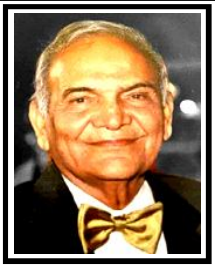

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HEALTH EFFECTS OF DISRUPTED CIRCADIAN RHYTHMS

P. D. GUPTA

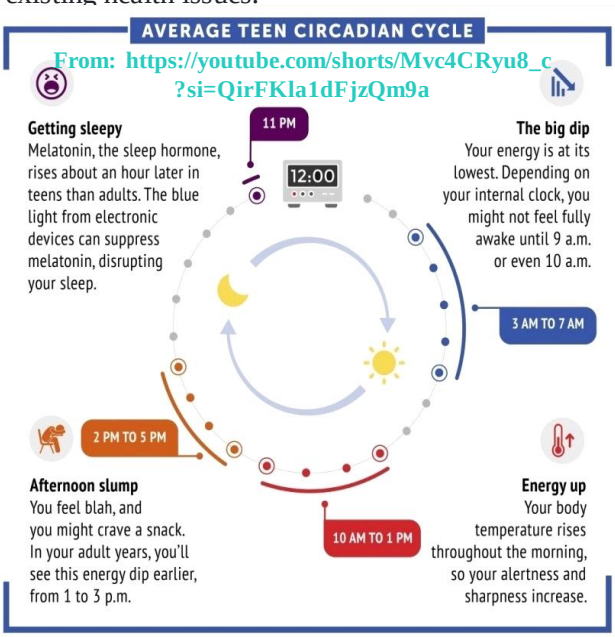
In 2017, Jeffrey C. Hall, Michael Rosbash, and Michael W. Young won the Nobel Prize for their circadian rhythms research. They identified proteins named as PER and TIM in fruit flies that have a specific role in controlling normal daily biological rhythms. During the light period, this protein (called PER) is produced by the cell but immediately broken down in the cytoplasm, keeping PER protein levels low, however during the dark period when night falls, another protein (called TIM) binds directly to PER, protecting it from breaking down. The PER-TIM complexes enter the nucleus and stop the cell from making additional PER. Then, as day breaks, the PER-TIM complexes break down, the block on PER transcription is lifted, and the cycle repeats.

In this way, PER regulates its own synthesis through a negative feedback loop. Feedback loops are coordinated systems that link the output of the system to its input. For example, a thermostat functions on a feedback loop: A home's furnace will turn off when the house reaches the set temperature and only turn back on when the temperature falls below that threshold again. In the case of PER, the protein directly controls the transcription of the gene that codes for it.

Circadian rhythms can fall out of sync with the outside world due to factors in the human body or environment. For example:

- Variants of certain genes can affect the proteins that control biological clocks.
- Neurological diseases, such as Alzheimer's disease, can disrupt circadian rhythms, causing poor sleep quality and changes in symptoms from day to night.
- Travel between time zones (jet lag) and shift work alters the normal sleep-wake cycle.
- Light from electronic devices at night can confuse biological clocks.

In humans when circadian rhythms are misaligned it is harder to fall asleep at bedtime, lead to more wake-ups during the night, and result in less sleep overall. Misalignment can first be confused as insomnia but frequent misalignment can in fact contribute to the development of insomnia. Drowsiness, poor coordination, and difficulty with learning and focus may occur when circadian rhythms fall out of sync short term. Long-term sleep loss and continually shifting circadian rhythms can increase the risks of obesity, diabetes, mood disorders, heart and blood pressure problems, and cancer, and can also worsen existing health issues.



The other example may be cited as to eating close to bedtime could be about throwing off the body's internal clock or "circadian rhythm." In this case, it's not the central circadian center located in the brain — the one that releases melatonin to make you sleepy at night. Instead, late eating could mess with your "peripheral circadian rhythm" or how other parts of your body know to adjust things when day turns to night.

Part of this peripheral system is found in our gastrointestinal tract. For example, if someone is eating late at night, the brain thinks it is nighttime and the gut thinks it is daytime, then there would be conflict between two internal clocks. "It is true that eating later at night can disrupt our circadian rhythm".