

Photobiomodulation in Alzheimer's mouse model falls short in preventive impact

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Photobiomodulation (PBM) treatment has been widely studied in murine and non-human primate models for treating neurodegenerative and other brain diseases. In a recent study published in [Scientific Reports](#), researchers assess [the efficacy of](#) PBM treatment in a transgenic murine model of Alzheimer's disease (AD).



Study: [A randomized, blinded study of photobiomodulation in a mouse model of Alzheimer's disease showed no preventive effect.](#) Image Credit: JuYochi / Shutterstock.com

What is PBM treatment?

PBM, or low-level light therapy (LLLT), involves the exposure of tissues to low-power light between 600–1,000 nanometers (nm) in wavelength emitted from light-emitted diodes (LEDs). Although lasers were previously utilized for PBM treatment, LED has become the preferred light source due to its low cost, higher potential for translation to human subjects, and better safety profile.

PBM treatment has been shown to mitigate various pathologies; however, the mechanisms responsible for its potential therapeutic effects remain unclear. Currently, researchers hypothesize that photoexcitation, which is the process by which photon absorption facilitates electron excitation, photoisomerization, or enhanced fluid perfusion/microcirculation, may be involved. Photon absorption by cytochrome C oxidase, which is involved in the production of adenosine triphosphate (ATP), has also been proposed.

About the study

In the present study, researchers treated 5xFAD mice, a transgenic model of AD, with low- or high-power PBM treatment and compared the effects of this treatment with controls. The two treatment groups received 810 nm light strokes at 100 hertz (Hz) three times a week for five months, and each treatment duration was two minutes. Treatment began during the first month of life and continued until the sixth month of life.

Mice underwent several behavioral studies before and after the five months of treatment, including the open field test, novel object recognition test (NORT), Y-maze, and Morris water maze. After euthanization, histopathological analysis of brains was performed to measure amyloid- β (A β), ionized calcium-binding adaptor molecule 1 (Iba1), and neuronal nuclear [antigen](#) (NeuN) expression.

Study findings

By two months of age, both brain gliosis and A β plaques were observed in

5xFAD mice, with behavioral cognitive impairments observed as early as five months of age. Notably, the researchers found that shaving the heads of the mice attenuated light transmission from PBM treatment by as much as 96%, which led the researchers to maintain shaved heads for the mice throughout the study period.

Without treatment, six-month-old 5xFAD mice took significantly longer to find the platform during the Morris water maze as compared to one-month-old mice, which likely reflects reduced motor performance in older 5xFAD mice. No significant differences were observed in the NORT and y-maze test between one and six months of age in untreated 5xFAD mice. In fact, mice exhibited a significantly greater discrimination index in the NORT and higher spontaneous alteration ratios in the y-maze test at six months of age.

Neither low- nor high-power PBM treatment significantly affected any behavioral outcomes in mice compared to controls. Likewise, no significant differences were observed between low- and high-power PBM treatment in terms of A β deposition, neuron proliferation, or microglial response within the brain as compared to control-treated mice.

Conclusions

The researchers of the current study utilized the most widely used and generally well-accepted murine model of AD to assess PBM's potential effectiveness in treating AD. By six months of age, neither low- nor high-power PBM treatment significantly affected behavioral performance or histopathological features of neurodegeneration.

Future studies could examine the long-term effects of PBM treatment beyond six months of age. Compared to the human progression of the disease, the six-month age of 5xFAD mice in this study corresponds to the mild cognitive impairment (MCI) stage of AD, when humans begin to exhibit slight signs of cognitive dysfunction despite widespread pathology within the brain.

Targeting the MCI stage of AD is crucial to mitigate its progression. Although recent AD treatments have been approved for use during this stage, many of these agents are associated with limited efficacy in improving clinical symptoms; thus, there remains an urgent need to identify novel therapeutics to treat MCI during AD.

Journal reference:

- Sipion, M., Ferreira, F.M., Scholler, J. *et al.* (2023). A randomized, blinded study of photobiomodulation in a mouse model of Alzheimer's disease showed no preventive effect. *Scientific Reports* 13.
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