Sleep tight—gene responsible for sleep deprivation and metabolic disorders identified

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Credit: xiaphias/Wikipedia

The sleep habits of fruit flies are remarkably similar to humans. They get most of their sleep at night, certain drugs and stimulants like caffeine can negatively affect their sleep, and if they get a lousy night's sleep it can even affect their memory performance. But what can they tell us about the connection between sleep deprivation and metabolic disorders

like diabetes, obesity, and blood glucose levels? A lot, according to a new study that is the first to identify that a conserved gene—translin—works as a modulator of sleep in response to metabolic changes.

Spearheaded by researchers at Florida Atlantic University, findings from this study are published in the April 4, 2016 issue of *Current Biology*, which establishes that translin is an essential integrator of sleep and metabolic state, with important implications for understanding the neural mechanism underlying sleep deprivation in response to environmental challenges.

Acute sleep loss in humans is associated with increased appetite and insulin insensitivity, while chronically sleep-deprived individuals are more likely to develop obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. Conversely, metabolic state has a potent impact on modulating sleep and our body clocks.

"In humans, sleep and feeding are tightly interconnected, and pathological disturbances of either process are associated with metabolism-related disorders," said Alex C. Keene, Ph.D., corresponding author and associate professor in the Department of Biological Sciences on FAU's John D. MacArthur Campus in Jupiter. "Despite the widespread evidence for interactions between sleep loss and metabolic dysfunction, little is known about the molecular basis of this interaction and how these processes integrate within the brain."

When fruit flies are hungry, they sleep less because they will sacrifice sleep for their quest to search for food. Keene and his collaborators used fruit flies in their study and created various scenarios between sleeping and foraging to test each gene one at a time to determine which gene didn't affect their sleep. They carried out a nervous system-specific RNAi screen to identify the genes required to keep hungry flies awake.

What they discovered is that translin, when knocked down in neurons, causes starving flies to sleep as soundly as they would on a full stomach. They also observed the same inability to suppress sleep while in starvation mode in the flies that carried a null mutation in translin.

Fruit flies were placed on specific diets as the researchers measured their sleep, and glycogen, triglycerides and free glucose levels. They broke down the starvation response in the fruit flies into separate mechanisms for hunger and sleep-suppression.

"While many genes have been identified as genetic regulators of sleep or metabolic state, mounting evidence from our study indicates that translin functions as a unique integrator of these processes," said Kazuma Murakami, co-first author and a Ph.D. student in the FAU/Max Planck Florida Institute Integrative Biology and Neuroscience (IBAN) program. "We also have been able to show that this gene is not required for general modulation of sleep. Furthermore, we now know that the energy stores in mutant flies are normal and that the starvation-induced sleep suppression phenotype is not due to increased nutrient storage."

Results of this study provide important evidence that translin is not required for the perception of starvation or to stimulate hunger-related behaviors, but is required to stimulate wakefulness in the absence of food.

"The identification of genes regulating sleep-feeding interactions will provide important insight into how the brain integrates and controls the expression of complex behaviors," said Keene.

More information: "Translin is Required for Metabolic Regulation of Sleep" *Current Biology*, 2016.