

Red Light *Therapy.*

Benefits backed by science — a compilation of recent clinical evidence.



— DEFINITION

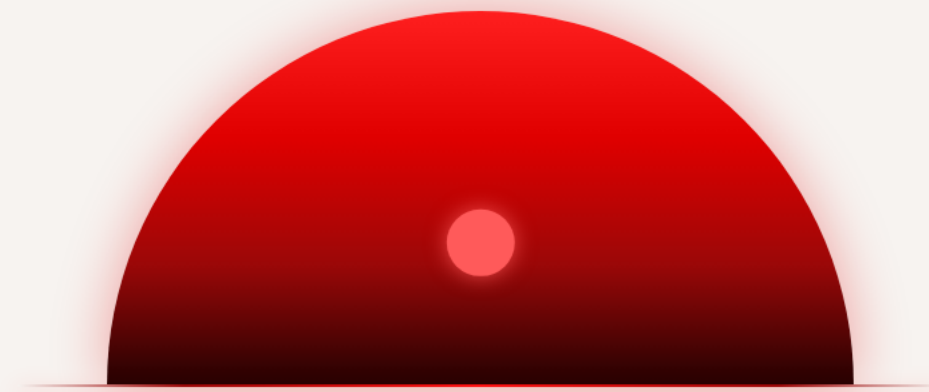
What is *photobiomodulation*?

PBM is the use of specific wavelengths of red and near-infrared light to stimulate cellular and biological processes in the body.

Also known as *Red Light Therapy* or low-level laser therapy (LLLT). The therapeutic band sits in the deep visible red and near-infrared range, where light penetrates tissue without generating heat.



THERAPEUTIC RANGE · VISIBLE RED → NEAR INFRARED



— MECHANISM OF ACTION

How light *speaks* to the mitochondria.

PBM stimulates the electron transport chain in mitochondria — specifically cytochrome c oxidase, Complex IV.

STEP 01  Photonic absorption 630–850 nm photons penetrate the skin and are absorbed by mitochondrial chromophores.	STEP 02  Cytochrome c oxidase Complex IV releases inhibitory nitric oxide and reactivates the electron transport chain.	STEP 03  ATP production ATP synthesis increases. The cell recovers energy availability to repair and regenerate.	STEP 04  Cellular modulation Reduction of oxidative stress, modulation of inflammation and homeostatic signaling.
---	--	---	--

Areas with the *strongest evidence.*

#	THERAPEUTIC AREA	EVIDENCE LEVEL	PAPERS	STRENGTH
01	Skin · Anti-aging · Collagen	High — multiple RCTs	3 papers · 2023–2024	
02	Wound healing	High — meta-analysis 18 RCTs	2 papers · 2024	
03	Chronic pain and joints	Medium-High — systematic review	2 papers · 2024–2025	
04	Muscle recovery	High — systematic review	2 papers · 2015–2025	
05	Neurology · Cognition · Mood	Medium — 10 studies	2 papers · 2021–2024	
06	Myopia control	Medium — developing	1 paper · 2024	
07	General health · Multi-systemic	High — umbrella review	2 papers · 2024–2026	

— TERRITORY 01

01

Skin, collagen and *photorejuvenation.*

Three trials and systematic reviews documenting wrinkle reduction, type I collagen synthesis, and the oncologic safety of PBM in aesthetic applications.

3 PAPERS · 2023 – 2024 · EVIDENCE LEVEL: HIGH

— SKIN · 3 PAPERS

Reduces wrinkles. *Builds collagen.*

PAPER 01 · REVIEW

Unlocking the Power of Light on the Skin: A Comprehensive Review on Photobiomodulation

Hernández-Bule ML, Naharro-Rodríguez J, et al.

| Int. J. Mol. Sciences (MDPI) · April 2024

Improvements in wrinkles and signs of photodamage. Histologically, increased type I collagen and reduced metalloproteinases. All trials reported PBM as a safe, athermic treatment with no side effects.

mdpi.com/1422-0067/25/8/4483

PAPER 02 · RCT

Reverse skin aging signs by red light photobiomodulation

Couturaud V, Le Fur M, et al.

| Skin Research & Technology · July 2023

Demonstrates reversal of skin aging signs through repeated sessions. Clinically visible improvements in texture, tone, and firmness.

[PubMed · Skin Res Technol. 2023 Jul;29\(7\):e13391](https://pubmed.ncbi.nlm.nih.gov/413391)

PAPER 03 · SAFETY

Oncologic Safety of Low-Level Light Therapy for Aesthetic Skin Rejuvenation

Graeme Ewan Glass

| Aesthetic Surgery Journal (Oxford) · Feb 2023

Within established parameters, red and IR light enhances the proliferation of healthy cells without affecting neoplastic cells. Does not induce dysplastic changes. Safe for post-cancer patients.

[ncbi.nlm.nih.gov/pmc/articles/PMC10309024/](https://pubmed.ncbi.nlm.nih.gov/413391)

— TERRITORY 02

02

Wound healing and *skin repair*.

Two studies — including a meta-analysis of 18 randomized clinical trials — on accelerated skin healing and tissue repair.

— WOUND HEALING · 2 PAPERS

Accelerates *skin repair*.

PAPER 04 · META-ANALYSIS · WOUNDS

Low-level laser/LED therapy significantly accelerates skin wound healing

Taha et al.

| Meta-analysis · 18 RCTs · 2024

Low-level LED/laser therapy significantly accelerates the healing of skin wounds. One of the most comprehensive meta-analyses in the field, with 18 randomized controlled trials included.

newhealthjournal.org · Taha et al., 2024

PAPER 05 · PROSPECTIVE STUDY

Combined red, blue and near-infrared LED PBM therapy on wound healing

Soliman J, Elsanadi R, et al. · UC Irvine

| Lasers in Medical Science (PMC) · March 2024

Prospective study with 25 volunteers using LED at three wavelengths (465 / 640 / 880 nm). Blinded evaluators confirmed the PBM-treated side healed consistently faster.

ncbi.nlm.nih.gov/pmc/articles/PMC10965566/

— TERRITORY 03

03

Chronic pain and *joint support.*

Two systematic reviews on chronic musculoskeletal pain and knee osteoarthritis, including pain at rest and mobility outcomes.

— PAIN AND JOINTS · 2 PAPERS

Eases pain. *Supports mobility.*

PAPER 06 · SYSTEMATIC REVIEW · PAIN

Photobiomodulation in chronic pain: a systematic review of randomized clinical trials

Multiple authors · systematic review

| PubMed / PMC · 2025

Covers publications 2015–2025 in PubMed, Embase, Scopus, LILACS, and MEDLINE. Evidence of significant reduction in chronic pain through PBM across multiple musculoskeletal conditions.

ncbi.nlm.nih.gov/pmc/articles/PMC12909510/

PAPER 07 · SYSTEMATIC REVIEW · ARTHRITIS

Systematic review on knee osteoarthritis and photobiomodulation

Oliveira et al.

| Systematic Review · 2024

Review of 10 studies on knee arthritis: PBM significantly reduces pain at rest. Patients reported improved mobility. Complements standard exercise and medication.

newhealthjournal.org/does-red-light-therapy-work-research

— TERRITORY 04



04

Muscle recovery and *athletic performance.*

PBM as a tool to reduce post-exertion muscle damage, modulate inflammation, and accelerate recovery. A consolidated reference in sports medicine.

2 PAPERS · 2015 – 2025 · EVIDENCE LEVEL: HIGH

— RECOVERY · 2 PAPERS

Less damage. *Less fatigue.*

PAPER 08 · SYSTEMATIC REVIEW · SEMINAL

Systematic review on red light for athletic performance and recovery

Leal-Junior et al.

| Review · 2015 · classic, still cited

Seminal systematic review documenting the efficacy of RLT for reducing muscle damage, post-exertion inflammation, and fatigue in athletes. Still a standard reference in sports medicine.

Multiple international clinical databases

PAPER 09 · UMBRELLA REVIEW

Effects of photobiomodulation on multiple health outcomes: an umbrella review of RCTs

Multiple authors

| PMC / PubMed · 2024–2025

A review of reviews of randomized clinical trials documenting PBM effects on muscle strength, recovery, and physical performance, along with other health outcomes.

[pmc.ncbi.nlm.nih.gov/articles/PMC12326686/](https://pubmed.ncbi.nlm.nih.gov/articles/PMC12326686/)

— TERRITORY 05

05

Neurology, cognition and *mood*.

Evidence exploring PBM for neurological support, dementia-related outcomes, and psychiatric measures such as anxiety and mood.

— NEUROLOGY + MOOD · 2 PAPERS

Brain, cognition and *mood*.

PAPER 10 · REVIEW · NEUROLOGY

Red light therapy in dementia: systematic review (10 studies)

Multiple authors · Research Review

| Research Review · WebMD / PubMed · 2021

A review including 10 studies found benefits of RLT for people with dementia across all reviewed studies. Suggests neuroprotective effects of PBM.

webmd.com · skin-problems-and-treatments/red-light-therapy

PAPER 11 · MENTAL HEALTH

Photobiomodulation and psychiatric outcomes

Qipei J, et al.

| Frontiers in Psychiatry · 2024

Research on the effects of PBM on mental health and psychiatric outcomes, including anxiety and mood.

Front. Psychiatry 14, 1267415 (2024)

— TERRITORY 06

06

Visual health and *myopia control*.

Developing evidence on repeated low-level red-light therapy as a potential approach for myopia control and visual health.

— VISUAL HEALTH · 1 PAPER

Light and *vision*.

PAPER 12 · MYOPIA

Safety of Repeated Low-Level Red-Light Therapy for Myopia: A Systematic Review

Y.C., R.X. et al.

| medRxiv (preprint, comprehensive review) · 2024

RLRL has emerged as a novel approach for myopia prevention, highlighted in the 2023 Digest of the International Myopia Institute. Systematic review of 7 databases without language restriction.

medrxiv.org/content/10.1101/2024.04.19.24306057

— TERRITORY 07

07

Multi-systemic health and *homeostasis.*

Panoramic and umbrella reviews showing PBM across metabolism, immune homeostasis, inflammation, circulation and recovery.

2 PAPERS · 2024 – 2026 · EVIDENCE LEVEL: HIGH

— MULTI-SYSTEMIC · 2 PAPERS

From discipline *to system.*

The clinical application of PBM has expanded beyond dermatology into a multi-systemic approach to homeostasis and repair.

PAPER 13 · GENERAL REVIEW

From light to healing: photobiomodulation therapy in medical disciplines

Multiple authors

| [PMC / PubMed](#) · 2024–2025

PBM exerts multifaceted effects on metabolism and immune homeostasis. Clinical applications have expanded from dermatology and wound healing into musculoskeletal, neurological, ophthalmic, and oncological conditions. Documented potential for symptomatic relief, accelerated recovery, and tissue protection under oxidative or inflammatory stress.

PAPER 14 · SCIENCE DEVELOPMENTS COMPILATION

Ten Huge Light Therapy Science Developments 2024 – 2026

Light Therapy Insiders · Science compilation

| [lighttherapyinsiders.com](#) · April 2026

Compilation of advances across five areas:

- 01 Cardiovascular health
- 02 Chronic inflammation
- 03 Immune function
- 04 Peripheral circulation
- 05 Gut health

— FINAL NOTE

Red light *has science* on its side.

This document is a compilation of scientific evidence for informational and educational purposes.
The cited studies are real and verifiable in databases such as PubMed, PMC, and MDPI. The
information presented here does not replace professional medical advice.