

**Dra Diana Diaz Rizzolo**

Doctor and Master's in Biomedicine and Translational Medicine.
Nutritionist. Professor at UOC and postdoctoral researcher at Columbia University (NYC-USA).
Coordinator of the SED GT Estilos de Vida initiative.



Chrononutrition: When Mealtime Timing Matters

The time of day at which food is consumed can be as important as the food choices themselves. Chrononutrition offers a new perspective on the relationship between meal timing and wellbeing. Adjusting meal schedules can significantly improve diabetes control.

In this day and age, when diet is a key and fundamental pillar not only for weight control but also to ensure the proper functioning of our body and help us live longer and better, it is something that we all already know. For decades, researchers and health care professionals have focused on finding the perfect formula in relation to how much and what to eat. We have focused our efforts on understanding how energy balance works, to be sure about how many calories are the correct amount according to the energy we expend. We have also worked hard to identify which nutrients are the most beneficial, where they come from, and in what balance they should be consumed in the diet. What we didn't know was that we were overlooking a very specific key question beyond what and how much: when. The time of day at which we consume our food, whether metabolism is cyclical like some of our hormones that respond to sleep and wakefulness, how the distribution of calories is impacted depending on whether it is still daytime or if night has fallen, and a long list of other factors, are questions that are now attracting much of our attention and to which we must start providing answers.

Eating late has been linked to poorer health overall. What we had not yet been able to identify was its causal relationship. That is, we knew that consuming food at later hours of the day is associated with a higher daily calorie intake (1) as well as increased consumption of ultra-processed foods (2). The tendency to consume more and lower-quality food at late hours can trigger a series of adverse effects on the body, including an increase in obesity and poorer glucose tolerance. These factors not only increase the risk of developing type 2 diabetes mellitus but also complicate the management of this disease once it has been established. Therefore, it has consistently been believed that the responsibility for a worse state of health was more about what people ate than when they ate it.

This disordered eating not only contributes to weight gain but also disrupts the body's circadian rhythms. Circadian rhythms are approximately 24-hour cycles that regulate many physiological processes, including glucose and insulin metabolism. In fact, we have known for years that glucose tolerance at night is lower than during the day (3).

Glucose intolerance, a condition in which the body does not efficiently manage blood glucose, is a common precursor to type 2 diabetes mellitus. Eating outside of optimal biological hours disrupts this balance, promoting fat accumulation and increasing insulin resistance (1).

Interestingly, a recent study has provided new evidence in the field of chrononutrition (4). We observed a group of people with prediabetes, comparing late with early eaters. Despite having similar amounts of body fat measured by MRI and consuming the same amount of nutrients and daily calories, late eaters showed significantly worse glucose tolerance than early eaters. It seems, then, that the popular saying Eat breakfast like a king, lunch like a prince, and dinner like a beggar makes sense. Not always does popular wisdom answer scientific questions or lead to health improvements, but in this case, it seems to be true.

Another important aspect, beyond the distribution of calories throughout the day, seems to focus on what the last meal of the day contains and when it occurs. Thus, in people with prediabetes, a late final meal (after 9 p.m.) is associated with 1.5 times more risk of developing type 2 diabetes mellitus in 5 years (5). In the same vein, we previously observed that in a healthy population, the time at which the last meal of the day was consumed predicted greater glycemic variability, even when this final meal was adjusted for calories and nutrients (6). In people with overweight and obesity (7), it has been observed that delaying the last meal of the day increased the feeling of hunger upon waking the next morning and decreased leptin levels throughout the rest of the day. Moreover, late consumption was associated with lower energy expenditure upon waking the next morning, lower body temperature throughout the day, and an increase in the expression of genes that favor the storage of body fat. For all these reasons, researchers concluded that late consumption of that final meal of the day caused changes that could increase the risk of obesity.

It seems that not only the time of the last meal is important, but also the time between it and bedtime is a determinant of our health. A study showed that people who had dinner 6.5 hours before going to »

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» bed had worse nocturnal glucose tolerance vs those who ate two and a half hours before bedtime (7). This is believed to be because the rise in insulin after a carbohydrate-rich dinner is affected by the rise in melatonin to induce sleep, which leads to a worse glucose curve in late diners and those who eat closer to bedtime.

Another interesting point to discuss seems to be the duration of the hours during the day when we are consuming food. This is known as feeding windows, with it being very common for the general population to have feeding windows of more than 14 hours per day. It has been reported that reducing the feeding window, without specifically promoting a reduction in calories consumed, could result in a negative caloric deficit and induce secondary weight loss. This could be focused as a different and more effective strategy depending on the target group, for inducing more stable and lasting weight loss. A recent randomized clinical trial with 65 adult participants with type 2 diabetes mellitus found that shortening the daily feeding window to 8 hours had a health benefit (8). Specifically, one group had no caloric restriction but could only eat between 12 p.m. and 8 p.m., while another group was instructed to reduce their daily energy intake by 25%. After 6 months, it was observed that the involuntary caloric restriction produced by shortening the feeding windows was greater than that of the group focusing on reducing calorie intake. This led to a weight reduction of nearly 4% in the group with reduced feeding windows, promoting a decrease in HbA1c.

Moreover, reducing feeding windows also promotes longer fasting periods, which in turn could represent an improvement in glucose metabolism. Specifically, it has been seen that there is better insulin sensitivity after 36 hours of fasting, with greater glucose variation and a reduced early insulin response (9). And although these results were not reproducible in people »

» with obesity or diabetes, all of them showed lower insulin levels and greater sensitivity to this hormone during fasting (10).

In conclusion, these findings underline that not only the quantity and quality of the food consumed matter, but also the time of day at which it is ingested. Thus, all these results indicate that, on one hand, the distribution of calories throughout the day plays a crucial role in metabolic health; on the other hand, advancing the last meal of the day could be of interest due to its impact on blood sugar levels, and finally, reducing feeding windows by extending fasting periods could lead to a decrease in HbA1c after inducing involuntary weight loss and improving insulin sensitivity. Eating in sync with circadian rhythms can optimize glucose metabolism and improve the insulin response, which is particularly important for people with prediabetes or type 2 diabetes mellitus. Distributing calories more evenly, with a significant intake in the early hours of the day, avoiding large meals at night, especially late ones, could represent an effective strategy to improve glycemic control and reduce the risk of complications associated with type 2 diabetes mellitus. **D**



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