

# Transcranial Photobiomodulation Treatment Effects in Former Athletes with Repetitive Head Hits

Spencer W. Liebel, Paula K. Johnson, Hannah M. Lindsey, Hilary A. Russell, Elizabeth S. Hovenden, Carmen Velez, Lawrence S. Carr, Elisabeth A. Wilde, & David F. Tate

## PURPOSE/INTRODUCTION

- Concussion (*i.e.*, mild traumatic brain injury) and repetitive sub-concussive head hits are recognized by the sports medicine community and society at large as a major public health concern.
- Psychiatric and neurocognitive functioning disruption and sleep disturbance are associated with these injuries.
- Transcranial photobiomodulation (tPBM) has been proposed as a non-invasive treatment.
  - tPBM involves shining red or near-infrared light at wavelengths between 600 nm – 1200 nm via light-emitting diodes (LED) onto the head.
  - The light is absorbed by brain tissue and achieves several proposed physiological benefits, including:
    - Acts on mitochondrial dysfunction suspected following head injury (*e.g.*, increased cellular oxygen consumption, ATP production);
    - Reduced inflammation;
    - Increased melatonin.
- The present proof-of-concept study begins to address tPBM's potential utility in the neurorehabilitation of athletes with repetitive head hits.

## METHOD

### PARTICIPANTS

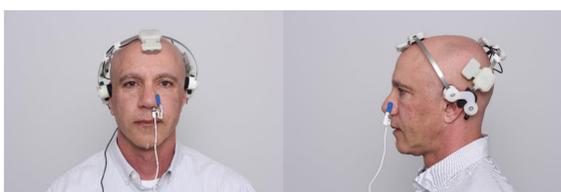
- 49 former male ( $n=45$ ) and female athletes ( $M_{\text{age}}=45.90$  years,  $SD=14.45$ ;  $M_{\text{education}}=15.31$  years,  $SD=12.66$ ).
- Inclusion criteria:
  - Aged 18-65 years;
  - Self-reported history of concussion and/or repetitive sub-concussive events.

### STUDY DESIGN

- Non-randomized, proof-of-concept.
- All participants received active tPBM treatment for 8 weeks.
- Pre- and post-treatment evaluations.
  - Paired *t*-tests analyzed pre- and post-treatment effects.

### MEASURES

- CES-D for depression symptoms.
- PCL-5 for posttraumatic stress symptoms.
- MPAA-4 for adjustment symptoms.
- PSQI for sleep quality.
- Simple reaction time via hockey puck drop.
- Bilateral grip strength via hand dynamometer.
- Bilateral hand dexterity via Grooved Pegboard.
- tPBM administered via the Vielight Neuro RX Gamma device (<https://vielight.ca/>).



## RESULTS

	Pre-Treatment	Post-Treatment	Paired <i>t</i> -test ( <i>p</i> )	Cohen's <i>d</i> (95% CI)
<b>Psychiatric Symptoms</b>				
CES-D Total Score	23.62 (10.62)	16.78 (8.54)	4.54 (<.001)	.75 (.38, 1.11)
PCL-5 Total Severity	29.05 (17.49)	20.63 (17.03)	3.43 (<.001)	.54 (.21, .87)
MPAI-4 Adjustment Index	21.88 (10.27)	14.28 (9.07)	5.23 (<.001)	.83 (.46, 1.18)
<b>Sleep Quality</b>				
PSQI Global Score	8.88 (4.13)	6.86 (4.00)	3.72 (<.001)	.57 (.24, .90)
<b>Reaction Time</b>				
SRT ( $M_{\text{ms}}$ (SD))	222.23 (26.56)	205.07 (22.74)	4.57 (<.001)	.73 (.37, 1.08)
<b>Fine Motor Coordination</b>				
Grooved Pegboard-dominant hand ( $M_{\text{s}}$ (SD))	77.45 (15.29)	75.37 (18.28)	1.27 (.213)	.19 (-.11, .50)
Grooved Pegboard-nondominant hand ( $M_{\text{s}}$ (SD))	83.55 (18.63)	80.21 (21.34)	1.86 (.070)	.29 (-.02, .59)
Grip Strength-dominant hand ( $M$ (SD))	0.48 (0.14)	0.50 (0.14)	-2.59 (.013)	-.41 (-.73, -.08)
Grip Strength-nondominant hand ( $M$ (SD))	0.46 (0.13)	0.49 (0.13)	-4.18 (<.001)	-.67 (-1.01, -.32)

## CONCLUSIONS

- Following tPBM treatment, study participants demonstrated statistically significant reductions in self-reported depression, posttraumatic stress, and adjustment symptoms.
- Sleep quality, simple reaction time, and bilateral hand grip strength improved following tPBM treatment.
- With effect sizes generally in the moderate and large ranges, results suggest that tPBM may reduce psychiatric symptoms and improve sleep quality, simple reaction time, and grip strength among former athletes with repetitive head hits.
- These data support future research on the potential adjunctive neurorehabilitation effects of tPBM in athletes:
  - Rigorous A-B-A-B study design, RCT, etc.

## ACKNOWLEDGEMENTS/CONTACT

- We are grateful to Vielight Inc for their support.
- Contact:
  - Spencer W. Liebel, PhD at [spencer.liebel@hsc.utah.edu](mailto:spencer.liebel@hsc.utah.edu)