

## How Sleep Loss Adds to Weight Gain

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By Anahad O'Connor

**Losing sleep tends to make people eat more and gain weight, and now a new study suggests that one reason may be the impact that sleep deprivation has on the brain.**

The research showed that depriving people of sleep for one night created pronounced changes in the way their brains responded to high-calorie junk foods. **On days when the subjects had not had proper sleep, fattening foods like potato chips and sweets stimulated stronger responses in a part of the brain that helps govern the motivation to eat. But at the same time, the subjects experienced a sharp reduction in activity in the frontal cortex, a higher-level part of the brain where consequences are weighed and rational decisions are made.**



The findings suggested that one unfortunate result of sleep loss is this “double hit” in brain activity, said Matthew P. Walker, an author of the study and a professor of psychology and neuroscience at the University of California, Berkeley. **A sleepy brain appears to not only respond more strongly to junk food, but also has less ability to rein that impulse in.**

Some experts have theorized that in a sleep-deprived state, people eat more food simply to make up for all the calories they expend as they burn the midnight oil. But the new study showed that the changes in brain activity were evident even when the subjects were fed extra food and not experiencing any increased sensations in hunger.

“Their hunger was no different when they were sleep deprived and when they had a normal night of sleep,” Dr. Walker said. “That’s important because it suggests that the

changes we're seeing are caused by sleep deprivation itself, rather than simply being perhaps more metabolically impaired when you're sleep deprived."

**The relationship between sleep loss and weight gain is a strong one, borne out in a variety of studies over the years.** Large population studies show that both adults and children are more likely to be overweight and obese the less they sleep at night. In smaller, controlled studies, scientists find that when people are allowed to sleep eight hours one night and then half that amount on another, they end up eating more on the days when they've had less sleep. **One pivotal study at the University of Colorado in March showed that losing just a few hours of sleep a few nights in a row caused people to pack on an average of about two pounds.**

Other studies have found that the underlying effects of sleep deprivation on the body can in many ways be pronounced. The stress hormone cortisol climbs and markers of inflammation rise. Hormones that stimulate appetite increase, while hormones that blunt it drop. People become less sensitive to insulin, raising their risk of Type 2 diabetes.

**But until now, few if any studies have looked at precisely what goes on in the brain when people are starved of sleep and then faced with food decisions.** In the new study, which was published in the journal Nature Communications, Dr. Walker and his colleagues recruited 23 healthy men and women and assigned them to two different regimes, each separated by about a week. On one occasion, the subjects came into the lab and got a normal night of rest – roughly eight hours – before waking up to a small breakfast of toast and strawberry jam.

The subjects then looked at 80 pictures of a variety of foods and were asked to rate how strongly they wanted them while an imaging machine measured brain activity. The subjects were told that after looking through the pictures, they would receive one of the foods that they rated the highest.

On another occasion, the subjects followed the same routine, but this time, instead of sleeping, they stayed awake through the night. They were also given snacks – like apples and peanut butter crackers – to offset any extra calories that they burned while staying awake.

**The research showed that when the subjects were bleary-eyed and sleep-deprived, they strongly preferred the food choices that were highest in calories, like desserts, chocolate and potato chips. The sleepier they felt, the more they wanted the calorie-rich foods. In fact, the foods they requested when they were sleep deprived added up to about 600 calories more than the foods that they wanted when they were well rested.**

At the same time, brain scans showed that on the morning after the subjects' sleepless night, the heavily caloric foods produced intense activity in an almond-shaped structure called the amygdala, which helps regulate basic emotions as well as our desires for

things like food and experiences. That was accompanied by sharply reduced responses in cortical areas of the frontal lobe that regulate decision-making, providing top down control of the amygdala and other primitive brain structures.

One expert who was not involved in the new study, Dr. Kenneth P. Wright Jr., called the findings exciting and said that they help explain why people make poor dietary choices and eat much more than they need to when fatigued.

“There’s something that changes in our brain when we’re sleepy that’s irrespective of how much energy we need,” said Dr. Wright, the director of the sleep and chronobiology lab at the University of Colorado at Boulder. “The brain wants more even when the energy need has been fulfilled.”

**But why would a lack of sleep disrupt the brain response to food?** Dr. Walker said he suspected that one factor that plays a role is a substance called **adenosine**, a metabolic byproduct that disrupts neural function and promotes sleepiness as it accumulates in the brain. One of the ways that caffeine stimulates wakefulness is by blocking adenosine. Adenosine is also cleared from the system when we sleep. Without enough rest, adenosine builds up and may start to degrade communication between networks in the brain, Dr. Walker said. Getting sleep may be the equivalent of rebooting the brain.

“I think you have about 16 hours of optimal functioning before the brain needs to go offline and sleep,” he said. “If you go beyond these 16 hours into the realm of sleep deprivation, then those brain networks start to break down and become dysfunctional.”

**Dr. Walker said it was increasingly clear from the medical literature that there is not a single tissue in the body that is not beneficially affected by sleep.** “It’s the single most effective thing people can do every day to reset their brain and body health,” he said.

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