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Internal Clocks Run Our Lives

by Ann Gerhardt, MD *May 2017*

Bottom Line at the Top: Many bodily functions are controlled by an internal clock in the brain that cycles us according to day and night. Individual cells of many of our organs also have their own internal clocks that control metabolism. People who want to be healthy should heed their circadian rhythms.

We've known for a long time that daily urges to perform bodily functions, like sleeping, waking, eating and pooping, are determined by circadian rhythms, which are daily cycles of ebb and flow of a bodily function. Most of these rhythms are controlled by a master clock located in a deep portion of the brain in the suprachiasmatic nucleus of the hypothalamus (SCN).

Sunlight prompts the SCN to trigger a sequence of events which raise cortisol levels, promoting wakefulness. Darkness causes it to trigger melatonin release, which tells us to sleep. When deprived of light, the SCN maintains a daily cycle of a little longer than 24 hours. Exposure to sunlight realigns the SCN to daylight and night.

Problems with SCN signaling directly cause sleep disorders, which disrupt our health. Jet lag makes us feel bad for days and night-shift workers have an above-average risk of obesity and diabetes. Depressed people have a variety of sleep disorder patterns, don't cycle cortisol normally and frequently are overweight.

Other atypical patterns occur naturally: Adolescents who stay up very late have a day cycle longer than 24 hours. Older people who fall asleep in early evening have a day cycle shorter than 24 hours.

Circadian rhythm also affects body weight via tiny 'clocks' in cells of liver, muscle, fat, pancreas and intestine. These clocks are semi-independent of the SCN: They normally cycle according to food intake instead of sun, but align with the SCN when their human eats only during daylight hours. This is optimal for health.

Cellular metabolic clocks are important for sugar metabolism. They gear up during the day to produce enzymes that 'burn' blood glucose but taper off at night. Eating at night leads to higher blood sugar levels in both healthy and diabetic people. Higher glucose levels in the evening, when most people are sedentary, shunts calories into fat.

Weight gain is faster when one habitually eats after dark, and it's easier to lose weight and keep it off if we eat only during daylight. A study of overweight people who shifted their eating from 15 or more hours per day to less than 12 hours only during daylight found that they lost weight more easily.

As many as five to ten percent of our genes are regulated in cycles. Body temperature, blood pressure and heart rate peak in the evening. We tend to eat different foods at different times of day. We are most alert in late morning. Coordination, reaction time and exercise capacity surge through the afternoon into early evening.

Most aspects of heart and blood vessel physiology follow a cyclic pattern. Blood pressure, heart rate, and blood vessel distensibility change according to our sleep-wake cycle. Blood pressure and pulse fall in the dark and during sleep. If blood pressure doesn't decline, it means that blood vessel walls are not functioning properly. They constrict when they should relax, possibly causing a stroke or heart attack in the wee hours of the morning. This occurs in people with diabetes, pre-diabetes, high blood pressure, deconditioning, advanced age and disrupted circadian rhythm.

Cellular immune, inflammatory and oxidation reactions also cycle, in part controlled by cellular clocks and in part by the SCN. Even the bacterial pattern in our intestine changes with loss of normal light/dark cycling, affecting intestinal integrity and the whole body's immune system.

Current knowledge about circadian rhythms tells us to do intellectual tasks in the morning, exercise in the afternoon, eat only during daylight and take blood pressure medicine with dinner and allergy medication at night. With more knowledge of our bodily rhythms, we may be able to control our health better by timing activities, food and medicine. ╣