

Jeewon Yoon<sup>1</sup>, Jejun Park<sup>1</sup>, Jisoo Baik<sup>2</sup>, Cherrie Ahn<sup>2</sup>, Yong-II Shin<sup>1,2,3\*</sup>

Department of Rehabilitation Medicine, Pusan National University Yangsan Hospital<sup>1</sup>

Research Institute for Convergence of Biomedical Science and Technology, Pusan National University Yangsan Hospital<sup>2</sup>

Department of Rehabilitation Medicine, Pusan National University School of Medicine<sup>3</sup>

## Introduction

Parkinson's disease (PD) is characterized by progressive dopaminergic neurodegeneration, mitochondrial dysfunction, and impaired cellular energy metabolism. Photobiomodulation (PBM) enhances mitochondrial cytochrome c oxidase activity, increases adenosine triphosphate production, and modulates neuroinflammation. While transcranial PBM has shown potential benefits in PD, the clinical effects of whole body-PBM (WB-PBM) remain unclear. To evaluate the safety, feasibility, and preliminary therapeutic effects of WB-PBM on cognitive and motor function in patients with PD.

## Methods

This single center prospective pilot study enrolled 15 patients with idiopathic PD (Hoehn & Yahr stage 1–3), 14 completed the 10 weeks protocol (Fig. 1). WB-PBM was delivered using a capsule type light emitting diode device (Fig. 2) emitting simultaneous wavelengths of 660, 810, 850, and 930 nm (35–65 mW/cm<sup>2</sup>), for 20 minutes per session, three times weekly (30 sessions). The primary outcome was the unified parkinson's disease rating scale (UPDRS I–III). Secondary outcomes included motor function tests (Berg balance scale, timed up and go, functional reach test, grip strength, clinical rating scale for tremor) and comprehensive cognitive assessment using the Seoul neuropsychological screening battery. Pre and post comparisons were analyzed using Wilcoxon signed rank tests ( $p < 0.05$ ).

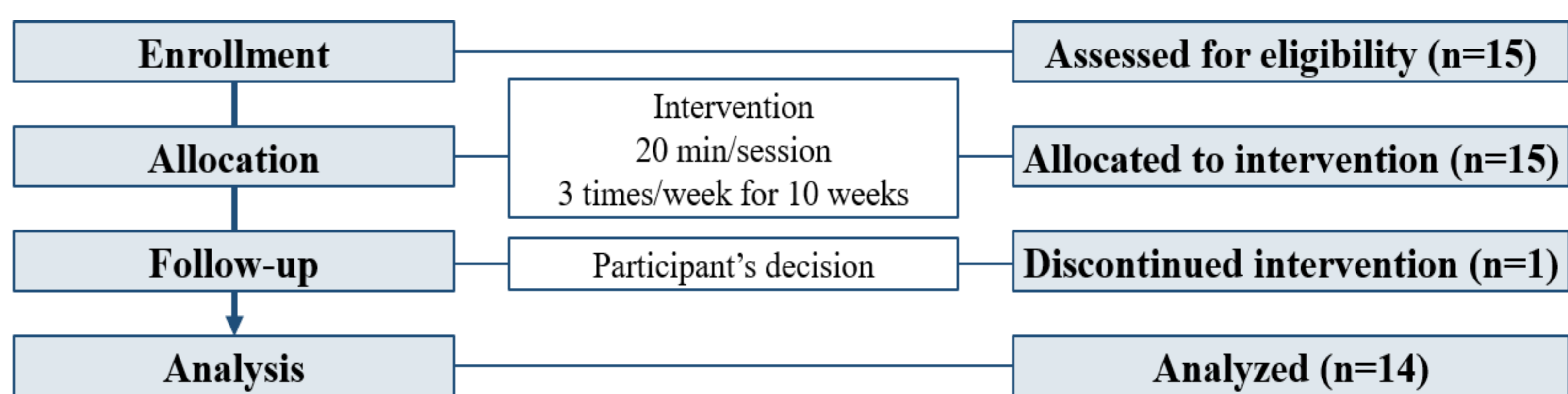


Figure 1. Consolidated standards of reporting trials (CONSORT) flow diagram in a pilot clinical trial of whole-body photobiomodulation for parkinson's disease



Figure 2. Whole-body photobiomodulation therapy device used in the study

## Results

UPDRS Part I significantly improved after intervention ( $p=0.008$ ,  $r=-0.71$ ), while Part II showed a trend toward improvement ( $p=0.053$ ). UPDRS Part III showed no significant change ( $p=0.964$ ), indicating maintenance of motor function (Table 1). Significant improvements were observed in verbal and visuospatial memory domains (Fig. 3). Seoul verbal learning test (SVLT) immediate recall ( $p=0.009$ ,  $r=-0.75$ ) and total score ( $p=0.006$ ,  $r=-0.77$ ) improved significantly. Rey complex figure test (RCFT) immediate recall ( $p=0.035$ ,  $r=-0.56$ ) and total score ( $p=0.042$ ,  $r=-0.55$ ) also increased significantly. Other executive and attention measures showed nonsignificant trends. No significant changes were observed in balance, gait, strength, and tremor measures, and no deterioration occurred. One participant reported mild localized hyperpigmentation but, no serious adverse events were observed.

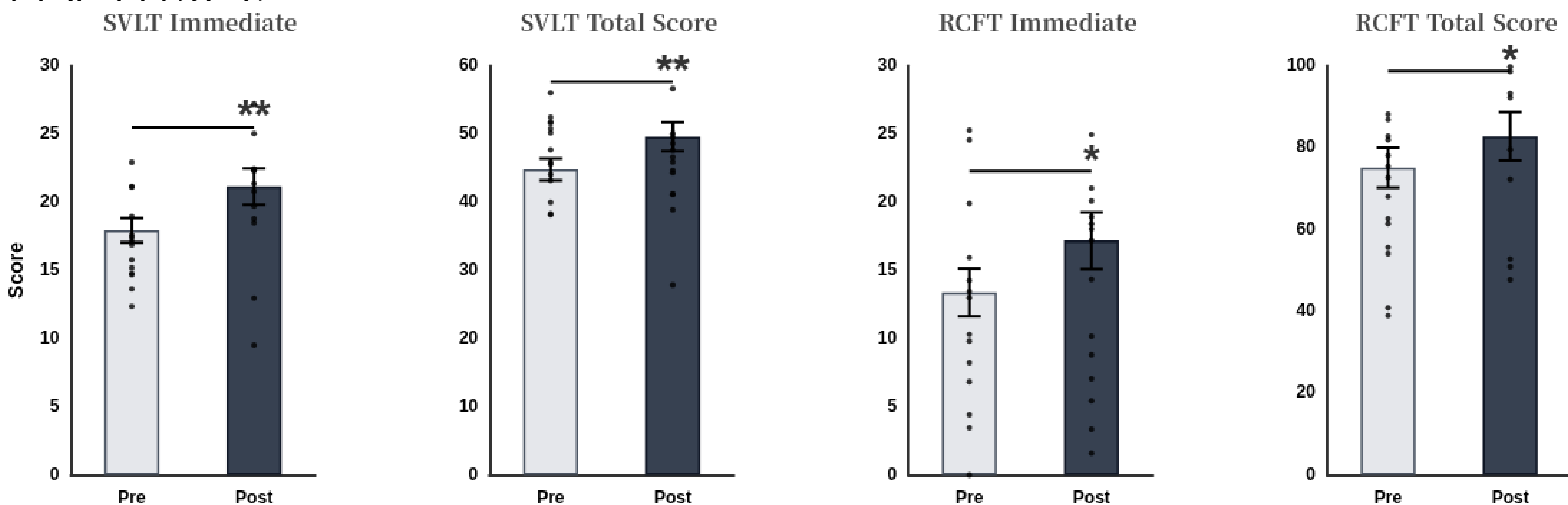


Figure 3. Pre-post changes in cognitive function measures showing statistically significant differences

Table 1. Within group pre-post comparisons of UPDRS scores following whole-body photobiomodulation therapy

	Baseline	Post treatment	Z	r	p
UPDRS Part I	2.57 ± 0.76	1.86 ± 0.95	-2.673	-0.71	0.008*
UPDRS Part II	8.79 ± 7.03	6.50 ± 4.38	-1.890	-0.52	0.053
UPDRS Part III	13.50 ± 10.89	11.93 ± 5.68	-0.045	0.01	0.964
UPDRS Total Score	24.86 ± 15.98	20.29 ± 8.71	-1.601	-0.42	0.119

UPDRS; Unified Parkinson's disease rating scale, Asterisk means statistically significant ( $p < 0.05$ ).

## Conclusion

WB-PBM demonstrated excellent safety and was associated with improvements in memory and non motor symptoms while maintaining motor function. The observed benefits in both cognitive and non-motor domains highlight the potential of WB-PBM to address aspects of Parkinson's disease that are often insufficiently managed by conventional therapies. Although limited by its small, single arm design, these findings suggest WB-PBM may represent a promising noninvasive neuromodulatory approach for PD. Larger sham controlled randomized trials are warranted.

\* Corresponding author's e-mail: rmshin01@gmail.com

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