

Meal times can reset body's internal clock

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Introduction

Life on Earth has evolved under the influence of day and night alternation. Body's response to this cycle is physical as well as mental and behavioral and it's called circadian rhythm. It's specific to all living beings and it's linked to the adjustment of organisms to sun's light, namely natural light.

Many of the body functions are influenced by the day-night cycle, such as: sleep, thermogenesis, blood pressure and pulse, hormone secretion (melatonin, cortisol, insulin, growth hormone), as well as the metabolic processes and adipogenesis. Impairment of the circadian rhythm may impact body's health status, leading to sleep disorders, cardiovascular disease, obesity, diabetes, depression etc.

Body's circadian rhythm is ensured by "many internal clocks". There is a CENTRAL clock in the hypothalamus (suprachiasmatic nucleus) which is influenced by the light coming from the external environment, and numerous PERIPHERAL clocks synchronized with the central one, which regulate metabolism, depending on meal times, day length, season, through hormonal signals (melatonin) or neuronal signals. (2)

Circadian rhythm disruption may influence body weight

The circadian rhythm may be influenced by certain food habits related to the type of nutrients (fat) or meal times but at the same time, it acts through hormones involved in the metabolic processes and sensation of hunger. Therefore, anything causing a desynchronization of the central clock with the external environment (through exposure to artificial light during the night, sleep disorders, or trans-meridian travel) and with the peripheral clocks may lead to metabolic disorders such as obesity, diabetes, or the metabolic syndrome.

Exposure to artificial light at night allows individuals to stay awake, active, and with a continuous sensation of hunger. Normally, our

organism is not set to receive food at night, which overlaps the increased melatonin secretion. Sleep impairment leads to impairment of melatonin secretion and consequently to modifications of serum glucose and insulin level, decrease in glucose uptake in adipose tissue and impairment of GLUT 4 (the main transporter of glucose to muscles and adipose tissue), which ultimately leads to modification of glucose tolerance (2). Moreover, sleep impairment also produces behavioral modifications, such as the exaggerated wish to eat sweet, hypercaloric products. Also, the sensation of hunger is altered (through ghrelin increase and leptin decrease). *Modifications of the circadian rhythm for more than 10 days lead to increase of postprandial glucose, insulin resistance, and increase of blood pressure.*

Frequent eating with no fasting period (such as during sleep) may cause increasing occurrence of obesity as well as cancer. While eating, the insulin/AKT/mTOR pathway is activated, which leads to activation of genes promoting anabolic and cell division processes. During the fasting and sleep periods AMPK pathway is activated, which leads to catabolic and reparative processes (1).

Is there a difference between night and day eating?

There are studies comparing the effects of a consistent breakfast with those of a consistent dinner (1). Although the 2 meals were identical in terms of calories and composition, the meal time was different, which led to a greater decrease in weight in the group receiving the most consistent food at breakfast as compared to the group having the same food at dinner (8,7 kg/ vs 3,6 kg). This is due to a different insulin response to the same number of Kcal and Carbohydrates/meal, but at a different time of the day. Working in shifts is known to cause obesity as well as other diseases. What we need to understand is that even though breakfast is an important meal of the day, it is not necessary to eat as soon as we wake up. We

can choose a consistent lunch, namely another important meal during the day, and not in the evening. Moreover, there is also a circadian rhythm of the sensation of hunger! The level of ghrelin, the hormone stimulating the sensation of hunger is low at 8 am.. Ghrelin concentration peak is reached at 7.50 pm. The practical aspect is that at 8.00 am the sensation of hunger is inhibited by the circadian rhythm and therefore there is no need to force eating! But the important thing is to have the most consistent meal during the day (eg lunch). Ghrelin reaches its concentration peak 1-2 days after a fasting period, and then decreases, which in practical terms corresponds to the situation in which, after a food restriction period, the most difficult are the 1-2 days, and afterwards the sensation of hunger is attenuated.

A recent study shows that **meal timetable can be influenced by the circadian rhythm (3)**, especially glucose homeostasis, with surprisingly no influence on the level of insulin or triglycerides. Exposure to light or supplementation of melatonin can alter the circadian rhythm, but not the metabolic processes as in the case of the time of our last meal. This study shows that delaying meal time by 5 hours has no consequences on the sleep state or sensation of hunger, does not alter hormone levels - melatonin and cortisol, PER protein blood level, which is the expression of the gene codifying the circadian rhythm. However, **delaying DINNER leads to alteration of glucose rhythm**, as well as **PER2 protein rhythm in the adipose tissue**. Therefore, DINNER time becomes a useful strategy for resetting the circadian rhythm in people who work in shifts or show desynchronization of body's internal clock.

The conclusion is that there is scientific evidence that **dinner time** in itself is of great importance, and not only its caloric consistency. To maintain an ideal body weight it is recommended to have DINNER at sunset, a smaller portion than at lunch, and a good and timely SLEEP will ensure a decreased sensation of hunger and less preference for sweet and hypercaloric food!

References:

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