

# Near-Infrared Light to Make Screenshot Healthy

Anne C. Berends\*, Tom Hilgerink\*, Michael R. Krames\*

\*SunLED Life Science BV, Amsterdam, Netherlands

## Abstract

The average screenshot globally is 7h/day. What if this time would contribute to our health and wellbeing? This can be achieved using near-infrared light. 50% of natural sunlight is near-infrared light and numerous studies have shown it improves our mental and physical health. The technology SunLED allows integration of a scientifically proven effective dose of near-infrared light in display devices. This paper describes how that works.

## Author Keywords

Near-infrared light, photobiomodulation, healthy screenshot

## 1. Introduction: The Role of Near-Infrared Light in Our Life

Modern human life, confined predominantly indoors, starkly contrasts with the environment of our evolutionary past, where natural sunlight was an integral part of daily existence. Today, up to 90% of our time is spent indoors.(1) Moreover, the average screenshot is 7h/day.(2) Our lifestyle choices (often combined with climate- or environmental- reasons) thus limit our exposure to the full spectrum of sunlight. One critical missing component is near-infrared (NIR) light, which constitutes 50% of natural sunlight and plays a vital role in photobiomodulation. This biological process enhances mitochondrial function, thus fueling metabolism and promoting systemic health and well-being. Despite its potential, NIR light is notably absent from indoor lighting and modern display technologies.

## 2. Clinical Evidence: Photobiomodulation and Health

A vast body of scientific literature developed since the 1960's shows all kinds of health benefits of NIR light, or photobiomodulation (PBM).(3) However, it was a recent clinical study that showed the systemic potential of this type of light for generally healthy people.(4) A study conducted by Chrono@Work and the University of Groningen evaluated 56 participants over a four-week period. The participants used specially designed desk lamps emitting NIR light at varying doses of 0, 1, 4, and 6.5 J/cm<sup>2</sup>. Their well-being, health markers, and sleep quality were assessed under these conditions.

The results were compelling (Figure 1). Improvements in mood and reductions in drowsiness were observed among participants receiving 6.5 J/cm<sup>2</sup> doses, particularly in the winter. Health markers also showed significant improvements, including reduced levels of inflammatory cytokines like IFN- $\gamma$  and TNF- $\alpha$  and a notable decrease in resting heart rate, which is a key indicator of physical health. These clinical results were further investigated on cell level by the University of Maastricht, indeed showing effects of immune-system related pathways.(5) Moreover, another field study performed by a Canadian research team on 150 healthy participants validated the earlier findings of improved mental and cardiovascular health after exposure NIR light.(6) Lastly, PBM has often been shown to have positive effects on eye health, e.g. macular degeneration and retinal damage,(7) which is of major interest for the display industry.

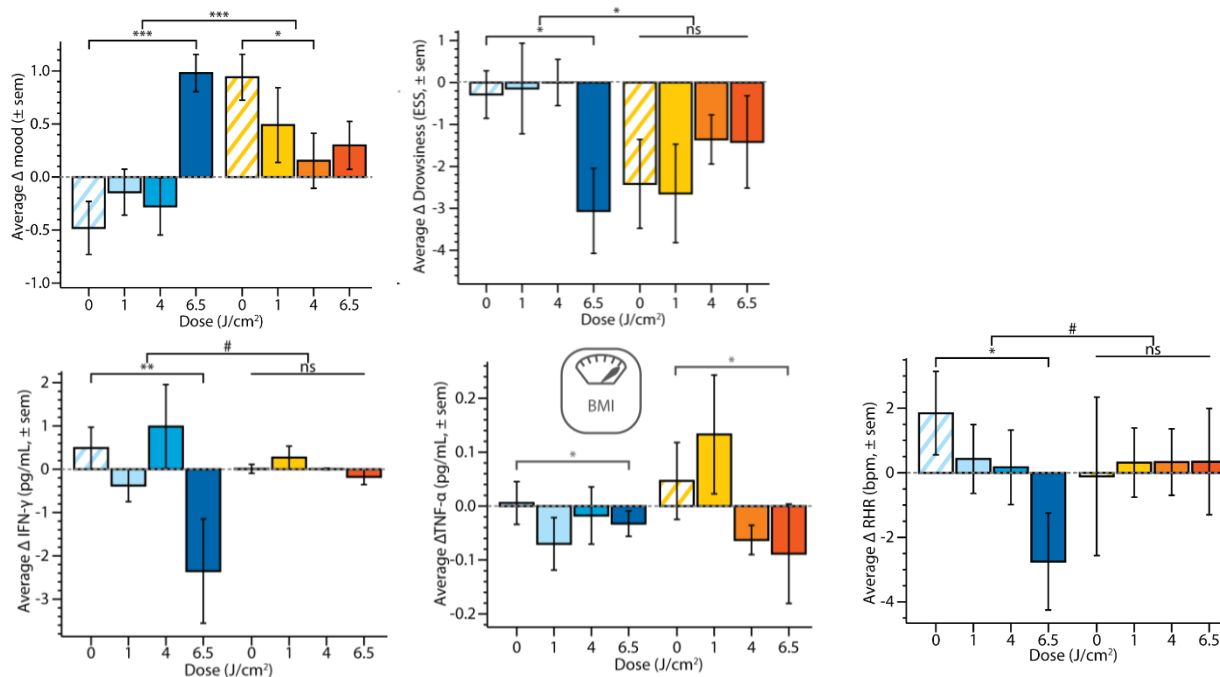


Figure 1. Data from the clinical study in ref [4], showing improved mood, reduced drowsiness, reduced inflammation, and reduced resting heart rate for people exposed to 6.5 J/cm<sup>2</sup> NIR compared to placebo.

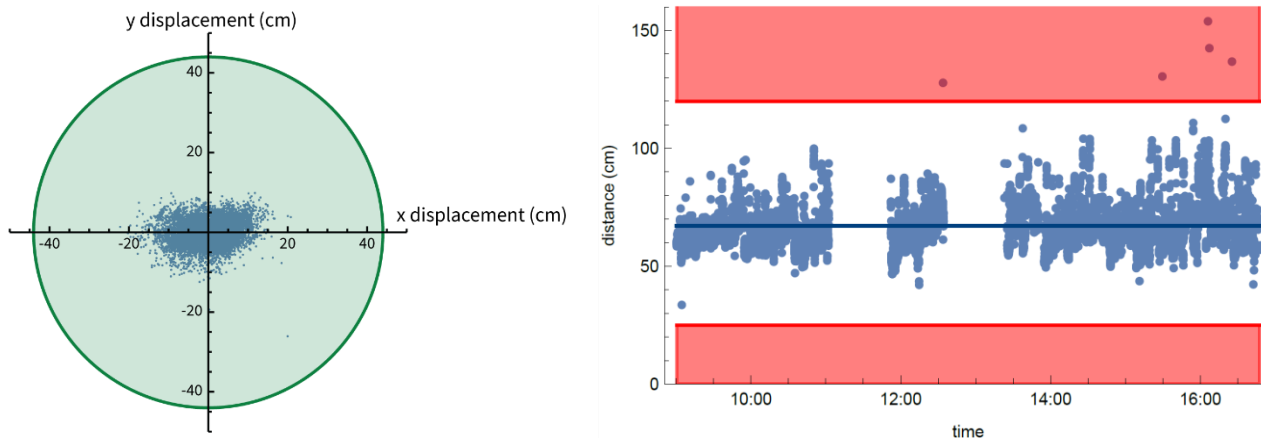


Figure 1. Measurements of behavior in front of an external pc monitor screen, showing very little movement of the user.

### 3. Implementing NIR in Display Technologies

The clinical study findings underscore the health benefits of NIR light, particularly during periods of reduced natural sunlight. This opens an opportunity to integrate NIR light into display devices like monitors, televisions, and smartphones, which are used extensively in daily life.

Advancements in solid-state lighting and optoelectronics have made the integration of PBM into display technologies feasible. High-power LEDs and vertical-cavity surface-emitting lasers (VCSELs) provide scalable solutions, while secondary optics optimize the distribution of irradiance, ensuring targeted delivery to users' faces and necks. For this targeted delivery, display devices in particular are perfect applications as users spend prolonged time in a very well-defined manner interacting with the display (Figure 2).

To achieve systemic health benefits, NIR light delivery through displays must meet specific irradiance and dose thresholds. Our recent prototype designs illustrate how this can be accomplished. For example, a USB-powered accessory with high-power LEDs has been developed to deliver a dose of 4 kJ over three hours while consuming only 4 W of power (Figure 3, Table 1). These designs incorporate features like distance sensors to ensure consistent dosing and pulsed operation to minimize energy draw. The same designs can be used for monitor integration.

Table 1. Design specifications for a monitor based NIR emitting device.

<b>LED</b>	High-power 850 nm (3x)
<b>Optic</b>	10 mm TIR, 28-degree beam (3x)
<b>Drive</b>	3.1A, 100 Hz, 10% DF
<b>Distance</b>	75 cm
<b>Peak irradiance</b>	5.9 mW/cm <sup>2</sup> (time avg)
<b>Duration</b>	3h
<b>Dose</b>	6.4 J/cm <sup>2</sup>
<b>Cum. Dose</b>	4 kJ (@ face & neck)

### 4. Conclusion and future directions

The integration of PBM into display devices represents a transformative opportunity to bring the benefits of NIR light into

everyday life. By leveraging advances in emitter technologies and intelligent design, displays can deliver meaningful health benefits without disrupting user routines. As the industry evolves, incorporating NIR light into personal devices offers a path to restore the natural health benefits of sunlight to those living predominantly indoor lifestyles.

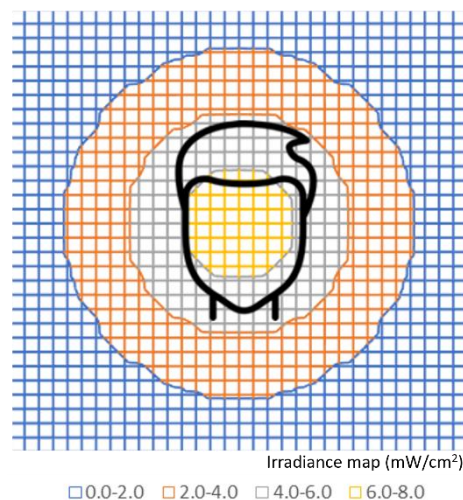


Figure 3. Irradiance map of a NIR emitting device according to the design specifications listed in Table 1.

### 5. References

1. Klepeis NE, Nelson WC, Ott WR, Robinson JP, Tsang AM, Switzer P, et al. The National Human Activity Pattern Survey (NHAPS): A resource for assessing exposure to environmental pollutants. *J Expo Anal Environ Epidemiol.* 2001;11(3):231–52.
2. Moody R. Screen Time Statistics: Average Screen Time in US vs. the rest of the world [Internet]. 2023 [cited 2023 Oct 10]. Available from: <https://www.comparitech.com/tv-streaming/screen-time-statistics/>
3. Hamblin MR, Ferraresi C, Huang YY, de Freitas LF, Carroll JD. *Low-Level Light Therapy: Photobiomodulation.* Bellingham, Washington, USA: SPIE Press; 2018.

**P-240 / A. C. Berends • Late-News Poster**

4. Giménez MC, Luxwolda M, Van Stipriaan EG, Bollen PP, Hoekman RL, Koopmans MA, et al. Effects of Near-Infrared Light on Well-Being and Health in Human Subjects with Mild Sleep-Related Complaints: A Double-Blind, Randomized, Placebo-Controlled Study. *Biology (Basel)*. 2023;12(1):60.
5. van der Vloet L, Ducarne Z, Heeren RMA, Berends AC, Vandenbosch M. Lipid analysis of human primary dermal fibroblasts and epidermal keratinocytes after near-infrared exposure using mass spectrometry imaging. *J Biotechnol*. 2024 Dec 10;396:53–61.
6. Roddick CM, Wang Y, Chen FS, Durmus D, Royer MP, Veitch JA, et al. Effects of near-infrared radiation in ambient lighting on cognitive performance, emotion, and heart rate variability. *J Environ Psychol*. 2024 Dec 1;100.
7. Zhu Q, Xiao S, Hua Z, Yang D, Hu M, Zhu YT, et al. Near infrared (NIR) light therapy of eye diseases: A review. *Int J Med Sci*. 2021;18(1):109–19.