

The Clockwork Body – Why When We Eat Matters

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'Body clocks are ancient mechanisms that regulate fundamental biological systems important to health, such as insulin secretion, the time we go to bed, the time we get up and the time we get hungry,' says Dr Joe Bass, associate professor of medicine at Feinberg School of Medicine and of neurobiology and physiology at the Weinberg College of Arts and Sciences.

Body clock

The body's primary circadian clock resides deep in the brain, in the suprachiasmatic nuclei. Local biological clocks are also found in tissues throughout the body, including the pancreas, lungs, liver, heart and skeletal muscles. The clocks operate on a 24-hour, circadian (Latin for about a day) cycle that governs functions such as sleeping and waking, rest and activity, fluid balance, body temperature, cardiac output, oxygen consumption, metabolism and endocrine gland secretion.

How the circadian clock may affect the development of diabetes

A study by Bass and colleagues published in *Nature* in 2010 showed that insulin-secreting islet cells in the pancreas, called beta-cells, have their own dedicated clock. The clock governs the rhythmic behavior of proteins and genes involved in insulin secretion, with oscillations over a 24-hour cycle. 'This is the first evidence of how the circadian clock may affect the development of diabetes' said Bass. 'The biological programs in animals for harvesting energy — much like the photosynthesis of plants — are under control of the clock. Our findings will help us figure out the causes of glucose abnormalities, but we still have a lot to learn.'

How the circadian clock may affect weight gain: Dr Steven Shea, director for the Center for Research on Occupational and Environmental Toxicology at Oregon Health and Science University and colleagues at Harvard report in a study published in *Obesity* that the body's internal clock, the circadian system, increases hunger and cravings for sweet, starchy and salty foods in the evenings. While the urge to consume more in the evening may have helped our ancestors store energy to survive longer in times of food scarcity, in the current environment of high-calorie food, those late night snacks may result in significant weight gain.

'Of course, there are many factors that affect weight gain, principally diet and exercise, but the time of eating also has an effect. We found with this study that the internal circadian system also likely plays a role in today's obesity epidemic because it intensifies hunger at night,' said a senior author on the study. "People who eat a lot in the evening, especially high-calorie foods and beverages, are more likely to be overweight or obese.'

Indeed, eating a lot in the evening can be counterproductive since the human body handles nutrients differently depending on the time of day. For example, glucose tolerance may be impaired in the evening. Additionally, consuming more calories in the evening predisposes people to more energy storage; we simply don't expend as much energy after an evening meal in comparison to morning meals.

Furthermore, artificial light enables people to stay up later than they probably should and often people don't get enough sleep. 'If you stay up later, during a time when you're hungrier for high-calorie foods, you're more likely to eat during that time,' Shea said. 'You then store energy and get less sleep, both of which contribute to weight gain. If weight loss is a goal, it's probably better to eat your larger, higher-calorie meals earlier in the day,' said Shea. 'Knowing how your body operates will help you make better choices. Going to bed earlier, getting enough sleep and choosing lower-calorie foods rather than higher-calorie foods in the evening can all help with weight loss.'