



Sylvia R. Karasu M.D.
The Gravity of Weight

Chrono-Nutrition: An Idea Whose Time Has Come

When we eat may be as important as what we eat.

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"At Breakfast," by Danish artist Laurits Andersen Ring, 1898, National Museum, Copenhagen. The woman pictured is the artist's wife.
Source: Wikimedia Commons/Public Domain

Hobbits are little people who are “inclined to be fat in the stomach”(J.R.R.Tolkien, *The Hobbit*, 1937). No wonder, since they eat six meals a day “when they can get them,” as I mentioned [in a previous post](#). Bilbo Baggins is just sitting down to “a nice little second breakfast...” when the wizard Gandalf appears and chastises him for not being ready to begin his adventure with the dwarves: “Here you are having breakfast or whatever you call it, at half-past ten.”

Does *when* we eat matter as much as *what* we eat? Some studies suggest that meal timing may indeed matter for maintaining health and avoiding chronic disease: Eating out of phase with our body’s circadian rhythms induces what researchers call “metabolic desynchrony” (Regmi and Heilbronn, *iScience*, 2020). The body’s circadian rhythms “orchestrate” (Jamshed et al, *Nutrients*, 2019) all aspects of our physiology, including our metabolism, hormonal signaling, and body temperature (Regmi and Heilbronn, 2020). The suprachiasmatic nucleus (SCN) in the anterior hypothalamus is the

“master regulator” and is synchronized—i.e., “entrained” to the sun’s light/dark 24-hour cycle. Almost all the cells in our body, though, have their own “peripheral” clocks (M. Bray and Young, *Current Obesity Reports*, 2012) that are highly synchronized and “exquisitely sensitive” to the timing of eating (Regmi and Heilbronn, 2020).

Our modern lifestyle potentially disrupts our circadian rhythms in three major ways: shift work, prolonged exposure to artificial light in our 24/7 world, and the ubiquitous availability of food in many cultures (Mattson et al, *Proceedings of the National Academy of Sciences, USA*, 2014). Studies have shown, for example, an association between those who work night shifts (20% of the U.S. workforce) and an increased risk of obesity and type 2 diabetes, with the longer someone does shift work, the higher the risk; researchers caution, though, that although circadian disruptions may impact glucose metabolism adversely, they cannot demonstrate a causal effect (Mason et al, *Diabetologia*, 2020)

Chrono-nutrition refers to the study of the relationship between food and the circadian clock system (Hawley et al, *Diabetologia*, 2020) and involves two aspects, namely that the timing of food intake contributes to health, and that food can lead either to sudden changes in or an actual resetting of that system (Tahara and Shibata, *Neuroscience*, 2013).

The concept of *time-restricted feeding* (TRF in animals; *eating, TRE* in humans) first appeared in the early 1980s (Tongiani et al, *Acta Histochemica*, 1982). In rodents, TRF has been shown to have advantages in terms of reduced weight gain, fat deposition, and even insulin sensitivity. Whether it can translate to an advantage in



J.R.R. Tolkien, author of "The Hobbit." Drawing by 20th century British artist Neale Osborne.
Tolkien's hobbits were described as "inclined to be fat in the stomach."
Source: Copyright Neale Osborne/Bridgeman Images. Used with permission.



"Cook and Waitress," English School, 20th century, Private Collection. In recent years, many people no longer eat breakfast at home, but rather at diners or fast food restaurants, or even "on the go"—of course, all before COVID-19 has affected everything this year. Source: Copyright, Look and Learn, Bridgeman Images, used with permission.

humans “remains unresolved and inconclusive” but “promising” (Gabel and Varady, *The Journal of Physiology*, 2020).

In humans, TRE has evolved as one of the strategies of intermittent fasting and is a means of limiting food intake to a specific number of hours a day, i.e., an *eating window*. This window varies across studies, but is often from 4 to 12 hours with the goal of weight loss and improved glucose regulation (Gabel and Varady, 2020). Caloric restriction is not necessarily part of TRE but with fewer hours to eat, some subjects find themselves eating fewer calories a day.

Researchers have divided TRE into *early TRE* and *late TRE*, depending on when eating begins for the day. Along the lines of Goldilocks, they are still trying to determine how many hours, and/or *when* these hours should begin, for “just right” food intake. It is in the context of TRE and evaluating the ideal time for initiating food intake that researchers question the significance of either eating or skipping breakfast for weight control and metabolic health.

Recently, studies have found that late TRE (12 pm to 8 pm, without attention to caloric intake and no morning meal), is not more effective for weight loss than eating throughout the day in a group of 105 subjects, 50 of whom had metabolic testing. There were no significant changes in fat mass, fasting insulin and glucose, HbA1c, total cholesterol, or blood pressure in those with late TRE. The investigators chose late TRE because “it is culturally easier to skip breakfast than dinner.” Though late TRE may be more amenable for long-term adherence, it may not be as optimal for metabolic benefits as reported with early TRE. Significantly, those in the late TRE group who did lose weight (less than 4 pounds over 12 weeks) lost 65% of this in *lean mass* (Lowe et al, *JAMA Internal Medicine*, 2020).



Swedish artist Hanna Pauli, "Breakfast-Time," 1887. Source: Wikimedia Commons/Public Domain



American artist Mary Cassatt, "Breakfast in Bed," ca. 1894. Huntington Library. Gift of The Virginia Steele Scott Foundation. When we eat may be as important as what we eat. Some researchers suggest not to eat for an hour after rising because of the interaction of insulin and melatonin. Source: Wikimedia Commons/Public Domain

A small study comparing both healthy people and those with type 2 diabetes found that breakfast skipping adversely affected clock-controlled genes and was correlated with increased glucose levels after eating in both groups (Jakubowicz et al, *Diabetes Care*, 2017). There is an association between breakfast skipping and increased weight but confounding issues, such as sleep duration and circadian rhythms, are often not taken into account. For example, our chronotype—i.e., whether we are a morning person or night person—may influence our HbA1c, a marker of blood glucose levels (Dhurandhar, *Current Opinion in Endocrinology, Diabetes and Obesity*, 2016). Further, a sample from the National Weight Control Registry found an association between some of those successful at weight-loss maintenance and a morning-type chronotype (Ross et al, *Journal of Behavioural Medicine*, 2016).

Studies have found an “intriguing” possibility that genetic variants may link breakfast skipping with chronotype and be responsible for an evening preference for eating (Dashti et al, *American Journal of Clinical Nutrition*, 2019). Perhaps research will find a genetic connection between chronotype and those with the night eating syndrome, who typically eat most of their calories much later in the day, including during the night, and have no desire for morning breakfast (Nolan and Geliebter, *Journal of Eating Disorders*, 2019).

Further, some investigators suggest that skipping breakfast may be detrimental to health, not because of skipping itself, but in combination with eating late into the night and creating circadian misalignment. They suggest avoiding eating meals 2-to-3 hours before bed and for up to an hour after waking because of an

interaction between melatonin and insulin levels (Chaix et al, *Annual Review of Nutrition*, 2019).

Researchers have found that skipping or consuming breakfast alone, though, without considering its context, including daily caloric consumption, physical activity, diet quality, or lifestyle behaviors (e.g. smoking, sleep) is not an effective strategy for weight loss (Bonnet et al, *Obesity*, 2020), and particularly not with the “carbohydratization” of breakfast in recent years (Kealey, *Breakfast is a Dangerous Meal*, 2016). But “just because breakfast consumption does not have a statistically significant effect on weight does not make breakfast a bad recommendation” (Bohan Brown et al, *F1000 Research*, 2020).

Bottom line: Time-restricted eating (TRE), with attention to our circadian rhythms, is a *promising* strategy for maintaining metabolic health (e.g., improved blood pressure and insulin sensitivity and more stable blood glucose levels), particularly



Kellogg's Magazine Advertisement, 1920s, English School, Private Collection. Kellogg is widely credited with developing the first breakfast cereal and marketing it to children, even in the 1920s. Source: Copyright, The Advertising Archives/Bridgeman Images. Used with permission.

when begun early in the day (and hence including eating breakfast) though it does not necessarily lead to weight loss. Researchers have not yet determined how many hours of food restriction are most beneficial. The *feasibility* of and long-term *adherence* to early TRE, where most food is consumed by late afternoon and well prior to a typical dinnertime remain open to question, particularly because of daily work schedules that may preclude eating, evening social activities primarily centered on eating, or even a lower biological drive to eat in the morning. Recent COVID-19 restrictions, though, may make this an ideal time to try this strategy.



American artist William James Glackens, "Girl with Teacup," c. 1920. Eating all our food prior to teatime (i.e., early TRE) may be most beneficial metabolically. Source: Photo copyright, Christie's Images/Bridgeman Images. Used with permission.

About the Author



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