Photobiomodulation (PBM) for Athletes

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PBM WELLNESS DEVICES - Enhancing recovery and performance and helping achieve better local and overall physical and mental health

CONGRATULATIONS TO MINA SATO – WORLD CHAMPION

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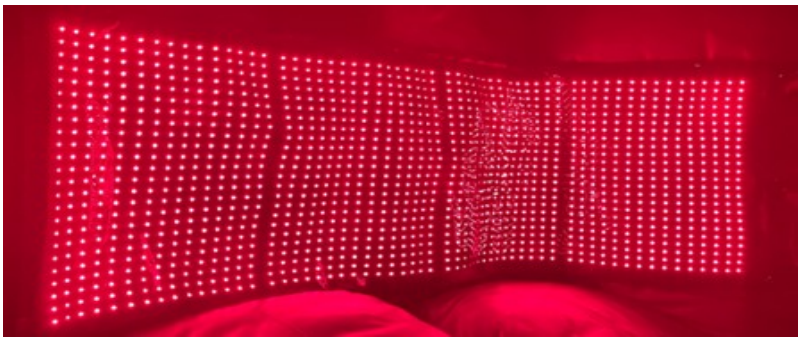
What about whole body Photobiomodulation Treatment with the PBM TYM Therapeutic Yoga Mat?



PBM TYM

Research is emerging on the use of Photobiomodulation therapy (PBMT) and its potential for augmenting human performance, however, relatively little research exists utilizing full-body administration methods. As such, further research supporting the efficacy of whole-body applications of PBMT for behavioral and physiological modifications in applicable, real-world settings are warranted. The purpose of this analysis was to observe cardiorespiratory and sleep patterns surrounding the use of full-body PBMT in an elite cohort of female soccer players. Members of a women's soccer team in a "Power 5 conference" of the National Collegiate Athletic Association (NCAA) were observed across one competitive season while wearing an OURA Ring nightly and a global positioning system (GPS) sensor during training. Within-subject comparisons of cardiorespiratory physiology, sleep duration, and sleep composition were evaluated the night before and after PBMT sessions completed as a standard of care for team recovery. Compared to pre-intervention, mean heart rate (HR) was significantly lower the night after a PBMT session (p = 0.0055). Sleep durations were also reduced following PBMT, with total sleep time (TST) averaging 40 min less the night after a session (p = 0.0006), as well as significant reductions in light sleep (p = 0.0307) and rapid eye movement (REM) sleep durations (p = 0.0019). Sleep durations were still lower following PBMT, even when controlling for daily and accumulated training loads. Enhanced cardiorespiratory indicators of recovery following PBMT, despite significant reductions in sleep duration, suggest that it may be an effective modality for maintaining adequate recovery from the high stress loads experienced by elite athletes.

Rentz LE, Bryner RW, Ramadan J, Rezai A, Galster SM. Full-Body Photobiomodulation Therapy Is Associated with Reduced Sleep Durations and Augmented Cardiorespiratory Indicators of Recovery. Sports (Basel). 2022 Jul 31;10(8):119. doi: 10.3390/sports10080119. PMID: 36006085; PMCID: PMC9414854.

INTRODUCTION

Benefits of photobiomodulation (PBM) have been known for several decades. More recently, PBM applied in sports for performance and recovery. Physical activities and fierce competition in the world of sports generate a state of psycho-emotional and physical stress that can induce chronic fatigue syndrome, failure in physical training, predisposition to muscle damage, physical and emotional exhaustion etc., for which PBM could be an excellent solution. In the present research, PBM has been shown to have valuable protective and ergogenic effects being the key to success for high performance and recovery. PBM applied creatively and targeted depending on sport and size of the level of physical effort could perfectly modulate the mitochondrial activity and thus lead to remarkable improvements in performance.

PBM can be applied in sports to the energy, metabolic, immune, and neuro-endocrine systems to modulate and enhance levels of training, performance and recovery mentally and physically in a natural, drug free manner.

1. What is photobiomodulation

Photobiomodulation (PBM) or Light Therapy is a safe, simple treatment that delivers concentrated light to the cells using the same wavelengths as natural light from the sun. PBM stimulates the mitochondria, the powerplants in our cells that produce energy. PBM also helps with antioxidant production to help with cell injury. In addition, PBM improves blood flow to improve the healing processes of the body. Light can energize and turn on various systems in your body, think about the incredible process where sunlight can help you create your own Vitamin D.

The most effective wavelengths beneficial at the cellular level are 660 nanometers (Red Light) and 850 nanometers (Near Infrared Light). 660 nm, is more quickly absorbed by the skin cells and stimulates collagen production and 850 nm penetrates deeper to promote muscle recovery. PBM works on a cellular level to stimulate biochemical reactions in the area where it's being administered called localized effect and can also spread throughout the body called a regional effect. The light interacts with the photoreceptors inside the mitochondria of our cells to boost energy production. This biochemical reaction then leads to the well-known benefits of increased collagen production, improved blood circulation, and reduced inflammation.

Think of the application of PBM to our bodies like filling the gas tank in a car. The light energy called a photon creates the fuel for our cells called ATP. PBM enhances mitochondrial function, which in turn increases ATP production. ATP is the "fuel" used by every one of our cells and is how everything in our bodies operate. More ATP makes it easier for cells to function efficiently and repair damage more quickly.As the gas in our car is used up to produce energy, more will be needed as the tank runs dry. One word of caution, too much light is not useful so don't overuse, just like adding gas to a full tank, it spills out and does nothing

to help your engine running better. ***Therefore, PBM will need to be delivered on a daily basis to replenish the cells with fuel required to help them and the tissues heal. PBM is natural enhancement of your own body to help you lead a healthier physical and mental life.***

The possible PBMT mechanisms of action were outlined years ago,(1) along with other mechanisms confirmed in recent studies such as skeletal muscle hypertrophy,(2,3) higher skeletal muscle glycogen,(4)and adenosine triphosphate (ATP) contents (4,5) when PBMT was applied as preconditioning,(5) or when applied after exercises, promoting better results than preconditioning.(4)

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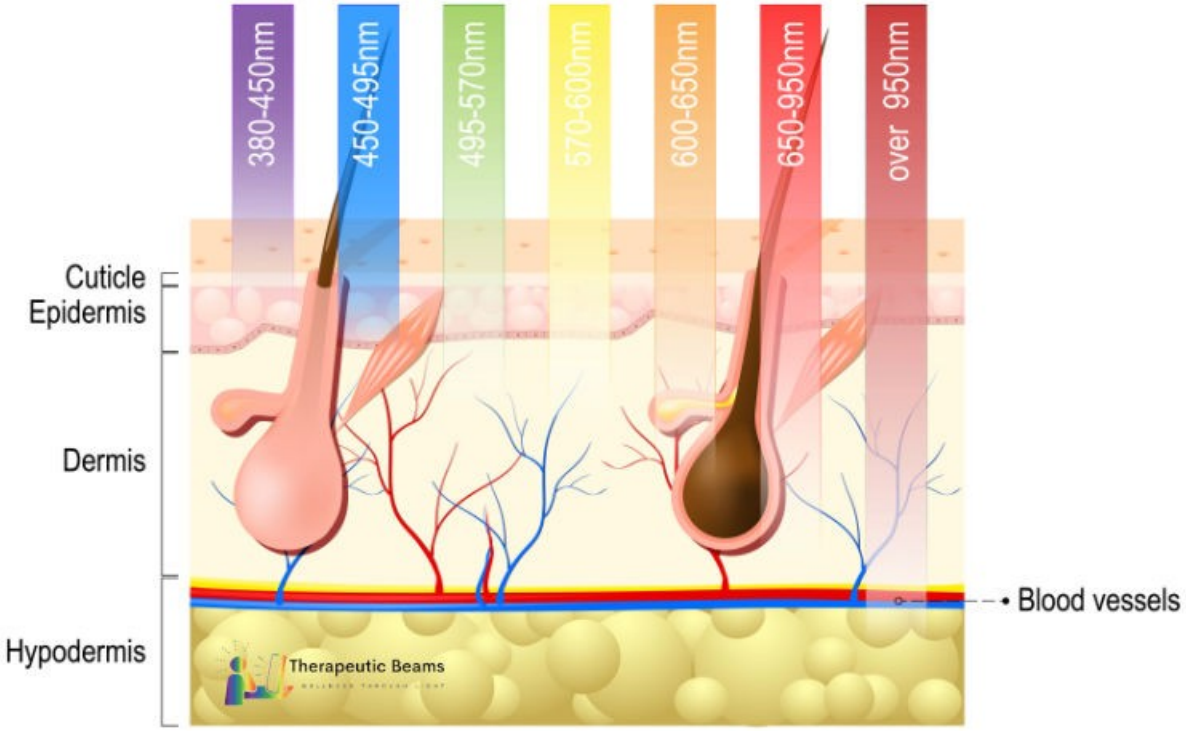

PBM also increases blood flow therefore cells receive more oxygen and nutrients. This action helps to reduce inflammation and stimulate repair. Since there's less inflammation for your body to address, leukocytes (or white blood cells) can be sent to more efficiently repair the cells damaged during your strenuous workout.

2. Recovery In Sports?

Recovery is perhaps the most critical aspect of athletics because it allows muscles and other tissues time to repair, rebuild, and strengthen. Without proper recovery, the body enters a cycle of constant activity where it never has the time it needs to recuperate and recover. The result is lack of gains, poor performance, injury and poor healing if injured.

During strenuous activity or exercise, microscopic tears develop in muscle tissue. The soreness and discomfort after a hard workout is the result of this exercise-induced muscle damage. The muscles need time to recover and with PBM this process of repair is enhanced, so the athlete can start training sooner and decrease the risk of injury.

Recovery also allows the body to restore its glycogen reserves. Glycogen is what your body uses to fuel your muscles for peak performance.

Recovery days also allow for mental rest, and they're critical in preventing overtraining syndrome. Not surprisingly, many athletes suffer from overtraining syndrome. Some experts suggest that up to 60% of elite and professional athletes suffer from overtraining syndrome, often characterized by increased fat storage, decreased libido, and moodiness (6).

3. Benefits of PBM for Athletes

One of the most significant benefits of PBM is its ability to aid in the different facets of muscle recovery. PBM allows muscles to recover while reducing the inflammation that causes pain and discomfort after a hard workout.

Reduced Muscle Soreness

Delayed onset muscle soreness (DOMS) is something that all athletes deal with, and it's perhaps the leading cause of soreness and discomfort after high-level athletic performance. One of the most promising characteristics of red light therapy is its ability to reduce or eliminate DOMS after strenuous activities. A 2006 randomized, double-blind placebo-controlled trial used red light therapy devices on the biceps brachii muscles to determine its ability to address muscle soreness.

The results of this study provide scientific evidence that PBM (phototherapy) as used in this study provides a beneficial effect to patients who may experience DOMS after a novel exercise session. (7)

Another randomized, double-blind, placebo-controlled study was similar in test design but focused on the rectus femoris muscle. This study looked at both performance and recovery. The researchers found, they were able to conclude that it effectively reduced creatine kinase levels and increased lactate removal (8).

Increased ATP Production

By increasing cellular energy with increased ATP production the cells and tissues of our body can maximize their function and thus assist the athlete in achieving their highest level of performance. With more cellular energy available, our bodies may experience less muscle fatigue, and our muscles can grow more quickly.

Improved Muscle Strength And Reduced Muscle Fatigue

A 2012 study found that PBM significantly increased peak force by 12.14% and mean average force by 13.09%, both of which measure strength. Researchers also found that (PBM)red light therapy delayed the onset of muscle fatigue. PBM may reduce oxidative stress and reactive oxygen species (ROS) production. Oxidative stress is known to impair contractile muscle function, which results in muscle fatigue (9) They conclude that both red than infrared LLLT are effective in delaying the development skeletal muscle fatigue and in enhancement of skeletal muscle performance.

PBM increases ATP production and cells can replicate more quickly, improving oxygenation in the process. These processes help fight oxidative stress, which translates to less muscle fatigue during sports or workouts. A 2016 study on professional rugby players demonstrates similar results concerning how red light therapy helps improve performance by reducing oxidative stress and fatigue. In this study, the test group received red light therapy before a fitness test. Compared to the control, the test group posted significantly faster sprint times. Athletes in the test group also noted that they felt less fatigue during their workouts, which helps explain why they saw improvements in their sprint times (10).

Muscle fatigue could mean the difference between a personal best and mediocre performance. A closely controlled double-blind trial with placebo studied how healthy men responded to red light therapy before engaging in strenuous exercise.The study focused on the quadriceps femoris muscles of trial participants, measuring their output and fatigue level. The participants who received red light therapy were able to perform, on average, 52% more reps while experiencing less fatigue than the participants in the control group (11).

Increased Blood Flow

PBM increases blood flow, which is critical for high-level performance (12). As blood flow increases, more oxygen and nutrients are delivered to your cells to fuel them. More blood flow also means less room for free radicals to affect your performance. In essence, the extra blood flow provides muscles with the fuel they need while keeping oxidative stress at bay. For athletes, this means they will have the strength and endurance you need to push through.

Accelerate Healing From Sports Injuries

An important area where PBM is showing promising results is injury recovery. One study shows incredible promise from a recovery perspective. Researchers provided injured university athletes with near infrared light therapy as part of their injury recovery routines. Students who received the 830 nm red light had a dramatically reduced RTP (return to play) time than those who received no red light therapy treatment.

The study suggests that near infrared light therapy was able to cut recovery time in half, from 19.23 days down to just 9.6 days (13)

These results suggest that PBM can effectively kickstart muscle healing while reducing the acute inflammatory response. This combination allows athletes to return to the field in significantly less time than those who don't use red light therapy.

Increased Collagen Production

Collagen is critical for muscles, ligaments, and tendons. Collagen makes tendons and cartilage stronger while also aiding in muscle repair. As a result, collagen plays a crucial role in healing muscle-related injuries. PBM can help stimulate collagen production (14)– which, in turn, means faster recovery and return to training or competition.

Reduced Muscle Pain

Near-infrared light (NIR) appears to reduce muscle pain from injury or overwork. More specifically, 830 nm NIR light has been shown to relieve pain and reduce inflammation while relaxing muscle spasms and enhancing blood circulation. All these benefits translate to quicker recovery and a faster return-to-play time for athletes. In addition to muscle recovery benefits, PBM can also heal more severe muscle injuries. PBM helps to restore and regenerate muscle tissue to heal the injured area more quickly. Certain wavelengths can penetrate more deeply, which helps for common athletic ailments like chronic inflammation (15)

PBM also shows promising results for deep tissue bruising. One small study of ten participants found that those who received red light therapy after surgical procedures healed between 33-50% more quickly than the control group (16).

4. WHEN TO USE PBM IN SPORTS

PRE PERFORMANCE WARM UP

Research suggests that using red light therapy before workouts or sports allows the athlete to achieve the most significant benefit. In a meta-analysis of over 30 studies, researchers in

Brazil concluded that PBM red light therapy before workouts displayed the best results across several measures like time-to-exhaustion and number of repetitions (17)

When performing the Bangsbo Sprint Test, rugby players who received PBM red light therapy before the test had faster average sprint times, a lower percentage of blood lactate, and a lower fatigue index compared to the control group (18)The lower blood lactate is especially significant, as it suggests the runners experienced less fatigue while sprinting.

Reinforcing those results, a study in the Journal of Athletic Training observed test subjects' performance when running on a treadmill. The group that received PBM red light therapy before their session fatigued more slowly, ran longer, and experienced less labored breathing. These results suggest that red light therapy provides tangible pre-workout benefits (20)

During A Workout

A study of recreational runners in Brazil measured their exhaustion rate, speed, time-to-exhaustion, and efficiency. The runners who received red light therapy during their workout scored higher by every measure compared to the control group (21) However this method may not prove to be too practical.

After Workouts

Recent peer-reviewed studies seem to suggest that PBM red light therapy is an effective and intriguing treatment after workouts.

One study, designed to measure PBM red light therapy's impact on workout performance when administered post-workout, delivered especially promising results. The study measured performance on a leg-press exercise over twelve weeks of workouts. After the study, those who received low level laser therapy enjoyed a 55% increase in their one-rep max. In comparison, those in the control group only increased theirs by 26% (22)

A 2016 study suggests that red light therapy is an effective way to reduce post-workout fatigue and recovery. Compared to the control group, the group that received PBM light-emitting diode therapy after workouts experienced less muscle fatigue and muscle damage while experiencing faster recovery and greater muscle mass. What's more, researchers conducted gene expression analyses and found fewer markers of inflammation and muscle atrophy (23)

Another study found that body fat percentage, oxygen uptake, and time-to-exhaustion were significantly improved when participants received PBM red light therapy before and after training sessions. These findings suggest that, for endurance athletes like distance runners, red light therapy might be a helpful practice for both before and after workouts (24)

How to use PBM devices – *suggestions are as follows however each athlete knows their body better than anyone else and the best way to determine the effect is to try different pre and post performance regimens and see which works best for them.*

If the primary goal is to improve athletic performance or to enhance muscle growth, it seems best to employ PBM red light therapy before your workout. Limited research suggests that photobiomodulation therapy provides the maximum benefit when applied between three to six hours before exercise.

If you're looking for a tool to aid in post-workout recovery, the best time to use PBM red light therapy seems to be after a workout.

While the research to substantiate the use of red light therapy both before and after workouts is limited at best, athletes won't do any harm by using it before and after workouts – especially for those looking to boost muscle endurance.

If you're looking to improve athletic performance while also speeding up muscle recovery, you can certainly use PBM red light therapy both before and after workouts.