If you don't snooze, do you lose? Wake-sleep patterns affect brain synapses

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An ongoing lack of sleep during adolescence could lead to more than dragging, foggy teens, a University of Wisconsin-Madison study suggests.

Researchers have found that short-term sleep restriction in adolescent mice prevented the balanced growth and depletion of brain synapses, connections between nerve cells where communication occurs.

"One possible implication of our study is that if you lose too much sleep during adolescence, especially chronically, there may be lasting consequences in terms of the wiring of the brain," says Dr. Chiara Cirelli, associate professor in the department of psychiatry at the School of Medicine and Public Health.

Mental illnesses such as schizophrenia tend to start during adolescence but the exact reasons remain unclear. The National Institute of Mental Health funded Cirelli's study; the findings appear in the current issue of *Nature Neuroscience*.

"Adolescence is a sensitive period of development during which the brain changes dramatically," Cirelli says. "There is a massive remodeling of nerve circuits, with many new synapses formed and then eliminated."

Cirelli and colleagues wanted to see how alterations to the sleep-wake cycle affected the anatomy of the developing adolescent brain.

Their earlier molecular and electro-physiological studies showed that during sleep, synapses in adult rodents and flies become weaker and smaller, presumably preparing them for another period of wakefulness when synapses will strengthen again and become larger in response to ever-changing experiences and learning. They call this the synaptic homeostasis hypothesis of sleep.

Using a two-photon microscope, researchers indirectly followed the growth and retraction of synapses by counting dendritic spines, the elongated structures that contain synapses and thus allow brain cells to receive impulses from other brain cells. They compared adolescent mice that for eight to 10 hours were spontaneously awake, allowed to sleep or forced to stay awake.

The live images showed that being asleep or awake made a difference in the dynamic adolescent mouse brain: the overall density of dendritic spines fell during sleep and rose during spontaneous or forced wakefulness.

"These results using acute manipulations of just eight to 10 hours show that the time spent asleep or awake affects how many synapses are being formed or removed in the adolescent brain," Cirelli says. "The important next question is what happens with chronic sleep restriction, a condition that many adolescents are often experiencing."

The experiments are under way, but Cirelli can't predict the outcome. "It could be that the changes are benign, temporary and reversible," she says, "or there could be lasting consequences for brain maturation and functioning."

Provided by University of Wisconsin-Madison