

Adolescent Chronotype and Self-Regulation: The Power of When

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Few elements of the living world are as ubiquitous as the circadian rhythm. Derived from Latin (circa = approximately; diem = day), the circadian rhythm is a roughly 24-hour intrinsic cycle that is the direct result of evolving on a planet with a 24-hour day–night period. The clock is found in animals, plants, fungi, and even unicellular organisms, allowing for the living world to be physiologically, metabolically, and behaviorally in tune with the external environment.¹

In humans, the reaches of the 24-hour cycle are far greater than many realize. The most well-known function of the circadian rhythm is to provide an alerting signal that waxes and wanes in a predictable fashion throughout the day. Perhaps not as well known is that organ systems and even individual cells display a 24-hour periodicity, all of which are kept in sync by the suprachiasmatic nucleus within the hypothalamus.

But what happens when the clock that is meant to keep us in synchrony with our environment is shifted? In this issue of *Pediatrics*, Owens et al² provide new insights into the consequences of altered circadian timing. They explore the relationship of chronotype, sleepiness, and sleep duration with self-regulation in adolescents. Individuals with delayed timing of sleep and wake compared with the social clock have an “eveningness” chronotype, whereas those with advanced timing harbor a “morningness” chronotype. During adolescence, the body clock tends to delay due to both inherent biological and environmental factors.³ The study

found that while delayed chronotype and increased subjective sleepiness correlated with lower scores for self-regulation, sleep duration did not. Although causality cannot be determined, previous research would indicate that the manipulation of sleep influences self-regulation, not vice versa.^{4,5}

Why would self-regulation correlate with chronotype more so than with sleep duration? After all, one may assume that any detrimental effects of a delayed chronotype are the direct result of sleep deprivation due to waking earlier than desired. Recent data indicate that sleep deprivation may not explain the complete picture. Even when sleep duration is controlled, delayed chronotype is associated with a variety of poor outcomes in adolescents, including increased risk of obesity, emotional difficulties, and poor school performance.^{6–8} Simply put, when the body is asked to eat, interact, and think at times that are not synchronized with circadian timing, the results can be detrimental.

Are we ready to say that chronotype is more important than sleep duration for adolescent self-regulation? More research is needed. Self-report of sleep duration by adolescents can be inaccurate when compared with objective measures.^{9,10} Further studies should seek to objectively characterize both sleep duration and circadian timing to better elucidate their contribution to self-regulation. However, such objective measures can be expensive and cumbersome, and therefore not feasible at the epidemiologic level.

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As evidence of the importance of circadian physiology grows, it will become harder to ignore societal implications. In its current form, the timing of grade school education and workplace schedules cater to a morningness chronotype. Those with an eveningness chronotype must conform to this timing. Is it fair to educate and test students when their clocks are out of sync with the school day? Should the workplace allow for flexible hours to accommodate worker circadian preference? Would surgeons have better outcomes if they timed surgeries based on their chronotype? There will be difficult and interesting questions to answer along the path toward change.

Although the pace of change is slow, there is progress, such as seen in the trend toward delayed start times for middle and high schools.¹¹ A deeper understanding of the circadian rhythm will help us uncover new ways to improve education, health care, and the workplace. Perhaps 1 day our chronotypes will be an essential element of everything from

our medical records to our résumés. It is only a matter of time.

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