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## **Photobiomodulation: The Role of Light in Preventing and Potentially Halting Alzheimer's Disease**

### **STORY AT-A-GLANCE**

- > The brain responds to near-infrared light in a process called photobiomodulation
- > Research shows near-infrared stimulation of the brain helps boost cognition and reduce symptoms of Alzheimer's, including more advanced stages of the disease
- > Delivering near-infrared light to the compromised mitochondria synthesizes gene transcription factors that trigger cellular repair, and your brain is one of the most mitochondrial-dense organs in your body

**By Dr. Mercola**

Alzheimer's disease currently affects an estimated 5.4 million Americans.<sup>1</sup> Projections suggest it will affect 1 in 4 Americans in the next 20 years, rivaling the current prevalence of **obesity** and **diabetes** and, by 2050, Alzheimer's diagnoses are projected to triple.<sup>2,3</sup>

Already, more than half a million Americans die from the disease each year, making it the third leading cause of death in the U.S., right behind **heart disease** and cancer.<sup>4,5</sup> Worst of all, there are no effective drug treatments available. So what can you do to avoid becoming another statistic?

In this interview, Dr. Lew Lim shares his expertise in the use of near-infrared therapy to treat **Alzheimer's disease**, and how you can use light therapy to radically reduce your risk.

*"Let me first say that I speak with some evidence," Lim says. "We have just been accepted for publishing into a scientific journal. Our recent case series report is a clinical study on a small number of people with Alzheimer's disease. The findings actually are quite significant."<sup>6</sup>*

*[W]e do get questions from skeptics like, 'How can light actually reach the brain to begin with, and then get a response from the brain?'*

*What I'd like to do is try and demonstrate that first. Then you can see that this is not all hocus pocus. It's actually doing something to the brain. Then we'll talk about the evidence."*

## **How Photobiomodulation Influences Brain Activity**

Reza Zomorodi, Ph.D., one of the top neuro-electrophysiologists in Canada, works with the Center for Addiction and Mental Health at the University of Toronto.

Zomorodi is also working with Lim on producing cutting edge brain imagery to better understand why some people are responding better and faster to the treatment than others.

Using an electroencephalogram (EEG) and a photostimulation device invented by Lim which emits near-infrared light (810 nanometers), they're able to explore the effect of the

photostimulation in the brain, and the changes that occur over the light spectrum.

The near-infrared device consists of four modules of light-emitting diodes (LEDs), held together with light metal frames that are placed on top of your head, with the LEDs pointed at specific regions on your scalp.

It also has an intranasal LED that targets the hippocampal area. In alpha mode, these LEDs emit pulsed light at 10 hertz or 10 pulses per second. Ten hertz was the frequency selected based on animal studies showing it helps accelerate neuron recovery in brain injured animals.

The mechanism of the effect created by this photostimulation device appears to be related to the interaction between the light and mitochondria to produce cellular energy, adenosine triphosphate (ATP) and other activating factors.

*"It boosts the energy of the brain and the brain uses this energy to generate more frequency, more oscillation, and organize or coordinate different networks,"*  
Zomorodi explains.

Lim recently introduced gamma frequency, which is 40 hertz (40 cycles per second) into the brain. Gamma is present while your brain is consolidating memory, helping it to minimize or prevent overactivity.

Recent animal research has shown the gamma frequency even significantly reduces amyloid plaques (associated with Alzheimer's) in the brain.<sup>7</sup>

Lim hopes that by targeting the hippocampus and other targeted areas of the brain with gamma frequency, where memory consolidation takes place, he may be able to achieve better outcomes in people with more advanced Alzheimer's — people for whom there is currently no hope whatsoever.

## **Photobiomodulation Literally Increases Brain Power**

For a live demonstration of this procedure, known as photobiomodulation, please see the featured video. In summary, the subject is fitted with 19 electrodes that measure the brain

activity with EEG brain mapping software.

The baseline frequency for a relaxed, awake subject is alpha. You can also see the actual location of the activity inside the brain of the subject. Green image means the brain activity is in normal range. Red means it's higher than normal, and blue indicates lower than normal activity.

After recording five to 10 minutes of rest EEG to establish the baseline activity of the brain, the photostimulation, which administers near-infrared light, is turned on. You can then observe the change in brain frequency (activity) on the EEG.

*"You can see this green immediately went to the red. It means higher activity and [that] the machine is transferring energy to the brain," Zomorodi explains. "The brain has more power, more energy for that specific frequency."*

## **By Modulating Brain Frequencies, You Can Improve Cognition**

In other words, what they're measuring is the frequency of the electrical signals coming from the brain itself, which is a consequence of the light therapy. They're not measuring the light entering the brain. Now, when you modulate one frequency, you also affect other frequencies, for better or worse, as they're all interconnected.

*"If you are stimulating the brain at the gamma frequency, you might also change the other frequency band, like the theta, alpha or the beta. This changing or modulation could stop or help a cognitive task."*

*Alpha, it has been shown, is a very important frequency for rest. Also, we find it in some mental health disorders — this alpha frequency usually is very low or very slow. Pushing the alpha up and normalizing the frequency is really helpful for cognitive skills," Zomorodi explains.*

## **Near-Infrared Is a Source of Fuel for Your Body**

Near-infrared light is thought to work by interacting with cytochrome c oxidase (COO) — one of the proteins in the inner mitochondrial membrane and a member of the electron transport chain. COO is a chromophore — a molecule that attracts and feeds on light.

When you eat food, the nutrients nourish your cells and provide fuel for biological functions. But this actually occurs indirectly, and food is not your body's sole source of fuel. Light is also a source. The macronutrients you get from your food are broken down in your gut. From there, they enter your bloodstream, which allows them to circulate throughout your body, nourishing all of your body's cells.

A key component that allows this system to work is that essential ingredients like fats and glucose are broken down into pyruvate that feeds your mitochondria, thereby allowing the mitochondria to process electrons to generate the ATP required for all of these biological processes.

As for light as a source of fuel, about 40 percent of the energy in sunlight is near-infrared. Unfortunately, few clinicians have any idea that light is a powerful fuel for your body. In my view, this ignorance is one of the reasons why Alzheimer's disease is skyrocketing in prevalence, as so many are routinely avoiding sensible sun exposure.

## **Infrared Light Triggers Cellular Repair**

Photobiomodulation also improves oxygenation to your cells. One of the ways it does this is by releasing nitric oxide (NO) back into your body after being exposed to red and near-infrared rays. NO is a vasodilator that helps relax your blood vessels, lower your blood pressure and improve vascular health.

Interestingly, when you deliver red and infrared light to the mitochondria, it not only triggers NO release, it also promotes synthesizing of gene transcription factors that trigger cellular repair — and this is as true in the brain as anywhere else in your body. In fact, along with your heart, your brain is one of the most mitochondrial-dense tissues in your body, and therefore stand to benefit a great deal from infrared exposure.

*"[I]f you look at the epidemiology of dementia and Alzheimer's globally ... countries that are in the northern hemisphere appear to have high risk of developing dementia and Alzheimer's. You look at the top 10 countries, they're all countries with winter, with shorter hours," Lim says.*

*You're an advocate of being in the sunlight. I think that is really what people ought to do. But in the north, there's not enough sun, right? In a way, what we're doing here, directing light into the brain ... has a ... similar effect as sunlight, but more targeted.*

*It has specific wavelengths that have an effect on the mitochondria of the neurons. Logically, that will lead to neuronal recovery if the neurons are performing sub-optimally or are damaged. That's been found in in vitro studies.*

*Before we did the study on humans, there were already at least three published studies of work done on mice and rabbits. When they directed red and infrared light to the brain, they found that the commonly accepted biomarkers, the amyloid beta plaques, were reduced. The behavior got better ... [W]e are the first to complete an albeit small study on humans that has given us a very significant result.*

*When we did a head-to-head comparison with the drugs (with the information we had from the pivotal trial with Aricept, which is commonly prescribed for Alzheimer's), the data we got was seven times greater, with no side effect. I think the key is not having a side effect. The safety is pretty much confirmed ...*

*This next trial we're doing involves 226 people. It's randomized, double-blind, placebo-controlled ... led by a professor of epidemiology at the University of Toronto. We'll have collaborators from Harvard and Boston University ... In the meantime, we are also doing a small study to get quicker data from about 40 people, which is also rigorously controlled."*

## **Countries With The Highest Rates of Deaths From Dementia**

<b>Rank</b>	<b>Country</b>	<b>Deaths per 100,000</b>	<b>Sunlight Availability</b>
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1

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Finland

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54

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Short

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2

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USA

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46

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Short

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3

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Canada

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36

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Short

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4

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Iceland

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34

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Short

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Rank	Country	Deaths per 100,000	Sunlight Availability per year
5	Sweden	32	Short
6	Switzerland	32	Short
7	Norway	30	Short
8	Denmark	30	Short



Rank	Country	Deaths per 100,000	Sunlight Availability per year
9			
	The Netherlands		
29			
	Short		
10			
	Belgium		
27			
	Short		

Source: WorldAtlas.com<sup>8</sup>

## Vitamin D and Light Exposure Appears Important for Alzheimer's Prevention

Research showing that people living in northern latitudes have higher rates of death from **dementia** and Alzheimer's than those living in sunnier areas suggest that **vitamin D** and/or sun exposure are important factors. The take-home message is to live further south.

That's one of the reasons why I moved to Florida from Chicago. But even if you live in the sub-tropics you have to be outside and get adequate **sun exposure** on your bare skin to receive the benefits of light. This may be one of the simplest, least expensive preventive methods available. Alternatively, Lim's work suggests photobiomodulation therapy may be an effective alternative.

*"Say you live in the northern hemisphere and you know you're not getting enough sunlight; this is one really easy way to do it," Lim says. "Here's an interesting thing that we found in our study. We did 12 weeks of active intervention [followed by] four weeks of no intervention at all ... We found that a number of people went straight into decline. We had some measure of modifying the disease ... People with more advanced stages are responding ...*

*But it showed that Alzheimer's is a strongly degenerative disease. It has a whole lot of power on its own. You've got to keep doing it regularly even with what we have. The key here is to make it really convenient and simple. You can't be going to a clinic the rest of your life and get treated, especially if you're living far away. It would cost you a lot of money.*

*That's the idea behind my invention. It's to make it as simple as possible. You'll just press the button and that's it. The treatment is 20 minutes. You can do it the rest of your life because you just put it on your head and your hands are free. You can go to bed with it. That's really the principle behind it.*

*Until the planned clinical trials are complete, we cannot tell how well the devices work for Alzheimer's. In the meantime, they are available as low-risk, general wellness devices."*

## **Sun Versus Near-Infrared Lamps**

While daily sun exposure is likely your best option, followed by specialized technology such as near-infrared treatments, other devices emitting the near-infrared spectrum may also be beneficial. Be sure it's 10 watts or less, and avoid keeping it stationary in any one area. As a general guideline, as soon as you feel warmth, move it. You do not need, nor necessarily want, heat when doing photobiomodulation. When asked for feedback on using sunlight or a near-infrared lamp as a preventive strategy, Lim says:

*"I think the sun is great. Probably the best ... as long as you don't get overexposed to ultraviolet (UV) ... I think that's really the most natural ... The*

*lamp, I tend to put safety first so I try to keep it as low power as possible, as long as it activates what it does.*

*When you have near-infrared (as it penetrates quite deeply), you don't need a lot of power ... [E]xperiments have found that 810 nanometers go the deepest in the live tissues. Why is that? It's because as you go beyond 810 nm, it gets absorbed by water more and more."*

## **Take Control of Your Health With Sensible Light Therapy**

It's important to emphasize that near-infrared light or sunlight is not a magic bullet all by itself. But it's a very important part of the answer that is vastly underappreciated. Another crucial component of Alzheimer's prevention is getting your body to burn fat as its primary fuel, because that will very effectively fuel and nourish your mitochondria in addition to radically improving insulin resistance. I spell out the details of this in my latest book, "**Fat for Fuel**," which comes out in May.

Ultimately, Alzheimer's is a disease caused by dysfunctional mitochondria. That's the reason why near-infrared works. It recharges your mitochondria, and the CCO specifically. If it didn't work that way, you wouldn't see the results demonstrated in the video above.