

TREATING THE BODY WITH LIGHT

How Red and Near-Infrared Light Are Transforming Human Health



A science-based guide for anyone who wants to understand how light shapes health at the cellular level.

By: Robert Broe

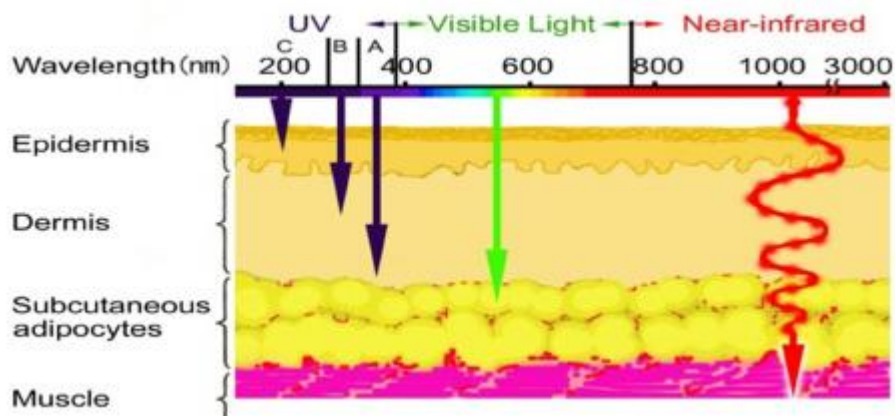
THE DRUG THAT ALREADY EXISTS

Imagine something that could speed healing, enhance brain function, reduce inflammation throughout the body, boost cellular energy production, improve athletic performance, support fat loss and muscle development, improve metabolic and immune health, and even slow the aging process — all without significant side effects.

If such a thing existed in pill form, pharmaceutical companies would race to patent it. Doctors worldwide would prescribe it to millions. It would generate billions in revenue and be widely heralded as a miracle drug.

This "drug" already exists — but not in a pill. It is red and near-infrared (NIR) light.

Researchers have published more than 6,000 studies on the remarkable health benefits of red and NIR light therapy, formally known as *photobiomodulation* (PBM). Despite being one of the most significant health discoveries of the last 50 years, most people have never heard of it. This gap reveals something important: our understanding of human biology is still catching up to what the evidence is telling us.



WHAT IS PHOTOBIMODULATION?

PBM is the use of specific wavelengths of red and near-infrared light to trigger beneficial biological changes in the body. With more than 6,000 published studies, it is one of the most scientifically supported wellness modalities available today.

LIGHT AS A BIOLOGICAL NECESSITY

All humans, from our earliest ancestors until very recently, spent the majority of their lives outdoors. Their bodies moved through daily cycles of bright sunlight and, in the evenings, the warm glow of firelight. This ancient relationship with light shaped far more than surface-level changes like tanning or pupil dilation. It built essential mechanisms into our cellular machinery — mechanisms that control everything from energy production to immune function, cellular regeneration, hormonal health, DNA repair, and metabolic regulation.

Many people are familiar with the idea that sunlight drives vitamin D synthesis through ultraviolet light interacting with compounds in the skin. There is also growing awareness of how blue light wavelengths entering the eyes influence circadian rhythms. But the relationship between light and human health runs far deeper than either of these.

Every cell in your body is, directly or indirectly, influenced by light in your environment. Light penetrates our skin and influences our cells — playing a vital, foundational role in human health. This is not fringe theory or pseudoscience. It is grounded in hard science and documented in thousands of peer-reviewed studies.

LIGHT AS AN ESSENTIAL NUTRIENT

An essential nutrient is a substance the body absolutely requires to function properly but cannot synthesize on its own in sufficient quantities. It must be obtained from an external source. When we lack an essential nutrient, we develop specific deficiency symptoms that can only be resolved by obtaining that particular substance: without vitamin C, we develop scurvy; without essential amino acids, we cannot build proteins properly; without iron, we cannot produce healthy red blood cells.

What makes a nutrient essential is not just that it is beneficial, but that it is absolutely required for life, causes clear deficiency symptoms when lacking, and serves a unique biological role that cannot be filled by other substances.

Most of us are unaware that just as our body depends on nutrients from food, it also requires specific wavelengths of light to be healthy. We can call these "light nutrients." Like essential dietary nutrients, our bodies need them in certain amounts and at certain times to function properly. These wavelengths trigger unique biological effects that cannot be replicated by any other stimulus — making them as essential to cellular health as vitamin C or omega-3 fatty acids are to overall wellness.

THE MODERN LIGHT DEFICIENCY CRISIS

Our ancestors did not have to think about light exposure. Their outdoor lives provided ample sunlight during the day, and firelight in the evenings. But in just a few generations, we have dramatically altered this relationship — and the magnitude of change is staggering.

Step outside on a sunny day, and your body receives 10,000 to 100,000 lux of full-spectrum light. Step into your office, home, or school, and that drops to a mere 100 to 500 lux — a reduction of up to one thousandfold. Today, the average person spends approximately 97% of their life indoors in artificial environments, resulting in an enormous reduction in overall light exposure.

But raw light intensity is only part of the problem. Modern artificial lighting provides a severely impoverished spectrum of light, lacking many of the wavelengths our bodies have evolved to use for specific biological functions.

Fluorescent lights and LEDs, while energy-efficient, emit an unnatural spectrum that bears little resemblance to the sunlight our bodies expect and need.

The 97% Problem

The average person today spends approximately 97% of their life indoors, under artificial lighting that lacks the specific wavelengths the body depends on for cellular repair, hormone regulation, immune function, and dozens of other biological processes.

THE INVERTED LIGHT CYCLE

Even more damaging, modern life has completely inverted our natural light-dark patterns. Our ancestors spent their days under bright, full-spectrum sunlight and their evenings in the warm, red-wavelength glow of fires. We do the opposite: we spend our days in dimly lit buildings under light that lacks vital wavelengths, then expose ourselves to bright, blue-rich light from screens and LED lighting well into the night.

This inversion of our natural light-dark cycles disrupts our circadian biology at a fundamental level, throwing off the intricate timing mechanisms that coordinate countless biological processes. Like a diet of processed junk food that leaves us overfed yet undernourished, our modern lighting environment bombards us with artificial light while depriving us of the specific wavelengths our bodies need. We get too much of the wrong kinds of light, too little of the right kinds, and receive them at the wrong times.

THE HEALTH CONSEQUENCES OF MAL-ILLUMINATION

The vast majority of people living in the modern world are suffering from what might be called chronic mal-illumination and are entirely unaware of it. This has widespread effects on brain and organ function, immune response, energy levels, mood, neurotransmitter balance, hormone levels, metabolic health, and virtually every major system of the body.

Sunlight deficiency has been linked with numerous serious diseases, including:

- Neurodegenerative diseases such as Alzheimer's, dementia, multiple sclerosis, and Parkinson's
- Dozens of types of cancer
- Obesity and metabolic syndrome
- Type 2 diabetes
- Heart disease

Low levels of sun exposure represent a risk factor for human health comparable in magnitude to cigarette smoking. Women with the lowest sun exposure have a twofold higher rate of death compared to those with the most sun exposure — a magnitude of increased mortality risk similar to that of smokers compared to non-smokers.

Evening exposure to artificial light actively compounds these problems. The blue-rich light from phones, tablets, computers, televisions, and LED lighting does not just keep us awake — it triggers a cascade of biological disruptions. Artificial light at night has been linked with:

- Several types of cancer
- Depression and mood disorders
- Fat gain, obesity, diabetes, and metabolic syndrome
- Insomnia and poor sleep quality

This crisis of mal-illumination represents one of the most significant yet underappreciated public health challenges of our time. The artificial lighting environments we have created in our homes, workplaces, and schools are fundamentally incompatible with our biological needs — a form of environmental mismatch that rivals poor nutrition in its impact on human health.

Most people's light exposure habits in the modern world are the equivalent of eating an all-fast-food diet: chronically deprived of essential elements needed for optimal health.

THE ELECTROMAGNETIC SPECTRUM AND HUMAN BIOLOGY

To understand why specific wavelengths of light have such powerful effects on the body, it helps to understand the broader context of the full electromagnetic spectrum. The spectrum spans an enormous range — from the infinitesimally short wavelengths of gamma rays (0.0001 nanometers) to the long waves of radio signals stretching over meters.

Visible light — the portion of the spectrum we can see — occupies just a tiny slice of this range, roughly 400 to 700 nanometers. Pass sunlight through a prism and it splits into the familiar rainbow: red, orange, yellow, green, blue, indigo, and violet. Beyond violet lies ultraviolet (UV) radiation; beyond red lies the infrared range.

Specific ranges of electromagnetic radiation powerfully influence human biology. Each bioactive wavelength interacts with our cells in distinct ways.

Ultraviolet Light (290-400 nm)

UV light has biological effects that extend far beyond its well-known role in vitamin D synthesis. When UV light strikes the skin, it triggers a complex series of photochemical reactions — beginning with the conversion of 7-dehydrocholesterol to pre-vitamin D₃, but this is just the beginning. UV exposure also modulates the production of beta-endorphins, nitric oxide, and various immunomodulatory molecules. Recent research has revealed that UV exposure influences the composition and function of the skin microbiome, affects the production of antimicrobial peptides, and modulates systemic immune responses.

Blue Light (380-500 nm)

Blue light serves as the primary regulator of our circadian rhythm, but its effects extend far beyond simple sleep-wake cycles. When blue light strikes specialized melanopsin-containing retinal ganglion cells, it triggers a cascade of biological events that influence the entire endocrine system. These cells connect directly to the suprachiasmatic nucleus — our master biological clock — which then orchestrates the timing of countless physiological processes. The implications are profound: blue light exposure patterns influence everything from hormone production and neurotransmitter balance to metabolic rate and immune function.

Far-Infrared Light (3,000-15,000 nm)

Far-infrared (FIR) light adds another dimension to light nutrition through its thermal and non-thermal biological effects. This wavelength range influences tissue function primarily through its interaction with water molecules, affecting cellular water structures and molecular bonds. These effects extend beyond simple heating, influencing blood-flow patterns, cellular metabolism, and the expression of heat shock proteins that play crucial roles in cellular protection and repair. FIR exposure can improve cardiovascular function, enhance detoxification processes, and influence mitochondrial function through mechanisms distinct from those of red and NIR light.

Red and Near-Infrared Light: The Therapeutic Window

Among all bioactive wavelengths, red light and NIR light hold a unique distinction: they can penetrate far deeper into human tissue than any other wavelength. This ability exists because of what is called the "optical window" or "therapeutic window" in human tissue — a specific range of wavelengths, roughly 600 to 1,000 nm.

This window exists because of the unique way different wavelengths interact with the major molecules in our tissues. Shorter wavelength light is strongly absorbed or scattered by hemoglobin in our blood and melanin in our skin. At longer wavelengths, water becomes the dominant absorber.

But in between — precisely where red and NIR light fall — there is a window where light can pass through these barriers much more easily, traveling several centimeters into the body to reach deep tissues, organs, and even bone.

Once in those deeper tissues, red and NIR light trigger unique and powerful biological effects — interacting with the mitochondria of cells, altering gene expression, enhancing cellular repair mechanisms, reducing inflammation, improving collagen synthesis, and accelerating wound healing, among many other benefits.

Why Red and NIR Light Are Special

No other wavelength of light can penetrate as deeply into human tissue. The "therapeutic window" at 600-1,000 nm is not an accident of physics — it is the result of millions of years of evolution, during which our bodies developed cellular mechanisms specifically tuned to receive and respond to these wavelengths.

THE SCIENCE OF PHOTOBIO-MODULATION

The field of photobiology — the study of light's effects on living systems — has transformed our understanding of how light interacts with human biology. Over the past several decades, as nutritional science has revealed the crucial role of food nutrients in human health, photobiology has been unveiling the essential nature of specific light wavelengths for health and healing.

Photobiomodulation (PBM) — modifying biology with light — has emerged as one of the most significant health discoveries of the last 50 years. Specific wavelengths of light can trigger beneficial biological effects, from enhanced cellular energy production to accelerated healing. The idea that light could penetrate our skin and influence our cellular machinery may seem like science fiction, but it is thoroughly documented in the scientific literature.

Think of the human body as a sophisticated solar panel, each cell containing different types of specialized, light-sensitive components. These cellular structures have evolved over millions of years to capture and utilize specific wavelengths of light in distinct ways. When we apply red and NIR light therapeutically, we are essentially correcting a deficiency — one that affects nearly every person living in the modern indoor world.

HOW RED AND NIR LIGHT DEFICIENCY DEVELOPS

Inadequate exposure to red and NIR light is perhaps one of the most problematic and overlooked of all modern light-nutrient imbalances. Unlike vitamin D deficiency from inadequate UV exposure — which produces measurable blood markers and well-characterized symptoms — or blue light disruption, which produces noticeable fatigue, irritability, and cognitive fog, red and NIR light deficiency produces effects that are more subtle, generalized, and insidious.

When you get inadequate red and NIR light exposure, the effects quietly affect cellular and systemic health without being immediately noticeable. Red and NIR light play a crucial role in mitochondrial function, supporting energy production, reducing oxidative stress, and promoting cellular repair. Without adequate exposure, the body's ability to maintain optimal cellular health declines over time.

There is no single biomarker associated with red and NIR light deficiency (as there is with vitamin D and sunlight), but the cumulative impact may manifest as:

- Slower recovery from exercise or injury
- Chronic fatigue and reduced resilience to stress
- Impaired immune function
- Over-accelerated cellular aging
- Generalized reduction in cellular performance across multiple body systems

Because these effects impact the body at a cellular level, rather than through a single, easily identifiable deficiency pathway, they are harder to directly associate with the lack of red and NIR light. This makes it easier for both individuals and healthcare systems to overlook their significance — even though they quietly underlie many aspects of systemic health. The absence of adequate red and NIR light does not create dramatic, immediate dysfunction. Instead, it subtly chips away at the body's capacity to thrive.

THE PROVEN BENEFITS OF RED AND NIR LIGHT THERAPY

Through precise application of therapeutic wavelengths and doses, modern PBM technology allows us to leverage ancient cellular mechanisms to achieve an extraordinary range of documented benefits. The following represents what the current body of scientific research has established across major health domains.

CELLULAR HEALTH AND REGENERATION

At the most fundamental level, red and NIR light work by interacting with the mitochondria — the energy-producing organelles within every cell. This interaction enhances the efficiency of cellular energy production, with cascading benefits throughout the body:

- Enhanced mitochondrial function and increased cellular energy (ATP) production
- Accelerated healing and tissue repair across all tissue types
- Stimulation of stem cell proliferation and differentiation
- Reduction in systemic inflammation at the cellular level

PHYSICAL PERFORMANCE AND RECOVERY

Athletes and active individuals represent one of the most enthusiastic adopters of PBM therapy, with compelling research support for performance and recovery applications:

- Enhanced strength, muscle mass, and overall athletic performance
- Accelerated muscle recovery and reduced exercise-related soreness
- Faster healing from sports injuries and overuse conditions
- Improved endurance and reduced markers of exercise-induced oxidative stress

ANTI-AGING AND AESTHETIC BENEFITS

The effects of red and NIR light on skin and body composition have attracted significant scientific and commercial interest:

- Reduction in wrinkles and fine lines through increased collagen and elastin production
- Improved skin tone, texture, and overall skin health
- Promotion of hair growth in individuals experiencing thinning
- Improved body composition through metabolic and hormonal effects

BRAIN AND COGNITIVE HEALTH

Emerging research into transcranial photobiomodulation — the application of red and NIR light to the head and brain — is producing some of the most exciting results in the field:

- Enhanced cognitive function, focus, and mental clarity
- Mood elevation and support for emotional wellbeing
- Support for brain health and neuroprotection
- Improved sleep quality through circadian and neurological effects

METABOLIC AND CARDIOVASCULAR HEALTH

The systemic nature of PBM's effects extends meaningfully into metabolic and cardiovascular function:

- Improved metabolic health and insulin sensitivity
- Enhanced cardiovascular function and circulation
- Strengthened immune system response
- Reduction in markers of systemic inflammation associated with chronic disease

A Note on Dosing and Timing

Like all nutrients and therapeutic agents, light of the wrong type, in the wrong dose, at the wrong time, or in the wrong location can have neutral or even damaging effects. The therapeutic benefits of red and NIR light depend on using appropriate wavelengths, correct dosing, and proper application. Working with knowledgeable practitioners and well-designed devices is essential for achieving the documented benefits.

CORRECTING THE DEFICIENCY: A PATH FORWARD

The recognition of light as an essential nutrient represents a fundamental shift in our understanding of human health. It forces us to reconsider our modern indoor lifestyle, in which we have inadvertently created a state of chronic light malnutrition — not unlike the nutritional malnutrition produced by a diet of processed food.

While our ancestors' outdoor lives provided automatic exposure to the full spectrum of light nutrients, we must now be intentional about how we obtain them. The good news is that modern science has given us the tools to do exactly that.

ANCESTRAL LIGHT SOURCES VS. MODERN PBM TECHNOLOGY

The sun has been our ancestral source of red and NIR wavelengths throughout human evolutionary history. But modern PBM technology allows us to harness these wavelengths more precisely and consistently than sunlight alone can provide. Dedicated red and NIR light therapy devices deliver calibrated doses of therapeutic wavelengths without the confounding variables of UV exposure, time of day, weather, latitude, and season.

This does not mean that sunlight should be abandoned — quite the opposite. Strategic, safe sunlight exposure remains one of the most powerful health interventions available. But for correcting red and NIR light deficiencies with precision, therapeutic PBM devices offer a level of control and consistency that sunlight cannot match.

ADDRESSING THE FULL SPECTRUM OF LIGHT HEALTH

Optimizing light health requires attention to all dimensions of our light environment, not just red and NIR therapy. A comprehensive approach to light nutrition includes:

- Morning bright light exposure — ideally including sunlight — to anchor the circadian rhythm and support serotonin and cortisol production
- Consistent daytime light exposure of adequate intensity and full-spectrum quality
- Strategic red and NIR light therapy sessions to correct deficiencies and leverage therapeutic effects
- Minimizing blue-rich artificial light exposure in the hours before sleep
- Using warm, low-intensity, amber-spectrum lighting in evening environments

Just as we would never expect a plant to thrive in darkness, or our bones to stay strong without vitamin D, our cells cannot function optimally without adequate exposure to the specific wavelengths of light they have evolved to use. The remarkable effects of red and NIR light therapy stem from millions of years of evolution, during which every cell in our bodies developed sophisticated mechanisms to capture and utilize these specific wavelengths. When we apply them therapeutically, we are not doing something exotic or unnatural — we are restoring something ancient.

A CLOSING PERSPECTIVE

The field of photobiology is still young, and our understanding of how light shapes human health continues to deepen with each passing year. What is already clear, based on thousands of published studies, is this: light is not merely something we see with. It is something our bodies require, at the deepest cellular level, to function, heal, and thrive.

The modern world has created a profound and largely invisible light deficiency. Recognizing it is the first step. Correcting it — through smarter outdoor habits, improved indoor lighting environments, and targeted therapeutic light exposure — is one of the highest-leverage investments any person can make in their long-term health.

We are, in a very real sense, creatures of light. It is time we started living like it.



Treating the Body With Light

By: Robert Broe