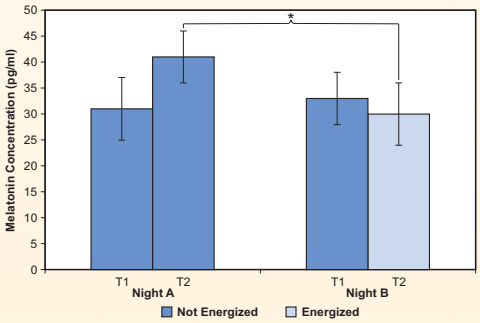
Pulsing Blue Light During Sleep Phase Shifts DLMO

Light through closed eyelids during sleep can provide a convenient and effective way to receive light therapy for the treatment of circadian sleep disorders.

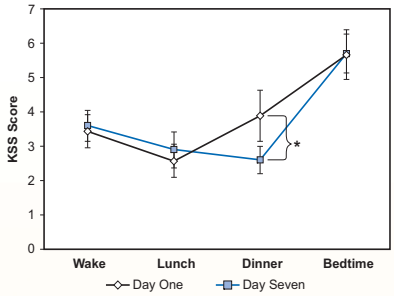
Using LRC's models of the spectral transmittance of the human eyelid (Bierman et al. 2011) and of circadian phototransduction (Rea et al. 2005; 2012), the efficacy of a sleep mask delivering one 2-second pulse of 480 nm (blue) light every minute for one hour was shown to significantly suppress melatonin and phase delay dim light melatonin onset (DLMO) in a laboratory setting (Figueiro et al. 2013). Two additional studies were performed to confirm and extend these results.

Laboratory Study: The goal of this study was to determine whether a higher frequency (two 2-second pulses of blue light per minute) would be more effective at suppressing nocturnal melatonin than one 2-second pulse of blue light per minute.

Field Study: The goal of this study was to determine whether it was possible to translate previous laboratory findings on light-induced phase shifting to home environments.



Laboratory Study: Mean ± standard error of the mean (SEM) of the melatonin concentrations (pg/ml) at T1 (always in darkness) and T2 (darkness or after one hour exposure to the blue light pulses). During the control night, the sleep mask was not energized and during the intervention night, the sleep mask was energized and delivered the blue light pulses. Melatonin concentrations increased from T1 to T2 when the sleep mask was not energized and decreased when it was energized. * = statistically significant



Field Study: Mean ± SEM Karolinska Sleepiness Scale (KSS) values collected during the first and last day of the intervention week. Subjects were significantly less sleepy at dinner time after one week of the light intervention (Day Seven) than on the first day of the intervention week (Day One). * = statistically significant

The laboratory study results demonstrated that the blue light pulses significantly suppressed melatonin by an amount similar to that previously shown in the same protocol at half the frequency. Field study results demonstrated that blue light pulses given early in the sleep episode significantly delayed circadian phase in older adults. These results are the first to demonstrate the efficacy and practicality of light treatment by a sleep mask aimed at adjusting circadian phase in a home setting.

	Baseline (h:min)	After Intervention (h:min)	Shift in DLMO (h:min)
	20:03	20:06	-0:03
	20:45	21:06	-0:21
	20:07	20:34	-0:27
	21:22	21:27	-0:05
	20:18	21:03	-0:45
	20:45	21:30	-0:45
	21:10	21:37	-0:27
	21:46	21:36	0:10
	19:15	19:54	-0:39
	19:00	19:37	-0:37
Average	20:27	20:51	-0:24
SEM	±0:16	±0:14	±0:05

DLMO times (h:min) at baseline and after the light intervention for every subject together with their respective phase shifts (baseline time minus intervention time; negative number = phase delay). Associated average and variance values (mean ± SEM) are also provided.

More Information

Figueiro MG, Plitnick B, Rea MS. 2014. Pulsing blue light through closed eyelids: Effects on phase shifting of dim light melatonin onset in older adults living in a home setting. *Journal of Nature and Science of Sleep (in press).*

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