

Light-emitting e-readers detrimentally shift circadian clock, study shows

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Reader Digital Book (PRS-505)

You may think your e-reader is helping you get to sleep at night, but it might actually be harming your quality of sleep, according to researchers. Exposure to light during evening and early nighttime hours suppresses release of the sleep-facilitating hormone melatonin and shifts the circadian clock, making it harder to fall asleep at bedtime.

"Electronic devices emit [light](#) that is short-wavelength-enriched light, which has a higher concentration of blue light—with a peak around 450 nm—than natural light," said Anne-Marie Chang, assistant professor of biobehavioral health, Penn State. "This is different from natural light in

composition, having a greater impact on sleep and circadian rhythms."

Chang and colleagues observed 12 adults for two weeks, comparing when the participants read from an iPad, serving as an [e-reader](#), before bedtime to when they read from a printed book before bedtime. The researchers monitored the participants' melatonin levels, sleep and next-morning alertness, as well as other sleep-related measures.

Participants took nearly 10 minutes longer to fall asleep and had a significantly lower amount of REM—rapid eye movement—sleep after reading from a light-emitting e-reader than they did after reading from a print book, the researchers report in today's (Dec. 22) issue of the *Proceedings of the National Academy of Science*.

"Our most surprising finding was that individuals using the e-reader would be more tired and take longer to become alert the next morning," said Chang. "This has real consequences for daytime functioning, and these effects might be worse in the real world as opposed to the controlled environment we used."

The researchers measured the amount of brightness coming from several devices, including an iPad, iPhone, Kindle, Kindle Fire and Nook Color. The Kindle [e-reader](#) does not emit light, while the iPad, Kindle Fire and Nook Color emit similar amounts of light. However, the iPad is the brightest of the devices measured.

The study participants were admitted to Brigham and Women's Hospital in Boston for the duration of the 14-day study, in order for the researchers to control for many factors. Each participant read from an iPad before bedtime for five nights in a row, and did the same with a printed book. It was randomly determined whether a participant read from a print book or an iPad first—the results showed that the order didn't make a difference. Participants were able to choose their own

reading material, as long as it could be considered "leisure" reading and did not contain any images or puzzles, only text.

The subjects read for four hours before bed, from 6 p.m. to 10 p.m., with time designated for sleep from 10 p.m. to 6 a.m. The researchers collected blood samples from the readers hourly to measure melatonin. Polysomnography—which records brain waves, heart rate, breathing and eye movements—was also used to determine how long it took to fall asleep, the amount of time spent asleep and the amount of time spent in each sleep stage. The researchers also used the Karolinska Sleepiness Scale to measure subjective sleepiness.

"We live in a sleep-restricted society, in general," said Chang. "It is important to further study the effects of using [light](#)-emitting devices, especially before bed, as they may have longer term health consequences than we previously considered."

More information: "Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness," by Anne-Marie Chang et al. *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1418490112

Provided by Pennsylvania State University

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