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The Future of Medicine: Boost Your Health, Mental Abilities and Athletic Ability with Light. "Photobiomodulation"

By Washington's Blog
Global Research, June 25, 2018
Washington's Blog 24 June 2018
Theme: Science and Medicine

If there was a pill which could boost your health, increase testosterone, sharpen your mind and supercharge your athletic abilities ... you'd take it, right?

Especially if there were no negative side effects ... and the pill was cheap?

Well, there is something like that.

But instead of a pill you pop in your mouth, it's a special type of light. Scientists call treatment with this special type of light "photobiomodulation" (or "PBM"), and they used to call it "low level light therapy" (or "LLLT"). Or some people simply call it "red light therapy".

If this sounds crazy, remember that our bodies evolved to make Vitamin D from a specific type of light (specifically, the ultraviolet light coming from the sun). And scientists say that the blue light from your devices can damage your eyes and may cause severe health problems. So it is clear that light has an effect on us.

Thousands of Scientific Studies from All Over the World Demonstrate the Power of This Approach

Let's jump right into the scientific proof that this approach is incredibly powerful for a vast range of conditions. We will link to the scientific studies, and note the academic institutions with which the researchers are affiliated.

Improves Athletic and Sports Performance

Top U.S. Olympic athletes state that PBM helps their performance. See this video, and then watch this one.
Many studies show that PBM can assist in athletic performance:

- Provides an advantage in sports performance (Massachusetts General Hospital, Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology, Universidade do Sagrado Coração)

- The effectiveness in improving muscle performance and recovery suggest applicability for high performance sports and in training programs (Harvard Medical School, Massachusetts General Hospital, Harvard-MIT Division of Health Science and Technology, Federal University of Sao Carlos, University of São

Paulo)

- Improves performance and accelerates recovery of high-level rugby players (Universidade Nove de Julho, Vrije Universiteit Amsterdam, Universidade Cidade de São Paulo)

- Significantly reduced return-to-play in injured university athletes (Lehigh University)

- Twin exposed to PBM performed better than twin not exposed in terms of reduced muscle damage, pain, and atrophy, increased muscle mass, recovery, and athletic performance (Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology, Massachusetts General Hospital, Federal University of São Carlos, University of São Paulo)

- Accelerates post-exercise recovery (University of Bergen,, University of Caxias do Sul, University of São Paulo)

- Improves muscular performance and accelerates recovery if applied before exercise (University of Bergen, Universidade Nove de Julho)

- Improves muscle performance, reduces muscle fatigue during exercises and benefits muscle repair(Massachusetts General Hospital, Federal University of São Carlos)

- Enhances physical performance, stamina, and provides prophylactic benefits to skeletal muscle(University of Florida)

- Decreases muscle injury (Tel-Aviv University)

- Helps all phases of muscle recovery process, including anti-inflammatory, antioxidative properties and bio-stimulation (University Paulista, Methodist University of São Paulo)

- Aids in muscle repair (Universidade Nove de Julho, University of São Paulo)

- Reduces loss of strength after resistance exercise, may be beneficial for improving muscle function during rehabilitation after musculoskeletal injury (University of Calgary, University of Florida, Troy University)

- Promotes mucle regeneration (Massachusetts General Hospital, Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology, Federal University of São Carlos, Universidade de São Paulo)

- Promotes skeletal muscle regeneration and accelerates tissue repair (Soochow University, Fudan University, South China Normal University)

- May modulate metabolic and renal function to achieve better performance (Harvard Medical School, Massachusetts General Hospital, Harvard-MIT Division of Health Science and Technology, Federal University of Sao Carlos, University of São Paulo)

- Significantly increases performance, decreases muscle soreness, and reduces to skeletal muscle damage (Universidade Nove de Julho)

- Aids muscle recovery (Federal University of São Carlos, University of São Paulo)

- Decreases muscle fatigue (Nove de Julho University)

- Reduces muscle inflammation (Universidade Luterana do Brasil)

- Helps with Achilles heel (University of Bergen)

- Strenghtens knee muscles and quickens recovery from exercise (Universidade Federal de Ciências da Saúde de Porto Alegre, Brazil)

- Assists with muscle fatigue and muscle injury (Harvard University, Federal University of São Carlos)

Good for the Brain

- Researchers at the Department of Psychology and Institute for Neuroscience, University of Texas at Austin found:

> "LLLT improves prefrontal cortex-related cognitive functions, such as sustained attention, extinction memory, working memory, and affective state. Transcranial infrared stimulation may be used efficaciously to support neuronal mitochondrial respiration as a new non-invasive, cognition-improving intervention in animals and humans. This fascinating new approach should also be able to influence other brain functions …"

They note:

> "LLLT supplies the brain with metabolic energy in a way analogous to the conversion of nutrients into metabolic energy, but with light instead of nutrients providing the source for ATP-based metabolic energy."

- Improves memory and attention (University of Texas at Austin)

- Improves reaction times, and improves performance on memory test in healthy test subjects(Massachusetts General Hospital, Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology, with funding from the U.S. National Institutes of Health, U.S. Air Force Office of Scientific Research, U.S. Army Medical Research)

- Improves cognition, reduces costs in traumatic brain injury treatment (VA Boston Healthcare System)
- Helps with dementia (Harvard Medical School, Boston University School of Medicine, Massachusetts General Hospital)
- Promising therapy for Alzheimer's and brain injury (Boston University Medical Center, St Michael's Hospital)
- Promising treatment for Gulf War syndrome (U.S. Department of Veteran's Affairs)
- Helps with Parkinson's (Lausanne University Hospital, École Polytechnique Fédérale de Lausanne, with funding from Swiss National Science Foundation)

Increases Testosterone

Studies from North Carolina State University, U.S. National Cancer Institute, College of Medical Sciences in Nepal, NRS Medical College and Dankook University, and the Wallace Memorial Baptist Hospital show that PBM may significantly increase testosterone levels in males.

Helps Prevent Macular Degeneration

- Studies from the State University of New York, University of Wisconsin at Milwaukee, and Austalian National University show that PBM can help reduce macular degeneration and other causes of blindness

Good for the Skin

- It's good for the skin (Massachusetts General Hospital, Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology, Defence Institute of Physiology & Allied Sciences, India, Aripam Medical Center, Israel):

> "In dermatology, LLLT has beneficial effects on wrinkles, acne scars, hypertrophic scars, and healing of burns. LLLT can reduce UV damage both as a treatment and as a prophylaxis. In pigmentary disorders such as vitiligo, LLLT can increase pigmentation by stimulating melanocyte proliferation and reduce depigmentation by inhibiting autoimmunity. Inflammatory diseases such as psoriasis and acne can also benefit."

- Stimulates, heals and restores skin (Harvard Medical School, Massachusetts General Hospital)
- Protects skin against wrinkles (Dankook University, Yonsei Wonju College of Medicine)
- Reduces wrinkles (Medical Light Consulting, Heidelberg, Germany, International GmbH, Windhagen, Germany)

- Helps in healing wound from Staph infection (Baqiyatallah University of Medical Sciences)

- Speeds healing of diabetic wounds (King Faisal Specialist Hospital and Research Centre)

- Hastens wound healing by promoting fibrous tissue, epidermal and endothelial cell proliferation(Chinese Academy of Medical Sciences, Peking Union Medicine College)

Mood and Depression

- Helps with major depression (Massachusetts General Hospital, Icahn School of Medicine at Mount Sinai)
- Assists with seasonal and non-seasonal depression (New York State Psychiatric Institute)
- Less experience of day-to-day anxieties and stressors in healthy test subjects (Massachusetts General Hospital, Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology, with funding from the U.S. National Institutes of Health, U.S. Air Force Office of Scientific Research, U.S. Army Medical Research)
- Improves mood (University of Texas at Austin)
- Improves behavioral recovery from neurodegeneration (University of Texas at Austin)

Protects the Heart

- Helps protect the heart after a heart attack (Sydney University, Australian Catholic University, University of New South Wales, Macquarie University, Maitland Hospital, Blacktown Hospital)

Reduces Pain

- Reduces pain after spinal cord injury (Australian National University)

- Reduce pain in cancer patients (University of Alabama at Birmingham Hospital)

Helps Teeth and Gums

- May improve healing, reduce inflammation and control pain (University of Birmingham)

- Improves blood flow and neovascularization, non-healing wounds can be healed, 'normal' wounds heal faster and better, pain and many types of inflammation can be significantly reduced (Kangbuk Samsung Hospital)

- May help to regenerate damaged bone (Shahid Beheshti University of Medical Sciences)

- Helps heal bone defects after grafts (Pontifícia Universidade Católica do Rio Grande do Sul)
- Promotes bone healing after socket extraction surgery (University of Medicine and Pharmacy of Târgu Mures)
- Helps promote healing after periodontal surgery (Tokyo Medical and Dental University)
- May help form dentin on damaged, immature teeth (AJA University of Medical Sciences, Tehran University of Medical Sciences, University of Tehran)
- Reduces harmful bacteria in mouth (Shahid Beheshti University of Medical Sciences, Qom University of Medical Sciences)
- May help reduce harmful bacteria in the mouth (University of Campinas)
- Reduces pain in mouth (Urmia University of Medical Sciences)
- Reduces tooth sensitivity (Atatürk University)
- Reduces tooth sensitivity (University of Ankara, Near East University)

Assists with Weight Loss

- Studies from Massachusetts General Hospital, Louisiana State University, Louisiana State University, Rensselaer Polytechnic Institute, and the San Antonio Medical Spa show that PBM can help with those trying to lose weight

Thyroid

- The University of Sao Paulo Medical School has shown that PBM can help with thyroid conditions.

Joint Pain and Arthritis

- Reduces osteoarthritis pain (University of Ottawa)
- Reduces pain and improves health status in chronic joint disorders (University of Bergen)
- Reduces osteoarthritis pain in knee (São Paulo University)
- Reduces pain and improves quality of life in patients with knee osteoarthritis (University of Dundee)

Nerve Damage

- Studies from Massachusetts General Hospital, Harvard Medical School, the University of Pennsylvania, Medical College of Wisconsin, and University of Wisconsin, Milwaukee show that PBM is helpful in addressing nerve damage

Other Healing Effects

Studies have shown many other beneficial effects from PBM, including:

- Increases peripheral blood flow (Brigham Young University)
- Helps with tumors (Institute of Research and Development, Brazil)
- Reduces pain from chemotherapy (University of Alabama, Children's Hospital Wisconsin NASA)
- Helps with burns (Karolinska Institutet, Sweden)
- Promotes wound healing, tissue repair, and the prevention of tissue death, to relieve inflammation and edema because of injuries or chronic diseases, and as an analgesic and a treatment for other neurological problems (Massachusetts General Hospital, Harvard Medical School, Guangxi Medical University, Harvard-MIT Division of Health Sciences and Technology; funding from U.S. National Institutes of Health, U.S. Air Force Office of Scientific Research)
- Reduces tinnitus (University of Manchester, Weill Cornell Medical College, Rumaillah Hospital and Hamad General Hospital)
- Fights certain types of bacterial infection (Friedrich Schiller University)
- Reduces baldness in men and women (various)

Indeed, an FDA scientists said at a recent conference that PBM showed positive effects on virtually every health condition studied so far.

(And the articles listed above are just a sample … I have collected hundreds of other links to scientific articles on the health benefits of PBM. But spamming you with links would be boring. And scientists such as Hamblin have written definitive summaries of the topic.)

How Was This *Discovered?*

The discovery of PBM – like many great scientific discoveries – was largely an accident …

Emeritus Professor, Radiation Oncology (Radiation Biology) Stanford University School of Medicine, Kendric C. Smith, notes:

> "The father of phototherapy is Niels Ryberg Finsen, who first used sunlight, and then red light, to treat patients with smallpox in the 1800's. He received a Nobel Prize in 1903."

In 1967, professor of surgery at Pazmany Peter University in Budapest named Endre Mester experimented on rats and mice to try to induce cancer with lasers. He shaved the mice, and then shot a red laser at them. To his surprise, the red laser didn't induce cancer … instead hair grew back faster on the animals.

In the 1990's, NASA ran experiments to see if LED lights could help plants grow onboard the space shuttle. But the astronauts soon noticed that the lights helped their wounds heal more quickly.

NASA notes:

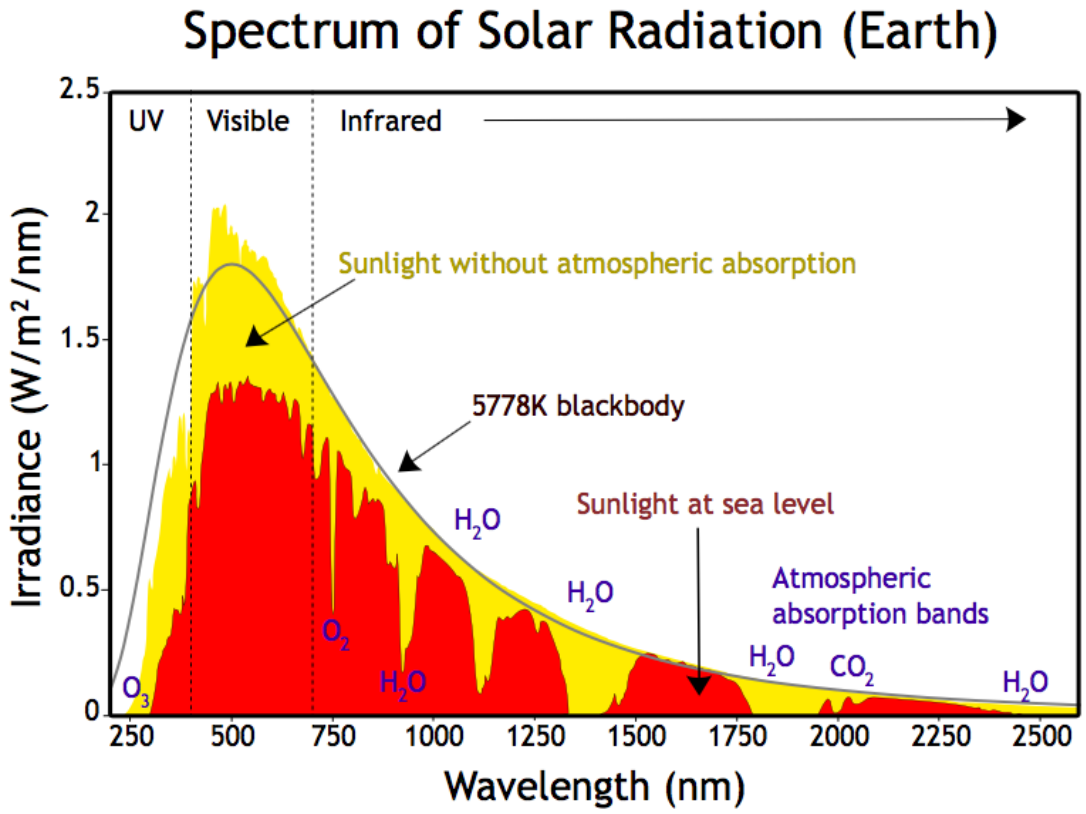
> "Tiny light-emitting diode (LED) chips used to grow plants in space are lighting the way for cancer treatment, wound healing, and chronic pain alleviation on Earth."

Evolutionary Basis for the Health Benefits of Red Light

What possible mechanism could explain the incredibly diverse positive effects from PBM? What possible evolutionary explanation is there for this treatment?

Our bodies evolved to consume certain materials to stay healthy. For example, we evolved to eat protein and drink water … so we need both to maintain health. Scientists have recently learned that our bodies also evolved to consume omega 3 fatty acids, and as mentioned above, to make Vitamin D from UV light.

The sunlight shining on our ancestors' and our bodies is comprised *mainly* of red and near infrared light between around and nanometers:



Source: Nick84, CC BY-SA 3.0

As NASA discovered with its red light experiments, red light helps plants to grow. And a new study from researchers from the U.S. and Finland show that virtually all life-forms respond favorably to light. They note:

> "Veterinarians routinely use PBM to treat non-mammalian patients. The conclusion is that red or NIR light does indeed have significant biological effects conserved over many different kingdoms, and perhaps it is true that "all life-forms respond to light".

Our ancestors were outside a lot. Many of them woke up shortly before dawn, and went to sleep shortly after dusk. So they got exposed to a lot of natural light ... not only bright overhead white sunlight, but also the red wavelengths in the sunrise and sunset.

So maybe we evolved to get a lot of exposure to red light. The fact that plants and other organisms seem to be positively effected by red light would support that argument.

But that still doesn't explain why red light applied to the *inside* of the body has beneficial effects. Specifically, red light shined inside the nose or – according to Chinese and Russian tests – directly into the bloodstream, have positive effects.

How could this be?

Scientists have proven that red light boosts the production of ATP by mitochondria, which are the powerhouses in our cells. *Every* cell in our body (other than red blood cells) contain mitochondria.

Now here's my personal theory ...

Mitochondria may originally have been photosynthetic bacteria. For example, a top evolutionary biologist – Oxford professor of evolutionary biology Thomas Cavalier-Smith – argues:

> [T]he first enslavement step [of the bacteria which would become mitochondria by larger organisms which would eventually evolve into humans] was uptake of a host carrier protein through the outer membrane (OM) and its insertion into the inner, cytoplasmic membrane (IM) of a photosynthetic purple bacterium that escaped into the host cell's cytoplasm from the food vacuole into which it was initially phagocytosed.

Studies show that photosynthetic purple bacteria utilize similar wavelengths to those used in PBM.

So while I obviously don't know why PBM does so many helpful things, my hypothesis is that PBM taps into latent abilities of our mitochondria ... that may have lain untapped for millions of years.

While this may sound whacky, the Harvard Medical School professor who wrote the book (actually severalof them) on PBM, Dr. Michael Hamblin, told me "I think there is something in your theory".

Postscript: In a separate article, I will discuss various ways to use PBM and get exposure to red light therapy.
