

Home-Based Transcranial Photobiomodulation Improves Cognitive Function in Mild Cognitive Impairment Due to Alzheimer's Disease: A Randomized, Placebo-controlled Clinical Trial

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Abstract:

Alzheimer's disease (AD) is a progressive neurodegenerative disorder in which early bioenergetic impairment, including mitochondrial dysfunction and cerebral hypometabolism, plays a central role in pathogenesis. Transcranial photobiomodulation (tPBM), a non-invasive neuromodulation technique using near-infrared light, has emerged as a potential approach to enhance cerebral metabolism and cognitive function.

This randomized clinical trial evaluated the safety and efficacy of a home-administered tPBM intervention in individuals with mild cognitive impairment (MCI) due to AD. Eighty participants meeting the NIA-AA criteria self-administered 808 nm tPBM over the bilateral dorsolateral prefrontal cortex six times weekly for 12 weeks. The primary outcome was the change in MoCA-K score from baseline to week 13, with secondary outcomes including K-MMSE2, CERAD-K, and GDepS. The active group demonstrated significant cognitive improvement compared to placebo, with MoCA-K scores increasing by 3.87 ± 2.51 points versus a decline of 0.74 ± 2.85 ($p < 0.001$). Significant improvements were also observed in K-MMSE2 and CERAD-K, while GDepS remained unchanged. No device-related adverse events were reported, and adherence was high. These findings support tPBM as a safe and promising non-pharmacological intervention for MCI due to AD and a potential strategy to delay progression to AD.

Keywords:

Photobiomodulation, Transcranial photobiomodulation, Mild cognitive impairment, Alzheimer's disease, Neuromodulation.