



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

A Time for Every Purpose: The Science of Chronopharmacology

They say timing is everything, but for taking medication?



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Whether you cannot read “To everything there is a season, a time for every purpose under the sun...” without hearing Pete Seeger’s music and the voices of The Byrds from their song “Turn, Turn, Turn” or whether you know these words from the *Bible’s Ecclesiastes* (3:1-8), they may be able to teach us something about the importance of our body’s natural rhythms as they relate to the timing of ingesting medication prescribed to us.

In recent years, researchers have come to appreciate that medications can have vastly different effects, from beneficial to toxic, depending on the time of day when they are administered. Sometimes this timing may be more important in determining a drug’s effect than its route of administration (e.g. oral or intravenous) or even how quickly the medication is eliminated from the body. This is the science of chronopharmacology,

and it is based on the fact that we, as well as all light-sensitive organisms (including some bacteria and fungi), have internal biological clocks, i.e. circadian rhythms, that regulate many, if not most, of our physiology. Originally it was thought that there was one “master clock” (i.e. “the pacemaker” or suprachiasmatic nucleus) that is located in the brain’s anterior hypothalamus and is synchronized by the earth’s 24-hour light-dark cycle as the sun’s light hits our retina. We now know that many other environmental signals called zeitgebers (“time givers”), such as eating (even specific foods such as

chocolate or other carbohydrates), drinking alcohol, or exercise can affect these natural rhythms and phase-shift them one way or the other. One of the most common causes of the phase-shifting of our circadian rhythms, of course, occurs with jet lag. Those who have experienced this syndrome that is brought on by jet travel across time zones know how uncomfortable it can make us feel, and how our patterns of eating and sleeping, as well as our sense of well-being, can be severely compromised, at least transiently.

We also now know that most cells have “clock” genes and can sense time; these genes control our sleep-wake cycle, body temperature, blood pressure, and many metabolic processes such as digestion and the release of many of our hormones (e.g. cortisol, melatonin, and insulin), as well as our intake of medications.

According to a 2010 article in the journal, *Annual Review of Pharmacology and Toxicology*, researchers Georgios Paschos and his colleagues at the University of Pennsylvania School of Medicine note that circadian rhythms can affect absorption, distribution, metabolism, and elimination of many of our commonly used medications. For example, benzodiazepines, calcium channel blockers, acetaminophen, and antidepressants are all absorbed more rapidly when given by mouth in the morning rather than at night. And the anticoagulant heparin is twice as effective when given during the day, whereas the antibiotic gentamycin is best tolerated when given in the afternoon. Furthermore, chemotherapeutic agents against cancer can have more devastating toxic effects (e.g. peripheral neuropathy) when cells are undergoing division, a process also under the control of circadian rhythms. Many medical conditions, such as arrhythmias, acute myocardial infarctions (e.g. more common in early morning hours), stroke, and even sudden death “exhibit prominent circadian patterns” that affect when they are more likely to occur and how severe the symptoms are. Even symptoms of allergic rhinitis and bronchial asthma are more severe in the morning.

Researchers believe that it makes sense from an evolutionary perspective that the administration of medication would be under circadian control as a defense system--what is called “xenophobic (from the Greek, “fear of strangers”) detoxification.” In other words, it may have evolved to protect us from any potentially noxious substances, including foods.

Eating, incidentally, is also affected by our circadian rhythms. For example, those who eat only one evening meal for the 24-hour period are more prone to weight gain and even obesity, as



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are those who have the night eating syndrome (e.g. eat most of their calories after 6 pm, frequent awakening during the night to eat, avoidance of breakfast, and even abnormal patterns of hormone secretion.)

Unfortunately, the science of chronopharmacology is still in its infancy, but it is certainly worthwhile to ask your physicians whether information is known about the importance of timing when taking medication prescribed to you.

About the Author



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In Print: *The Gravity of Weight: A Clinical Guide to Weight Loss and Maintenance*

Online: my own website

