Exposure to Early Evening Daylight in Spring Creates Teenage Night Owls

Chronic sleep restriction, which is common in adolescents, has been associated with poor school performance, mood changes, obesity, depression, and suicidal thoughts. Sleep onset is governed in part by the circadian timing system. Environmental cues such as light/dark patterns help synchronize circadian rhythms to the 24-hour solar day. LRC researchers investigated if prolonged exposure to daylight in the early evening hours in the lengthening spring day would result in sleep restriction in adolescents. Dim light melatonin onset (DLMO), a well-established circadian marker, was measured. Melatonin onset typically occurs about two hours prior to sleep times, so later DLMO results in later sleep times.

Method

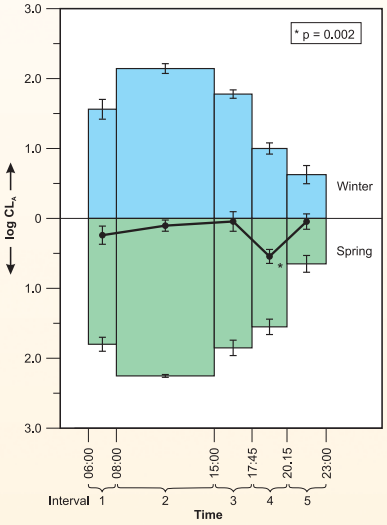
Sixteen eighth-grade students from upstate New York wore the Daysimeter, a small, head-mounted device developed by the LRC, that measures an individual's exposure to photopic and circadian light (CL_A) as well as rest and activity patterns. Students wore the device for seven consecutive days in the winter (March 2009) and in the spring (May 2009). Researchers also collected sleep logs for one week and saliva samples at the end of each week (winter and spring) to determine their DLMO.

A middle-school student gathers light exposure information with the Daysimeter

Results

Researchers found that the students were exposed to significantly more circadian light in the spring evenings compared to winter, resulting in a delay in DLMO by an average of 20 minutes measured in one day in spring relative to one day in winter. Students' sleep logs also collectively showed a 16-minute average delay in reported sleep onset and a 15-minute average reduction in reported sleep duration.

The biggest impact on the delayed sleep patterns was a result of the extended hours due to seasonal change—not as a result of electric lighting after dark at home. The results of this study, combined with a previous study that showed that the lack of morning circadian light also delays DLMO, support the general hypothesis that the entire 24-hour pattern of light/dark exposure influences synchronization of the body's circadian clock with the solar day, and thus influences teenagers' sleep/wake cycles. This study is the first to relate field measurements of circadian light exposures to a well-established circadian marker (the rise in melatonin levels) during two seasons of the year.



The figure above illustrates Log-CL_A exposure values with associated standard error of the means (SEMs) between 06:00 and 23:00 h for winter and spring, subdivided into five intervals: 1. morning light, 2. in-school hours, 3. winter early evening, 4. spring early evening, and 5. late evening. The differences in log-CL_A values for each of the five subdivisions are shown with their associated SEMs, and connected with solid lines for visual clarity. Log-CL_A values for winter and spring were significantly different during the fourth subdivision when there was differentially more daylight available in the spring evenings than during the winter evenings (p = .002, indicated by an asterisk).

Further Information

Figueiro MG and MS Rea. 2010. Evening daylight may cause adolescents to sleep less in spring than in winter. *Chronobiology International*. 27(6): 1242-1258.

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