The timing of sleep just as important as quantity

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Credit: Vera Kratochvil/public domain

Washington State University researchers have found that the timing of

an animal's sleep can be just as important as how much sleeps it gets.

Ilia Karatsoreos, an assistant professor in WSU's Department of Integrative Physiology and Neuroscience, shifted mice from their usual cycle of sleeping and waking and saw that, while they got enough sleep, it was of poorer quality. The animals also had a disrupted immune response, leaving them more open to illness.

Most sleep research focuses on the effects of sleep deprivation or the overall amount of sleep an animal needs. This is generally referred to as sleep's homeostatic process, which is driven by sleepiness or "sleep pressure."

The work by Karatsoreos and his colleagues—published in the journal *Brain, Behavior and Immunity*—is a rare look into the circadian process, a brain-driven clock that controls the rhythms of various biological processes, from digestion to blood pressure, heart rate to waking and sleeping. The cycle is found in most everything that lives more than 24 hours, including plants and single-celled organisms.

Research into the system has significant implications for modern living, write Karatsoreos and his coauthors, as "disruption of the circadian clock is nearly ubiquitous in our modern society" due to nighttime lighting, shift work, jet lag and even the blue-tinged light emitted by cell phones and tablets.

Typically, sleep researchers have a hard time studying sleep deprivation and the circadian cycle separately, as a change in one usually affects the other. However, Karatsoreos and his colleagues saw their model did not affect an animal's total sleep, giving them a unique look into the effects on the timing of the sleeping-waking cycle.

The researchers used mice whose body clocks run at about 24 hours -

much like our own - and housed them in a shorter 20-hour day. This forced their biological clocks out of sync with the light-dark cycle. After four weeks, the researchers injected the mice with lipopolysaccharide, a molecule found in bacteria that can make an animal sick without being contagious.

The researchers saw that the disrupted animals had blunted immune responses in some cases or an overactive response in others, suggesting the altered circadian cycle made them potentially less able to fight illness and more likely to get sick.

"This represents a very clear dysregulation of the system," said Karatsoreos. "The system is not responding in the optimal manner."Over time, he said, this could have serious consequences for an organism's health.

"Just like you have a car that you're running into the ground—things don't work right but you keep driving it until it stops. That's what could happen if you think of disruption going on for years for somebody who's working shift work," he said.

To his surprise, the mice on the 20-hour cycle were getting the same amount of sleep as they did on the 24-hour cycle. But the sleep wasn't as good. The mice woke more often and the pattern of electrical activity in their brains related to restorative sleep was greatly reduced.

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