

Blue Wavelength Light Treatment for Improving Sleep in Patients with Post-Traumatic Stress Disorder

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SUMMARY

Post-traumatic stress disorder (PTSD) is a mental health condition triggered by a traumatic event and is known to cause various symptoms, such as disturbed sleep. Research has proven that sleep improves brain function and other capacities, including judgment, decision-making, and physiological maintenance. Recently, blue-light therapy has been explored, and clinical experiments have illustrated their ability to alter sleeping patterns in PTSD patients. Daily morning exposure to blue light for 30 minutes helps to reduce daytime sleepiness and fatigue, causing PTSD patients to sleep earlier in the night. Being a non-pharmacological intervention, blue-light therapy's safety prospects have attracted the attention of researchers to aid in improving the health outcomes for PTSD patients.

ABSTRACT

Traumatic life events comprise the etiology of post-traumatic stress disorder (PTSD). PTSD patients are known to face adverse impacts on their mental and physical health. Symptoms of concern relating to PTSD include heightened anxiety levels, intrusive memories, nightmares, and problems with sleeping. Disrupted sleep leads to exhausted brain function that impedes the daily activities of individuals and impacts their perceived quality of life. Therefore, researchers have sought to examine interventions that help to improve sleep and circadian rhythms. Recently, blue-light therapy has been the target of clinical research to understand its role in alleviating PTSD symptoms. Results from clinical trials indicated that patients receiving blue light showed significant reductions in daytime sleepiness and fatigue. Furthermore, these individuals displayed faster reaction times and greater phase advances in circadian rhythms, leading to earlier sleep onset at night. As we work towards focusing our attention on addressing mental health issues, investigating the benefits of non-pharmacological interventions such as blue-light therapy can help improve the health outcomes of PTSD patients.

Keywords: Blue light, Circadian rhythm, Light therapy, Post-traumatic stress disorder, PTSD

1.0 INTRODUCTION

Post-traumatic stress disorder (PTSD) is a psychiatric condition that is correlated with significant levels of impairment, poor quality of life, and adverse impacts on physical health.² Individuals differ in the level of exposure to stressful life events, and due to their varying capacities of resilience, they showcase vulnerability to adversity differently.⁸ Thus, individuals have vastly different health outcomes following objectively similar traumatic life events.⁸ In recent years, there has been increasing attention directed at the psychological impact of trauma and ways to reduce its effects on human health.⁸

Although there remains an abundance of pharmacologic treatments for PTSD symptoms, there are few non-pharmacologic treatment methods.⁸ Recently, exposure to blue-wavelength light has been discovered to improve sleep and circadian rhythms, both of which are disrupted in PTSD patients.⁵ Proper sleep and circadian rhythms have potent effects on cognitive functioning in humans, including their critical impact on the retention of extinction memories.^{5,8} Therefore, it is vital to target sleep deprivation symptoms of PTSD as a way to alleviate distress and improve health outcomes. This news article will analyze the efficacy of blue-light therapy in improving sleep among PTSD patients.

2.0 POST-TRAUMATIC STRESS DISORDER

Upon exposure to chronic stress, the neuroendocrine system is prime to prepare the body for survival.⁸ The brain regions that are functionally adapted to respond to this signal include the anterior cingulate cortex (ACC), insula, and amygdala.⁸ However, chronic stress can result in these regions becoming hyper-responsive to any situation perceived as a threat.⁸ Exaggerated activation of the amygdala enhances the encoding of emotional memories.⁸ These salient memories can lead to subsequent changes in behaviour and reach a point where it manifests itself as PTSD.⁸ The development of PTSD in an individual leads to a conditioned fear response following a traumatic event.⁸

2.1 Symptoms

PTSD can present itself via the following symptoms: hyperarousal, intrusive memories, and persistent nightmares that can persist long-term and have pronounced implications on patients' daily activities.⁸ Problems with sleeping are the most common complaint among individuals with PTSD, leading to the symptom of memory recall issues.⁸

2.1 Sleep Deprivation Incidence and Impacts

The self-reported rates of sleep deprivation are as high as 90% among PTSD patients; it is the driving factor in the persistence and severity of symptoms presented by the disorder.⁸ In fact, clinical research shows that the severity of sleep disturbance is associated with PTSD severity.⁸ Restorative sleep is found to be the most effective non-pharmacological mechanism for controlling the symptoms of the disorder.⁸

3.0 BLUE LIGHT THERAPY

Recently, researchers have identified it to be an effective method that can help alleviate the disturbances faced by PTSD patients.⁵ Exposure of PTSD patients to blue light is found to result in a greater phase advance in circadian rhythms, sleep pattern improvements, and enhanced daytime alertness.⁵ Consequently, morning blue-light exposure can produce improvement in neurocognitive performance and PTSD symptom reduction.⁵ Blue light, specifically in a narrow spectral band from wavelength 460 to 480 nanometres, is illuminated from a light box provided to patients undergoing blue-light therapy.⁷

Within blue-light therapy, the light box device is to be placed at arm's length and at a slight angle from the gaze of the patient, such that it is sufficient to cover their eyes and face with the light.⁶ This therapy is to be conducted for 30 minutes in the morning within two hours of waking up for maximum efficacy.³ The light box is portable and can be utilized at the convenience of the patient within the comfort of their home.³ Daily home-based blue light therapy that is self-administered can significantly improve depressive symptoms and is known to reduce sleep disruptions among people that have experienced trauma.³ Furthermore, due to the non-pharmacological nature of this intervention, patients avoid the adverse side effects associated with pharmacological interventions.³

3.1 Mode of Action

Blue light exposure selectively stimulates intrinsically photosensitive ganglion cells located in the retina of the eye that synapses with the suprachiasmatic nucleus, which is known to be the brain's master circadian rhythm clock.⁷ Upon stimulation, retinal ganglion cells signal to suppress melatonin secretion in the brain, which leads to greater wakefulness.⁷ According to the timing of the administration of blue light, there is a phase shift in circadian rhythms.⁷ In a therapeutic setting, blue light can be utilized in a way that induces wakefulness in PTSD patients and circadian shifts to result in earlier onset of sleep.⁷ Exposure to blue light in the morning reduces fatigue during the day along with sleepiness, to shift patient sleeping patterns so that they sleep earlier in the night.⁷

Neuroimaging evidence in a clinical trial shows that blue-light therapy is correlated with improved functional and structural connectivity between the thalamus and the parietal cortex of the brain.⁶ Improved interconnectedness between these regions helps improve cognition, memory, and processing speeds.⁴ Furthermore, blue light alters white matter diffusion characteristics in tracts passing through the thalamus, which contributes to improved white matter integrity in PTSD patients.^{6,7} Research has shown that disruptions of sleep due to disorders can result in reduced white matter integrity in patients.¹ Sleep architecture is related to white matter microstructure in healthy individuals with healthy sleeping patterns.¹ Therefore, positive structural changes within white matter following blue-light therapy can help improve sleep quality significantly.

3.2 Success

Randomized-controlled clinical trials have shown the success of blue-light therapy in improving sleep among PTSD patients. Exposure to blue light produced significant phase advances in sleep onset com-

pared to control groups that received no treatment.⁵ Throughout the clinical trial, participants with PTSD assigned to the blue-light therapy (BLT) group showed significant phase advances, generally falling asleep 57.5 minutes earlier compared to the control group.⁵ Results showcased these earlier sleep onsets in 80% of the participants in the BLT group.⁵ Compared to the control group, 87.5% of the participants in the BLT group showed significant reductions in daytime sleepiness post-treatment.⁵ Furthermore, 93.8% of participants who underwent BLT showed improvements in executive functioning by completing puzzles 1280 milliseconds faster compared to the control group.⁵

Another study aimed to investigate the benefits of morning blue-light therapy at home with portable light box devices. Patients experiencing symptoms of trauma, such as daytime sleepiness, sleep disturbance, and insomnia symptoms, were recruited.³ The results indicated significant differences between the blue-light and control groups.³ Researchers found significantly greater decreases in sleep disturbance, insomnia symptoms, and reaction time in individuals who were exposed to daily morning blue-light therapy.³ Additionally, participants in the blue-light therapy group reported more significant improvements in productive activity compared to the non-treatment group.³

4.0 CONCLUSION

Morning blue-light therapy exposure proves to be an effective tool in alleviating the symptoms associated with PTSD, such as sleep disturbances. Understanding the role of blue light in neurological changes that reduce the severity of PTSD symptoms is essential as it can help provide patients with a convenient and safe non-pharmacological approach to improving their health outcomes.

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