

Out of the shadows: the impacts of light on human health

Part 1 of a two-part series

BY CLAIRE THOMPSON



Horizontal/vertical nightlights, as proposed in Dr Mariana Figueiro's 24-hour lighting scheme, reduce the risk of falls for older adults by helping them maintain balance and navigate at night. Image courtesy of Lighting Research Center.

Ever wondered why bright light lifts your mood or why you eat more when you're tired? Ever noticed that you sleep better when you've spent the morning outside? Whether or not you're conscious of these bodily responses, they're all being triggered by the same thing: light.

Light plays a key role in governing the circadian system, an internal clock that keeps the body synchronised with the 24-hour solar day. The circadian system is responsible for a range of bodily functions and for regulating key hormones, including those that control our sleep/wake cycle (melatonin), our feelings of hunger (leptin) and our ability to feel full (ghrelin).

In the days of yore – before electricity, before computers, before the dim and unchanging illumination of typical indoor work environments – activities that supported the natural rhythms of the circadian system were more prevalent in daily life; that is, exposure to daylight in the mornings, and a gradual reduction in light over the course of the day. But according to Dr Mariana Figueiro, the head of the Light and Health Program at Rensselaer's Lighting Research Center in Troy, New York, our modern lifestyle may be turning the natural rhythms of the circadian system upside down and wreaking havoc with our health.

"We're designed to wake up in the morning, get a lot of light from daylight, and then sleep in dark nights," Dr Figueiro says.

"And I think what's happening with the built environment is that we've lost that – we're in dim lights during the day, and then we may be exposing ourselves to too much light in the evening, so that's what's messing with our systems."



Dr Figueiro and her team specialise in research that looks at the role of light in preventing, treating and mitigating the impacts of a range of health conditions. Her work has revealed that light has the capacity to trigger a variety of circadian responses depending on the colour and intensity of the light source and the duration and time of day that individuals are exposed to it.

"In terms of spectral sensitivity of the circadian system, as measured by acute melatonin suppression, 460 nanometre blue light is what we're maximally sensitive to. So if you're using a narrow band light source that is blue, you're going to need a lot less light to activate the circadian system than if you're using a white, warm light source, such as incandescent light," Dr Figueiro says.

During the day, exposure to blue light keeps the circadian rhythms ticking over. Daylight is rich in blue light and is an ideal source for supporting daytime alertness. However, thanks to lifestyles that keep us largely inside throughout the working week, not many of us are actually getting the daylight hits we need. At night,

melatonin starts being produced about two hours prior to bedtime, signalling the body that it is time to sleep. Our access to electric lights and backlit electronic devices that project some blue light directly to the back of the eye can suppress melatonin and confuse the circadian system into thinking that it is daytime.

Confused or disrupted circadian rhythms lead to poor sleep, which has been linked to a nasty array of diseases, including obesity, diabetes, heart disease and a number of cancers. For example, several epidemiological studies have shown that nurses working rotating shifts over an extended period of time are more susceptible to breast cancer. While the reasons for this are not clear, one of the working hypotheses is that the exposure to light at night and resulting melatonin suppression is a contributing factor the development of cancer.

"It's been shown in animal models that melatonin has a protective effect against growth rates of tumours," Dr Figueiro says.

"The work on diabetes and obesity shows that if you sleep five hours a night instead of sleeping

Dr Mariana Figueiro's research examines whether saturated red or blue light from LEDs can increase alertness and performance in this Lighting Research Center (LRC) Lab Study. Image courtesy of Lighting Research Center.

eight hours for four consecutive days, you become pre-diabetic, and you become hungrier.”

Blue light before bedtime and at night may be bad news; however, blue light in the morning and during the day can have a beneficial effect on health. Dr Figueiro and her team recently conducted a study into the impact of blue light exposure on Alzheimer’s patients. The results were astonishing: after only four weeks, study participants were experiencing increased sleep efficiency, increased sleep duration, reduced sleep disturbances, reduced agitation and reduced depression.

“Residents at nursing homes and assisted living facilities are exposed to constant dim light, 24 hours a day,” she says.

“What we’re showing is by simply giving them a robust light/dark pattern, we’re seeing dramatic improvements to their health and wellbeing.”

But blue light is only one piece of the puzzle when it comes to lighting and human health. For example, seasonal depression has long been treated via the use of light box therapy that exposes patients to significant quantities of white light, while investigations into red, green and blue light have indicated a role in modulating levels of cortisol, the body’s

stress hormone. The next big thing is red light: lab studies at the Lighting Research Center are already showing that red light makes people feel more alert during the day and at night without impacting their sleep cycles.

“What’s interesting about red light is that it will not affect melatonin, and it’s not something that will change the timing of your sleep. If you give people, again, saturated red – it’s a 640 nanometre red – you see an increase in brain activity. We’re seeing some improvement in reaction times, we’re seeing improvement in subjective ratings, so people feel more alert with red light,” Dr Figueiro says.

Green light is the next frontier. While studies from Brigham and Women’s Hospital and Harvard University have already demonstrated that green light can impact circadian cycles, its full potential remains an exciting unknown. Further research is on the cards for Dr Figueiro and team in the near future – the next step in unravelling the intricate relationship between humans and light.

Keep an eye out in the October issue of *Lighting Newswire* for Part 2 of this series, which will look at how health-conscious lighting can be integrated into commercial and residential lighting design.



Dr Mariana Figueiro, Lighting Research Center (LRC) Light & Health Program Director and Professor at Rensselaer Polytechnic Institute. Image courtesy of Lighting Research Center.

Lighting Research Center work conducted in 2012 found that light from self-luminous “backlit” displays, such as iPads, causes melatonin suppression. In the study, participants viewed these tablets in three ways: without goggles; through orange-tinted goggles capable of filtering out radiation that can suppress melatonin; and through clear goggles fitted with blue LEDs to suppress melatonin. Image courtesy of Lighting Research Center.

