

Effects of BioLight Low-Level Light Therapy (LLLT) on Sleep, Stress, and Physiological Parameters.

Kevin Longoria^{1*}, BSc, MSc; Kerry Martin^{1*}, PhD

¹Biostrap, Bradbury, CA, United States

Keywords: low level light therapy, LLLT, Biostrap, wearable technology, photoplethysmography

Published online: October 2021 © The Author(s) 2021

Corresponding Author:

Kevin Longoria, BSc, MSc

Biostrap USA

260 Mount Olive Drive

Bradbury, CA 91008

United States

Phone: (323)999-4757

Email: kevin@biostrap.com

Abstract

Background: Low-level light therapy (LLLT) refers to direct exposure of tissue to red and infrared light to elicit therapeutic physiological responses. LLLT has been shown to affect the mitochondria, specifically through oxidative stress and inflammatory signaling, which may have an effect on endothelial function allowing better blood flow regulation to tissues as well as vascular remodeling and growth (de Marchi, et al., 2011; Leal, et al., 2010; Chu et al., 2017). Therefore, LLLT may enhance cardiovascular function through a dynamic set of changes related to mitochondrial, inflammatory, and oxidative-stress effects.

Objective: This study aimed to provide objective and self-reported evidence of acute and longitudinal physiological effects of low-level light therapy in a population of 25 apparently healthy participants who experience low-to-moderate ultraviolet exposure and physical activity levels.

Methods: A total of 25 existing Biostrap users (14 females; 11 males) were recruited for this study, having expressed interest in participating through an internal opt-in survey. All participants completed an informed consent and were provided a BioLight Restore panel at no cost for the duration of the study. This phase-based study consisted of a baseline (2-weeks), intervention (4-weeks), and wash-out (2-weeks). In addition to semi-continuous and passive data collection via the Biostrap wrist-worn device, participants were prompted to complete intermittent manual biometric recordings and a daily survey, and to perform a LLLT session twice daily for 10 minutes throughout the intervention phase. A linear mixed effects model and repeated measures ANOVAs were used to compare physiological changes between and within study phases.

Results: Twenty-four participants (96%) maintained compliance throughout all study phases. Although longitudinal analysis did not reveal significant physiological changes, manual biometric recordings performed immediately prior to and after completing LLLT sessions revealed dramatic changes ($p < 0.05$) in HRV root-mean-square of successive

differences (RMSSD), high-frequency HRV, and decreased stress index. A notable increase ($p = 0.07$) in low frequency HRV was also observed. Participants reported decreased musculoskeletal pain and training-related soreness throughout the study duration.

Conclusions: The BioLight LLLT reduces physiological stress as indicated by significant changes in HRV metrics, which may suggest long-term effects. Longitudinal metrics including deep sleep duration and resting heart rate seem to be affected by consistent BioLight therapy. Additional research examining the effect of daily exposure duration, intervention timing, or intervention duration is recommended to optimize the dose administered to LLLT users.

References

- Chu, Y. H., Chen, S. Y., Hsieh, Y. L., Teng, Y. H., & Cheng, Y. J. (2017). Low-level laser therapy prevents endothelial cells from TNF- α /cycloheximide-induced apoptosis. *Lasers in Medical Science, 33*(2), 279–286. <https://doi.org/10.1007/s10103-017-2364-x>
- de Marchi, T., Leal Junior, E. C. P., Bortoli, C., Tomazoni, S. S., Lopes-Martins, R. L. B., & Salvador, M. (2011). Low-level laser therapy (LLLT) in human progressive-intensity running: effects on exercise performance, skeletal muscle status, and oxidative stress. *Lasers in Medical Science, 27*(1), 231–236. <https://doi.org/10.1007/s10103-011-0955-5>
- Leal, E. C. P., Lopes-Martins, R. L. B., Frigo, L., de Marchi, T., Rossi, R. P., de Godoi, V., Tomazoni, S. S., Silva, D. P., Basso, M., Filho, P. L., de Valls Corsetti, F., Iversen, V. V., & Bjordal, J. M. (2010). Effects of Low-Level Laser Therapy (LLLT) in the Development of Exercise-Induced Skeletal Muscle Fatigue and Changes in Biochemical Markers Related to Postexercise Recovery. *Journal of Orthopaedic & Sports Physical Therapy, 40*(8), 524–532. <https://doi.org/10.2519/jospt.2010.3294>