COMMENTARY

How to Get a Bigger Dose of Bright Light

Commentary on Dewan et al. Light-induced changes of the circadian clock of humans: it is more effective to increase duration than light intensity. SLEEP 2011;34:593-599.

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Bright light is routinely used to treat winter depression or seasonal affective disorder (SAD).[1] Bright light can also be used to phase shift circadian rhythms to treat the circadian rhythm sleep disorders caused when modern society imposes unhealthy sleep schedules that are not in alignment with the natural time for sleep dictated by the circadian clock. These situations include jet lag,[2] shift work,[3] space shuttle flights,[4] and the delayed sleep phase disorder.[5] Clinicians, patients, researchers and consumers of light boxes who self-treat want to know how to get the largest dose of bright light. The answer from the paper by Dewan and colleagues in this month's issue of *SLEEP* is clear; increase the duration of the light exposure, not the intensity.[6] These investigators woke subjects up in the middle of the night to expose them to bright light in the middle of the phase delay region of our light phase response curve (PRC),[7] the last half of the delay region in the Khalsa et al. PRC.[8] Durations were 1, 2, or 3 h and intensities were 2000, 4000, or 8000 lux. All 9 combinations were tested. Intensities were produced by adjusting two large 2-foot wide light boxes (one on each side of the bed) or four light boxes (two on each side of the bed) and by turning on two or three of the lamps inside each box. Subjects watched TV at the foot of the bed. The resulting circadian rhythm phase delays ranged from no shift to a shift of about 2 h, with the largest phase shifts produced by the 3-h exposures. Increasing duration significantly increased the magnitude of the phase shift, but increasing intensity did not.

Those who want a quick fix would rather hear that a shorter duration works as well, even if the intensity has to be greater. In fact, the trend has been for shorter durations of more intense light. This was initiated by a 1990 study,[9] in which SAD patients were given 30 min of morning light from a new light box that delivered a whopping 10,000 lux. Their remission rates were similar to patients who were given the then standard treatment of 2 h of 2500 lux. Light box manufacturers react swiftly to the latest research, and soon many of them made light boxes that could deliver 10,000 lux. However, most of the antidepressant response is due to placebo effects,[10,11] and both treatments undoubtedly produced great expectations for success—the long 2-h standard treatment and the new 10,000 lux light box that was so powerful that only 30 min was needed. Furthermore, similar antidepressant effects do not tell us if there were similar phase shifts. In fact, there is controversy over whether phase shifting circadian rhythms is necessary for SAD treatment.[12]

Dewan et al.[6] were surprised that they did not get the expected dose response of larger phase shifts from more intense light. Other researchers studied the effect of light intensity on the magnitude of phase shifts in humans. About 15 years ago we tested 3 different intensities of light (high ~5700 lux, medium ~1230 lux and low < 250 lux for 3 h/day) in a simulated night shift work protocol.[13] The phase shifts produced by the high and medium intensities were about twice as large as for the low intensity light, but high and medium were not significantly different from each other. We concluded that extremely bright light was not necessary, at least not in our protocol. Another lab used a 6.5 h light exposure and found that the maximum phase shift occurred when the light intensity reached ~550 lux. Increasing the intensity up to 9100 lux did not increase the size of the phase delay.[14] Does this mean that there is no need to use light brighter than ~550 lux—the intensity of very bright office lighting—to help phase shift rhythms? No. In that study[14] subjects were in the dark and in very dim light < 10 lux for almost 3 days before the 6.5 h light exposure. A dim light history makes the system more sensitive to light.[15] Thus, those results cannot be generalized to treatment of people who are occasionally exposed to outdoor light. Research is needed to test different intensities in protocols that could be adopted for treatment (feasible durations, intermittent patterns, preferably with a single light box).

Can the results of the Dewan study be generalized to treatment in the real world? The most obvious problem is that subjects were awakened in the middle of the night for bright light exposure, with 4 h sleep/dark episodes before and after the exposures. This protocol does not match any treatment regimens. Also, the light was applied continuously, but people are more likely to take breaks to do things away from the light box and thus get their bright light treatment intermittently. We routinely test intermittent light patterns because they are more feasible for compliance.[3,16] The study of Dewan et al. utilized only one day of light treatment, whereas most treatment in the real world would take place over days or weeks.[1-5,7,9,12,13,16] Finally, only phase delays were tested, not phase advances, and advances are much more difficult to achieve. Nevertheless, I agree with their statement that "…we believe that the results obtained in the present study represent a general property of the human circadian system…."[6]

So, how do we get the largest dose of phase-shifting light? Are there any tricks besides spreading intermittent light over a large part of the delay or advance portion of the light PRC?

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The discovery that there are photoreceptors in the retina besides rods and cones, and that these intrinsically photosensitive retinal ganglion cells (ipRGCs) are most sensitive to blue light and serve the circadian system,[17] led the light box manufacturers to build blue and blue-enriched light boxes. Despite media hype, the availability of inexpensive little blue light boxes, and carefully controlled laboratory studies using special apparatus showing the superiority of blue over other wavelengths for phase shifting,[18,19] I do not know any studies showing that a blue or blue-enriched light box can produce larger phase shifts than the traditional white light boxes.[20-22] We do have unpublished data showing that the little blue light box can produce as large a phase shift as larger white light boxes, at least when our staff supervises subjects closely to make sure the light shines in their eyes (it's relatively easy to move out of range of the smaller light boxes).

In general, I suggest using as large a light box as possible because it's easier to stay within range. Try to cover as much of the visual field and as much of the appropriate portion of the phase response curve as possible. More studies will be needed to determine the shape of the light PRC for light that could be used in treatment regimens (feasible durations, intermittent patterns, single light box) and to confirm the most efficacious light exposure parameters for inducing circadian phase shifts in everyday environments.

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DISCLOSURE STATEMENT

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