



The Effects of Photobiomodulation on Cardiorespiratory Endurance in Adults with Chronic Obstructive Pulmonary Disease: A Systematic Review

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Introduction/Purpose

Chronic Obstructive Pulmonary Disease (COPD) affects millions of Americans and is the 3rd leading cause of disease related deaths in the US.¹ People with COPD experience symptoms of dyspnea, muscle weakness, and decreased endurance.¹⁻² Photobiomodulation (PBM) utilizes laser therapy (LT) and/or light-emitting diode therapy (LEDT) to remove blood lactate, enhance vasodilation, and increase muscle ATP. As a result, PBM inhibits muscle fatigue and oxidative stress in the muscle to improve cardiorespiratory endurance (CRE).³⁻⁴ The purpose of this systematic review is to determine the effects of PBM on CRE in adults with COPD.

Materials/Methods

Four electronic databases (CINAHL, ProQuest, PubMed, ScienceDirect) were systematically searched using search terms: (COPD OR “chronic obstructive pulmonary disease” OR “obstructive disease”) AND (Photobiomodulation OR “low level laser” OR “light emitting diode” OR phototherapy). Search limits: English, peer-reviewed. Selection criteria: adults 18 years or older diagnosed with COPD, group interventions using PBM (LT or LEDT) with a control, comparison group, or compared to baseline. Primary outcomes included endurance, dyspnea, and lower limb fatigue (LLF). Two reviewers independently assessed each study for methodological quality and came to a consensus based on PEDro guidelines.

References

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Summary of Interventions

Study	PEDro Score	Type of Device	Intervention
Miranda EF et al. ³	9/10	LT (super-pulsed) LEDT (infrared and red)	Location: 6 sites of quadriceps femoris Frequency: 250 Hz (super-pulsed), 2 Hz (Red), 16 Hz (Infrared) Time per site: 228 seconds
Miranda EF et al. ⁵	6/10	LEDT (infrared and red)	Location: Muscle bellies of rectus femoris, vastus medialis, vastus lateralis Frequency: Continuous output Time per site: 30 seconds
Miranda EF et al. ⁶	9/10	LT (super-pulsed) LEDT (infrared and red) Electromagnetic field	Location: 9 sites on knee extensor muscles, 6 sites on knee flexors, 2 sites on the calf Frequency: Not specified Time per site: Not specified
Costa IP et al. ⁴	10/10	LEDT (infrared)	Location: 50 sites on quadriceps femoris, 50 sites on hamstrings Frequency: Not specified Time per site: 15 seconds
Mohamed AR et al. ⁷	5/10	LT (low level)	Location: 7 sites on anterior and posterior intercostal spaces Frequency: 5000 Hz Time per site: 1 minute
Luniewski J. ⁸	4/10	LT (low level)	Location: Not specified Frequency: Not specified Time per site: Not specified

Results

Of the 697 articles screened for eligibility, 6 met the inclusion criteria (4 RCTs, 2 quasi-experimental). Sample sizes ranged from 10-40 participants (total=126) and the ages ranged from 19-74 years old. Four of the 6 studies reported statistically significant improvements in 3 primary outcome areas: endurance, dyspnea, and LLF. Statistically significant improvements were noted for LLF (peak torque) with the use of LEDT and LT on the quadriceps muscles.³ Endurance (6MWT) demonstrated statistically significant improvements in 2 studies when using LT alone⁷ or combined with LEDT⁶ when applied over the lower extremity muscles. Lastly, 2 studies demonstrated statistically significant improvements in dyspnea scores (self-report scales and pulmonary function tests) when treatment groups received LT alone³ or combined with LEDT.⁵ One study demonstrated clinically relevant improvements in 3 primary outcomes when using LEDT.⁸ One study did not find statistically significant or clinically relevant outcomes when applying LEDT.⁴ There was no correlation between number of sites or duration of treatment session and statistically significant outcomes.³⁻⁸

Conclusion/Clinical Relevance

Moderate to strong evidence supports using PBM to improve CRE in adults with COPD. Specifically, studies using LT revealed more robust findings including improved endurance, LLF, and dyspnea. Limitations included small sample size, the same lead researcher on 3 of the 6 studies, and lack of group randomization in 2 of the 6 studies. Further research is needed to assess the specific parameters of LT PBM for the most optimal CRE outcomes in adults with COPD. Clinicians should consider incorporating PBM to improve CRE in adults with COPD. LT may be more beneficial due to the deeper tissue penetration which enhances oxygen uptake into the muscle. Specifically, applying LT to the quadriceps or intercostals may benefit endurance, dyspnea, and LLF.

PRISMA

Records identified through database searching: (n = 697)

Records after duplicates removed: (n = 663)

Records excluded after screening by title, abstract, design and language: (n = 653)

Full-text articles assessed for eligibility: (n = 10)

Studies included: (n = 6)