Vedant_IARCO_2025 - Vedant.pdf

by Sanaul Haque

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IARCO RESEARCH PROPOSAL

Full Legal Name: Vedant Varhadkar

Institution: Inventure Academy

Category: Junior

Class/Grade/Year: A level

Country: India

Submission Date: September 30, 2025

Registered Email Address: vvarhadkar@gmail.com

Research Topic: To What Extent Does Blue Light Exposure Disrupt Circadian Rhythms and Spike Inflammatory Cytokines in Adolescents?

Title: Exploring The Role of Blue Light in Disrupting Circadian Rhythms and Inflammatory Response.

Introduction to the Research Problem

Adolescents today often exceed two hours of daily screen time from electronic devices like phones and laptops, which emit high amounts of blue light. Blue light is the light emitted from the sun and screens with high energy and a short wavelength. Exposure to this inhibits the production of melatonin and interferes with circadian rhythms, which can lead to systemic inflammation due to increased amount of cytokines. Adolescence is a critical period for growth, cognitive and physical development, it also comes with a natural circadian phase delay, making them more susceptible to sleep disruption. In many urban and suburban settings this contributes to heightened stress, and sleep deficit on top of their fluctuating hormones. While blue light's role in circadian rhythm disruption has been well documented, the link to inflammatory responses remains underexplored, especially in young populations. This study seeks to fill this gap by investigating whether evening blue light exposure significantly alters circadian alignment and boosts pro-inflammatory cytokines, supplying key evidence to introduce interventions in a world full of digital use.

Existing Literature Review

Previous studies increasingly demonstrate that blue light disrupts biological clocks, particularly via hormonal and inflammatory pathways [1], [6]. Exposure to blue light delays melatonin onset and reduces subjective sleepiness unsettling normal circadian rhythm [1]. Adolescent screen use is associated with poor sleep outcomes quality which may amplify stress responses and hinder the body's ability to recover [2], [8]. Evidence from young adults further links disrupted sleep to elevated inflammatory cytokines such as IL-6, suggesting a pathway by which evening blue light exposure can dysregulate immune function [3], [10]. Animal and cellular studies provide mechanistic support, indicating constant light exposure enhances inflammasome activity in the hippocampus connecting circadian disruption with neuroinflammation [3]. While blue light induces reactive oxygen species (ROS) and inflammatory signaling in skin cells, indicating systemic effects beyond local tissue damage [7]. Additionally general reviews highlight the role that circadian dysregulation plays in a variety of illnesses, frequently by inflaming chronic conditions [4], [5]. The effects of light pollution on cytokine regulation are most noticeable during sleep, with blue wavelengths escalating hormonal imbalances and related immunological changes [6, 9]. Adolescent specific research is still rare despite this evidence; the majority of studies concentrate on sleep outcomes rather than

immune biomarkers [2], [6]. This proposal aims to close this gap by integrating immunology and circadian science to investigate the physiological effects of evening blue light exposure and its possible effects on adolescent health through the use of rhythm tracking and cytokine analysis in adolescents. This study fills the gap by combining immunology and circadian science with rhythm tracking and cytokine analysis in adolescents to investigate the physiological effects of evening blue light exposure and its possible effects on adolescent health.

Methodology

This study will employ a controlled experimental design with both physiological and self-reported measures:

Quantitative Component:

-A controlled experimental design will be used, comparing two groups of adolescents aged 13–18 of 20 each. One exposed to blue-enriched evening light via screens for two hours before bedtime, and a control group exposed to filtered, low-blue warm light for the same duration.
-Circadian rhythms will be assessed using : salivary melatonin onset and sleep diaries.
-Cytokine levels will be measured via blood samples taken pre and post intervention using ELISA assays.
-Self-reported outcomes on sleep quality and energy levels will be collected using standardized questionnaires.
-A total of 80 participants will be recruited through local schools, with random assignments to groups. Excluding adolescents with : diagnosed sleep disorders, chronic illness, or regular use of anti-inflammatory medication.

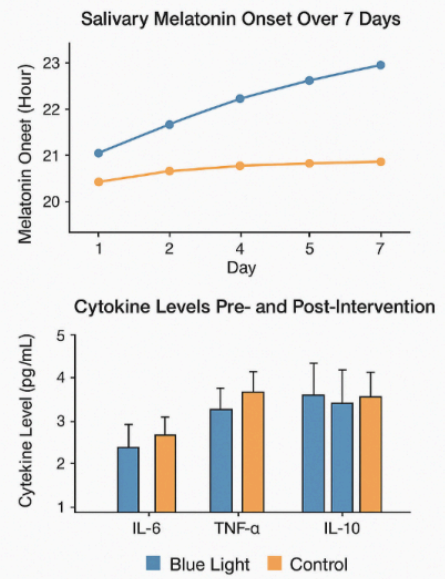
Qualitative Component:

-Participant experiences with evening light exposure will be captured via short open ended responses in questionnaires as well as sleep diaries.

Ethical Considerations:

- Ethical approval will be obtained from a recognized institutional board.
- Informed consent from participants and parental consent will be secured prior to participation.
-All procedures like blood collection, will be conducted under medical supervision.
- Data confidentiality and anonymity will be strictly maintained.

Test results:



-Will be presented via graphs, to illustrate the difference between two groups.
- By testing for Melanin Onset over time and Cytokine levels.

References

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