Lack of deep sleep may increase risk of type 2 diabetes

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Suppression of slow-wave sleep in healthy young adults significantly decreases their ability to regulate blood-sugar levels and increases the risk of type 2 diabetes, report researchers at the University of Chicago Medical Center in the “Early Edition” of the *Proceedings of the National Academy of Science*.

Deep sleep, also called “slow-wave sleep,” is thought to be the most restorative sleep stage, but its significance for physical well-being has not been demonstrated. This study found that after only three nights of selective slow-wave sleep suppression, young healthy subjects became less sensitive to insulin. Although they needed more insulin to dispose of the same amount of glucose, their insulin secretion did not increase to compensate for the reduced sensitivity, resulting in reduced tolerance to glucose and increased risk for type 2 diabetes. The decrease in insulin sensitivity was comparable to that caused by gaining 20 to 30 pounds.

Previous studies have demonstrated that reduced sleep quantity can impair glucose metabolism and appetite regulation resulting in increased risk of obesity and diabetes. This current study provides the first evidence linking poor sleep quality to increased diabetes risk.

"These findings demonstrate a clear role for slow-wave sleep in maintaining normal glucose control," said the study's lead author, Esra Tasali, MD, assistant professor of medicine at the University of Chicago Medical Center. "A profound decrease in slow-wave sleep had an immediate and significant adverse effect on insulin sensitivity and

glucose tolerance."

“Since reduced amounts of deep sleep are typical of aging and of common obesity-related sleep disorders, such as obstructive sleep apnea these results suggest that strategies to improve sleep quality, as well as quantity, may help to prevent or delay the onset of type 2 diabetes in populations at risk,” said Eve Van Cauter, PhD, professor of medicine at the University of Chicago and senior author of the study.

The researchers studied nine lean, healthy volunteers, five men and four women between the ages of 20 and 31. The subjects spent two consecutive nights in the sleep laboratory, where they went to bed at 11 P.M., slept undisturbed but carefully monitored, and got out of bed 8.5 hours later, at 7:30 A.M.

The same subjects were also studied for three consecutive nights during which they followed identical nighttime routines. During this session, however, when their brain waves indicated that they were drifting into slow-wave sleep they were subtly disturbed by sounds administered through speakers beside the bed.

These sounds were loud enough to disrupt deep sleep but not so loud as to cause a full awakening. This technique enabled the researchers to decrease slow-wave sleep by about 90 percent, shifting the subjects from the onset of deep sleep (stage 3 or 4) to a lighter sleep (stage 2) without altering total sleep time.

"Our system proved quite effective," Tasali said. When asked about the sounds the next morning, study subjects vaguely recalled hearing a noise "three or four times," during the night. Some recalled as many as 10 to 15. On average, however, subjects required about 250-300 interventions each night, fewer the first night but more on subsequent nights as "slow-wave pressure," the body's need for deep sleep, accumulated night after

night.

"This decrease in slow-wave sleep resembles the changes in sleep patterns caused by 40 years of aging," Tasali said. Young adults spend 80 to 100 minutes per night in slow-wave sleep, while people over age 60 generally have less than 20 minutes. "In this experiment," she said, "we gave people in their 20s the sleep of those in their 60s."

At the end of each study, the researchers gave intravenous glucose (a sugar solution) to each subject, then took blood samples every few minutes to measure the levels of glucose and insulin, the hormone that controls glucose uptake.

They found that when slow-wave sleep was suppressed for only three nights, young healthy subjects became about 25 percent less sensitive to insulin. As insulin sensitivity decreased, subjects needed more insulin to dispose of the same amount of glucose. But for eight of the nine subjects, insulin secretion did not go up to compensate for reduced effects. The result was a 23 percent increase in blood-glucose levels, comparable to older adults with impaired glucose tolerance.

Those with low baseline levels of slow-wave sleep had the lowest levels after having their sleep patterns disrupted and the greatest decrease in insulin sensitivity.

The alarming rise in the prevalence of type 2 diabetes is generally attributed to the epidemic of obesity combined with the aging of the population. "Previous studies from our lab have demonstrated many connections between chronic, partial, sleep deprivation, changes in appetite, metabolic abnormalities, obesity, and diabetes risk," said Van Cauter. "These results solidify those links and add a new wrinkle, the role of poor sleep quality, which is also associated with aging."

"Chronic shallow non-REM sleep, decreased insulin sensitivity and elevated diabetes risk are typical of aging," the authors conclude. "Our findings raise the question of whether age-related changes in sleep quality contribute to the development of these metabolic alterations."

Source: University of Chicago