

# Eating late increases hunger, decreases calories burned, and changes fat tissue

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Obesity afflicts approximately 42 percent of the U.S. adult population and contributes to the onset of chronic diseases, including diabetes, cancer, and other conditions. While popular healthy diet mantras advise

against midnight snacking, few studies have comprehensively investigated the simultaneous effects of late eating on the three main players in body weight regulation and thus obesity risk: regulation of calorie intake, the number of calories you burn, and molecular changes in fat tissue. A new study by investigators from Brigham and Women's Hospital, a founding member of the Mass General Brigham healthcare system, found that when we eat significantly impacts our energy expenditure, appetite, and molecular pathways in adipose tissue. Their results are published in *Cell Metabolism*.

"We wanted to test the mechanisms that may explain why late eating increases obesity risk," explained senior author Frank A. J. L. Scheer, Ph.D., Director of the Medical Chronobiology Program in the Brigham's Division of Sleep and Circadian Disorders. "Previous research by us and others had shown that late eating is associated with increased obesity risk, increased [body fat](#), and impaired weight loss success. We wanted to understand why."

"In this study, we asked, 'Does the time that we eat matter when everything else is kept consistent?'" said first author Nina Vujović, Ph.D., a researcher in the Medical Chronobiology Program in the Brigham's Division of Sleep and Circadian Disorders. "And we found that eating four hours later makes a significant difference for our hunger levels, the way we burn calories after we eat, and the way we store fat."

Vujović, Scheer and their team studied 16 patients with a [body mass index](#) (BMI) in the overweight or obese range. Each participant completed two laboratory protocols: one with a strictly scheduled early meal schedule, and the other with the exact same meals, each scheduled about four hours later in the day. In the last two to three weeks before starting each of the in-laboratory protocols, participants maintained fixed sleep and wake schedules, and in the final three days before entering the laboratory, they strictly followed identical diets and meal

schedules at home. In the lab, participants regularly documented their hunger and appetite, provided frequent small blood samples throughout the day, and had their body temperature and [energy expenditure](#) measured. To measure how eating time affected molecular pathways involved in adipogenesis, or how the body stores fat, investigators collected biopsies of [adipose tissue](#) from a subset of participants during laboratory testing in both the early and late eating protocols, to enable comparison of gene expression patterns/levels between these two eating conditions.

Results revealed that eating later had profound effects on hunger and appetite-regulating hormones leptin and ghrelin, which influence our drive to eat. Specifically, levels of the hormone leptin, which signals satiety, were decreased across the 24 hours in the late eating condition compared to the early eating conditions. When participants ate later, they also burned calories at a slower rate and exhibited adipose tissue gene expression towards increased adipogenesis and decreased lipolysis, which promote fat growth. Notably, these findings convey converging physiological and molecular mechanisms underlying the correlation between late eating and increased obesity risk.

Vujović explains that these findings are not only consistent with a large body of research suggesting that eating later may increase one's likelihood of developing obesity, but they shed new light on how this might occur. By using a randomized crossover study, and tightly controlling for behavioral and [environmental factors](#) such as physical activity, posture, sleep, and light exposure, investigators were able to detect changes the different control systems involved in energy balance, a marker of how our bodies use the food we consume.

In future studies, Scheer's team aims to recruit more women to increase the generalizability of their findings to a broader population. While this study cohort included only five female participants, the study was set up

to control for menstrual phase, reducing confounding but making recruiting women more difficult. Going forward, Scheer and Vujović are also interested in better understanding the effects of the relationship between meal time and bedtime on [energy balance](#).

"This study shows the impact of late versus early eating. Here, we isolated these effects by controlling for confounding variables like caloric intake, [physical activity](#), sleep, and light exposure, but in real life, many of these factors may themselves be influenced by meal timing," said Scheer. "In larger scale studies, where tight control of all these factors is not feasible, we must at least consider how other behavioral and environmental variables alter these biological pathways underlying [obesity risk](#)."

**More information:** Frank A.J.L. Scheer, Late isocaloric eating increases hunger, decreases energy expenditure, and modifies metabolic pathways in adults with overweight and obesity, *Cell Metabolism* (2022). DOI: [10.1016/j.cmet.2022.09.007](https://doi.org/10.1016/j.cmet.2022.09.007). [www.cell.com/cell-metabolism/f ... 1550-4131\(22\)00397-7](https://www.cell.com/cell-metabolism/fulltext/S1550-4131(22)00397-7)

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