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Brain responds same to acute and chronic sleep loss

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Burning the candle at both ends for a week may take an even bigger toll than you thought. Researchers at the University of Wisconsin-Madison have found that five nights of restricted sleep--four hours a night--affect the brain in a way similar to that seen after acute total sleep deprivation.

The new study in rats, appearing in the current online edition of the *Proceedings of the National Academy of Sciences,* adds to the growing evidence scientists are accumulating about the negative effects of restricted sleep for both the brain and the body.

"There's a huge amount of interest in sleep restriction in the field today," says Dr. Chiara Cirelli, associate professor of psychiatry at the School of Medicine and Public Health, who led the research.

Many people are sleep restricted, either because they have to or because they choose to be, she says.

"Instead of going to bed when they are tired, like they should, people watch TV and want to have an active social life," she says. "People count on catching up on their sleep on the weekends, but it may not be enough."

This "casual" lack of sleep can be harmful.

"Even relatively mild sleep restriction for several nights can affect an individual's ability to perform cognitive tasks," Cirelli says. "For

instance, recent studies in humans have shown that 5 days with only 4 h of sleep/night result in cumulative deficits in vigilance and cognition, and these deficits do not fully recover after one night of sleep, even if 10 hours in bed are allowed. Sleep restriction can also increase resistance to insulin, leading to a risk of diabetes."

Cirelli and her team kept rats awake 20 hours a day over five days while continuously recording the animals' brain waves with a sophisticated EEG as they were asleep and awake. The EEGs measured slow wave activity (SWA), the best marker of an individual's need to sleep as well as the intensity of sleep that follows a period of wakefulness.

"Slow-wave activity reflects the fact that sleep is regulated by homeostasis: in general, the longer we stay awake, the higher is SWA in the subsequent sleep. We knew that this was true after acute total sleep deprivation (for instance when we stay up all night); now we found that this is also true after chronic sleep restriction. " Cirelli notes..

According to the rat cumulative SWA measures, the sleep restriction produced intense recovery sleep following each wake cycle, with both longer and deeper sleep. The more effective the researchers were in keeping the animals awake during those 20 hours, the larger the sleep rebound they saw during the following four hours.

"It was an indirect but powerful indication of how sleepy the animals actually were," Cirelli says.

Even when the animals seemed awake and were moving around, heightened SWA was evident in their "wake" EEG.

"Monitoring SWA levels during waking time is very important in understanding the whole picture," she says. "High SWA levels during periods of both sleeping and waking signal that you need to go to sleep."

The researchers also found that SWA levels were different in different areas of the brain, and they speculate that this may depend on what parts of the brain had been used during the waking period.

Knowing that sleep restriction evokes the same brain response as sleep deprivation will help scientists better understand the harmful effects of sleep disturbances, says Cirelli.

"Scientists have learned much from 40 years of studies on total sleep deprivation, she says. "Now we know we can apply the lessons we learned from acute sleep deprivation to chronic sleep restriction, which is very relevant to people's lives today."

Provided by University of Wisconsin-Madison

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