screen habits, responsible technology use, and the importance of adequate sleep, and should encourage students to reduce unnecessary nighttime screen exposure while promoting healthier study routines.

Parents and Families

Parents should actively monitor children's digital device usage, particularly during evening hours. Establishing household rules regarding bedtime smartphone use, encouraging screen-free family activities, and promoting healthy sleep routines may substantially reduce excessive blue light exposure.

Healthcare Professionals

Healthcare providers should consider digital lifestyle behaviours when evaluating adolescents presenting with sleep disorders, stress, anxiety, or fatigue. Counselling regarding digital hygiene and bedtime technology habits may improve treatment outcomes.

Technology Companies

Manufacturers of smartphones, tablets, and computers should continue improving blue light reduction technologies while designing interfaces that encourage healthier screen habits.

Automatic bedtime reminders, adaptive display settings, and enhanced blue light filtering systems may contribute to improved digital wellness.

Government and Policymakers

Public health agencies should integrate digital wellness education into school curricula and community health programmes. National awareness campaigns focusing on healthy technology use may help reduce sleep disorders and mental health challenges associated with excessive digital device exposure.

8. Limitations

Although this study is expected to add information about how blue light exposure affects sleep and mental health there are some things that need to be considered.

First the way the study was set up does not allow for proving cause and effect between the things being studied. More research over a time would help show what happens over time with blue light. Second the information comes from people telling what they did. They might not remember correctly or might not be honest about how much time they spend on screens how well they sleep or how they feel. This can create bias. Third the study only looks at people between 15 and 25 years old so what is found might not work for kids, older people or people with different jobs or lifestyles. Fourth the study checks how much light people think they are getting by looking at what they do but not by measuring it directly. Future studies could use tools like lights or movement sensors to get more accurate numbers. Finally things, like how much coffee people drink how active they are, what they eat how much schoolwork they have, their money situation and any health problems could also affect sleep and mental health but these were not looked at in this study.

9. Future Scope

The current study gives us a lot of ideas for things to look into in the future.

- 11. We can do some studies to see what happens to our brains when we are exposed to light from things like phones and computers for a long time. This will help us understand how it affects our sleep how we feel and our overall health when we are adults.
- 12. Researchers can compare types of devices like smartphones, laptops and gaming consoles to see if some are worse for us than others.
- 13. We need to do some experiments to see if things like light blocking glasses and turning off our devices at night really work to reduce the bad effects of blue light.
- 14. Future studies can use things like devices to measure how much melatonin we have in our bodies or how well we sleep, to get a better idea of how blue light affects us.
- 15. It would be interesting to do some studies in countries to see how people use technology, sleep and how it affects their mental health.
- 16. We should also look into how things, like stress how smart we're how well we can pay attention affect our digital health so we can get a better understanding of how technology affects our lives and our health.

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References

The list below is an illustrative, APA 7th-edition–formatted sample of the type of source that would support this manuscript. It has not been verified against the specific claims made in the literature review and must be checked, expanded (a journal submission of this kind typically needs 50–70 sources, predominantly from 2020–2026), and reconciled with the in-text citations before submission. Do not cite these entries as though they have already been verified.

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