

# Chronic sleep loss degrades nighttime performance

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(PhysOrg.com) -- Although the exact function of sleep remains unknown, sleep is clearly necessary for optimal cognitive performance, learning, and memory. Sufficient sleep is also important for cardiovascular, metabolic, and immune functions. New findings by Harvard researchers at Brigham and Women's Hospital (BWH) show how as little as one night's sleep loss - or sleep loss over several weeks - combine with the body's natural 24-hour rhythms to determine how well people perform at a given moment.

The researchers found that chronic sleep loss over three weeks caused performance to deteriorate at a faster rate for each consecutive hour spent awake, particularly during natural low-performance periods late at

night. When individuals with a history of chronic sleep loss attempt to work extended hours into the night, their reactions become about 10 times slower, increasing the risk of accidents and errors. These new findings appear in today's edition of Science Translational Medicine.

The natural, or circadian, rhythms and sleep-wake cycles are normally intertwined, so special study conditions are required to tease apart these influences on how well people function without sleep. The researchers scheduled nine healthy volunteers to live for three weeks on a schedule consisting of 43-hour “days,” each with 33 hours of scheduled wakefulness and 10 hours of scheduled sleep. This equates to 5.6-hour sleep opportunities every 24 hours. Researchers were able to assess the effects of acute sleep loss from long consecutive hours awake, chronic sleep loss from reduced overall sleep over weeks, and the independent cycling of the circadian rhythm.

The researchers found that:

- After waking from a 10-hour sleep, subjects’ performance was always good, but it deteriorated as the 33-hour waking days continued.
- As the chronic sleep debt increased, performance on reaction timing tests deteriorated at a faster rate for each hour spent awake, although it was still within normal limits just after they woke up.
- When the body’s circadian rhythm was at the lowest-performing point late at night and in early morning, the reaction times were always slower, especially with acute and chronic sleep loss.
- When the circadian rhythm was at the highest-performing point in the late afternoon and early evening, reaction times were relatively normal despite substantial acute and chronic sleep loss.

“Many people have a false sense of reassurance that they can quickly recover from a chronic sleep debt with just one or two days of good sleep,” said Harvard Medical School (HMS) clinical fellow in neurology Daniel Cohen, lead author of the paper and a researcher in the Division of Sleep Medicine at BWH. “Our work may help explain this: One long night of sleep can restore performance to normal levels for about six hours after waking, and the late afternoon and early evening alerting signal of the circadian rhythm can largely hide the effects of chronic sleep loss during the rest of a normal day. However, the lingering effect of chronic sleep loss causes performance to deteriorate dramatically when these individuals stay awake for an extended period of time, for example when they try to pull an all-nighter.”

“Individuals who get too little sleep during the work or school week but try to catch up on weekends may not realize that they are accumulating a chronic sleep debt,” said Elizabeth Klerman, senior author of the paper and an HMS associate professor in the Division of Sleep Medicine at BWH. “This may lead to a dangerous situation in which individuals do not realize the extent of their sleep deprivation and their vulnerability to sudden sleepiness when they try to drive or work late into the night.”

“These findings contribute to the growing body of research showing that resident physicians who are required to work in hospitals for 30-hour shifts twice per week often make fatigue-related errors,” said Charles Czeisler, an HMS professor who heads of the Division of Sleep Medicine at BWH and co-author of the paper. “Burning the candle at both ends at the expense of sleep renders tasks such as driving a truck, operating heavy machinery, or performing surgery dangerous, especially during the hours ordinarily reserved for sleep.”

Provided by Harvard University

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