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Seeing the Light

THE THERAPEUTIC BENEFITS AND RISKS OF LIGHT

By Claudia S. Copeland, PhD

Electromagnetic radiation, or light, is the basis for most life on earth. With rare exceptions, the food chain begins with photosynthesis, so we all fundamentally depend on the sun's rays for sustenance.





THE BIOLOGICAL EFFECTS OF LIGHT, though, go far beyond production of the food we eat. Light has a host of biological effects on humans, the therapeutic potential of which are being increasingly explored.

While the coherent light of lasers can be used for applications like surgery, non-coherent, “natural” light is diffuse. Consequently, its uses are less direct, with clinical success often preceding understanding of the underlying mechanisms. One of the most clearly effective therapeutic uses of visible light is light box therapy for seasonal affective disorder, or SAD, a type of depression related to the shorter days of winter. This treatment utilizes a desktop “light box” that emits high-lux (intensely bright) light. Both white light (essentially the same as sunlight, but with the UV wavelengths filtered out) and blue light (460 nm wavelength, optimized for intrinsically photosensitive retinal ganglion cells, which are involved primarily in circadian rhythm, rather than visual image, functions) can effectively treat SAD.

More recently, light therapy has been investigated for other types of depression, including antepartum depression, and does appear to be effective in the treatment of non-seasonal depression. (It does not provide any extra benefit as an adjunct to treatment with antidepressants, though.) This begs the question: while it makes intuitive sense that seasonal depression can be treated by light, why would nonseasonal depression respond to such treatment? One answer may be that many cases of nonseasonal depression might actually be akin to low-grade SAD, since the time spent in bright light by today’s indoor workers is very low, even in the summer.

According to Dr. Simon N. Young of McGill University in Montreal, at 45°N (Northern United States/Southern Canada), people are only exposed to bright light for 91 minutes per day, on average, even on weekends. While there’s considerably more sunshine in Louisiana than in Montreal, the uncomfortably humid summer weather motivates



The 45th parallel approximately defines part of the international border between Quebec, Canada, and New York and Vermont, United States

LIGHT THERAPY



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many people here to spend daylight hours indoors in the air conditioning. Considering the amount of time we spend indoors, along with the fact that many people wake up in the dark, bright light therapy in the morning may be useful as a type of preventative wellness activity, especially for those experiencing sleep problems or unexplained low energy levels.

Sleep-related problems are in fact widespread enough to have formed a clinical area of their own. Circadian rhythm disorders are defined as misalignment between the endogenous circadian rhythm and the desired or socially acceptable sleep-wake schedule. They can stem from genetics-based idiosyncrasies, or they can be problems experienced by clinically normal individuals upon environmental disruption, such as jet lag. The open-24-hours New Orleanian bar culture can be one such source of circadian rhythm problems, since, for many students and young professionals, having an active social life means staying out late on weekend nights. When weekend bedtimes

are not far from Monday morning's wake-up time, the body is subjected to substantial circadian stress. While partying late in the French Quarter is easily addressed by lifestyle change, phase changes imposed by shiftwork (or having to be awake for both daytime childcare and irregular nighttime service-industry jobs) are not, and neither is jet lag. Evidence is building that the same bright light therapy used to treat depression can alleviate circadian rhythm disorders due to both endogenous and exogenous causes. Light box therapy in the morning is an effective treatment for delayed sleep phase disorder (difficulty falling asleep followed by either sleeping late or not getting a full night's sleep). For advanced sleep phase disorder (getting very sleepy early in the evening and then waking up well before 5am), light box therapy in the afternoon can help. Both experimental evidence and numerous field studies have indicated some degree of benefit from using bright light therapy for jet lag. Timing depends on the direction and length of the flight, in line with whether the

traveler's new location imposes an advanced or delayed phase disruption.

Another type of blue light therapy does not involve the eyes at all; the light is absorbed through the skin—most notably, in the case of phototherapy for babies with neonatal jaundice. Neonatal jaundice, caused by elevated bilirubin levels, can result in excessive sleepiness, problems with feeding, and, in extreme cases, a syndrome of permanent neurological damage called kernicterus. Blue light (wavelength 420-448 nm) oxidizes trans-bilirubin to the more water-soluble cis-bilirubin, and this reaction is presently a conventional treatment widely used to reduce hyperbilirubinemia in these infants. While blue light is optimal, exposure of infants to sunlight is also a perfectly effective treatment. In fact, this was the first form of phototherapy for neonatal jaundice—discovered in the 1950s by English nurse Sister J. Ward, who found that exposure of the infants to sunshine improved their condition. (Years later, her clinical success was explained through chemistry and



DR. MARY LUPO
the first
dermatologist
to use IPL for
photo-rejuvenation
in Louisiana.

well—they are easily available over the internet without any need for a prescription or doctor’s visit. Unfortunately, unsupervised self-treatment has resulted in severe sunburn in patients who mistakenly think that “natural herbal” preparations are always mild and free of “side effects.”)

In addition to psoriasis treatment, UV light treatment has been moderately successful in treating several other skin conditions. Both PUVA and narrow-band UVB treatment are quite effective in treating cutaneous T-cell lymphoma (a type of cancer that first appears on the skin), and may be useful in other skin carcinomas as well. UV light therapy has also been used with some success to treat vitiligo, and has been found to be a promising treatment for atopic dermatitis.

When it comes to skin, though, the most widespread interest in novel phototherapy treatments is not for a disease condition at all, but rather for normal changes associated with aging. Light-based therapies are particularly attractive for skin rejuvenation, as they are relatively mild and non-invasive; the perfect treatment for conditions that bother people, but do not justify more invasive treatment protocols. Intense pulsed light, or IPL, is a non-laser light treatment that has been used for hair removal, acne, and pigmentation disorders. It has also been used for a great number of “off-label” cutaneous conditions, many of which are associated with aging skin. Dr. Mary P. Lupo, the first dermatologist to use IPL for photo-rejuvenation in Louisiana, has been working with this technology since 1999. Based in subtropical New Orleans, her patient population has an overall high lifetime exposure to sunlight. She has found that intense pulsed light in the visible light range is “extraordinarily effective for improvement of the signs of sun-induced skin aging, including red areas, telangiectasia (dilated capillaries), and mottled pigmentation. It also improves red scars from acne and temporarily shrinks the pores.”

confirmed through clinical trials, leading to the wide use of this treatment today.)

Light therapy can also be used to treat the skin itself. PUVA, a combination treatment regimen using UVA light and psoralens, which sensitize the skin to UV light, is widely

used to treat psoriasis. Psoriasis has in fact been treated using this type of phototherapy since the dawn of history: in ancient Egypt, psoriasis was treated with sunlight and psoralen-containing plants as early as 2000 BC. (Such plant extracts are used today as



**Blue light therapy for babies
with neonatal jaundice**



As with UV treatment, IPL and other visible-spectrum light therapies should be directed by a highly experienced specialist who is knowledgeable about proper eye protection.

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Unlike laser, which is coherent light of a single wavelength, IPL is “more of a shotgun treatment, with multiple wavelengths.” As such, it “does more at one time and is usually less intense than laser.” Treatment requires multiple sessions, though newer devices can generally achieve results in 2-3 sessions, compared with the 5-6 sessions that were required with older technology, according to Dr. Lupo. However, there is “no downtime” and there is less bruising and swelling than seen in comparable treatment with lasers.

Clearly, simple exposure to light, with a little clinical optimization, can have big results. However, one of the most appealing aspects of light therapy is the idea that such a “natural” non-invasive treatment modality must be quite safe. Is this really true, though? Aside from sunlight-induced

burns, what kinds of safety concerns are warranted when thinking about light therapy? Many skin phototherapy regimens involve UV light, and this always carries some risk of skin cancer, as well as premature aging. In addition, patients who undergo long-term UV treatment for psoriasis may be at increased risk for cataracts. As such, any treatment involving UV light or sunlight (which includes UV wavelengths) should be done under medical supervision, especially if photosensitizing agents are also used.

While IPL using non-UV light is considered safe for the skin, it can damage the eyes. Cases of iris and pupillary defects following IPL without sufficient eye protection suggest that ocular damage, and symptoms such as photophobia and pain, may be permanent. Eye protection is also essential to protect

infants’ eyes during phototherapy for neonatal jaundice. As with UV treatment, IPL and other visible-spectrum light therapies should be directed by a highly experienced specialist who is knowledgeable about proper eye protection.

Light box therapy for depression also only uses visible light, and is generally considered safe. However, there are concerns and contraindications. In certain individuals, light box therapy for depression can lead to mania or hypomania, and should be avoided in known bipolar patients. In addition, some studies have indicated that long exposures to blue light (60 minutes) can reduce rod sensitivity. Of greater concern, some (though not all) studies have indicated that age-related maculopathy (ARM) can be induced by the visible spectrum of normal sunlight, and therefore could be induced by bright light therapy as well, especially blue light therapy. (This is a particular problem after cataract surgery, when the cataractous lens is replaced by a new, clear intraocular lens that does not filter out higher-energy blue radiation as natural lenses do.) Some research indicates that antioxidant supplementation can help to mitigate blue light damage. In line with common sense and caution, bright light therapy is generally not recommended for patients with retinal disease or diabetes, and patients taking medications that sensitize the retina to light. ■