Delayed meal times reset body clocks

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The human body runs according to a roughly 24-hour cycle, controlled by a "master" clock in the brain and peripheral clocks in other parts of the body that are synchronized according to external cues, including light. Now, researchers reporting in *Current Biology* on June 1 have found that at least one of those clocks can also be reset based on what time a person eats breakfast, lunch, and dinner.

The findings suggest that regular meal times might help people to keep

their clocks on the same time, the researchers say.

"A 5-hour delay in meal times causes a 5-hour delay in our internal blood sugar rhythms," says Jonathan Johnston of the University of Surrey. "We think this is due to changes in clocks in our metabolic tissues, but not the 'master' clock in the brain."

Researchers knew that the body's clock system and metabolic control were tightly linked. Studies had also shown that circadian rhythms respond to meals. However, the researchers explain, it has only recently become possible to study relevant markers of the human body's many clocks, both inside and outside the brain.

In the new study, Johnston, along with Sophie Wehrens and their colleagues, enrolled ten healthy young men in a 13-day experiment in the lab. The men ate three meals at 5-hour intervals. All meals had the same calorie and macronutrient content.

Each participant started with a meal time set to 30 minutes after waking, and then, after getting used to eating early, they switched to a meal served 5 hours later for 6 days. After completing each meal schedule, the men underwent 37 hours of a specialized laboratory routine that allowed measurement of their internal circadian rhythms. The routine included dim lighting, small hourly snacks, limited physical activity, and no sleep.

The change in meal time didn't seem to influence hunger or sleepiness in the participants. It didn't change markers of the brain's master clock, including rhythms of melatonin and cortisol, or clock gene expression in the blood, either. However, the researchers discovered that later meal times significantly affected blood sugar levels. After late meals, blood sugar rhythms were delayed more than 5 hours on average.

"We anticipated seeing some delays in rhythms after the late meals, but

the size of the change in blood sugar rhythms was surprising," Johnston says. "It was also surprising that other metabolic rhythms, including blood insulin and triglyceride, did not change."

The researchers also found that the rhythmic expression of a gene known as PER2, which encodes a core clock component, was delayed in fat tissue by about 1 hour. The findings show that molecular clocks in people may be regulated by meal times and that those shifts could underpin changes in blood sugar levels.

The findings suggest that people who struggle with circadian rhythm disorders, including shift workers and those on long-haul flights, might consider timed meals as part of an overall strategy to help resynchronize their body clocks. Now that the influence of meal times on human metabolic rhythms is clearer, the researchers say, it will be important to learn more about the health consequences.

More information: Current Biology, Wehrens et al.: "Meal Timing Regulates the Human Circadian System" www.cell.com/current-biology/f … 0960-9822(17)30504-3 , DOI: 10.1016/j.cub.2017.04.059

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