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School Times Oppose Circadian Rhythms of Adolescents

The circadian rhythm is a natural clock that determines when people are able to sleep. A lack of an appropriate amount of sleep daily can be negative for their health and ability to function throughout the day. For adolescents, sleep is particularly important since it contributes to their ability to grow and sets the tone for their adult lives. There are both internal and external factors that may impact one's ability to keep to their circadian rhythm, but external factors are, in general, easier to identify and resolve.

The range of external factors affecting circadian rhythms are wide, but many of them fit the typical student's life. These factors include parental influence, school start times, and employment and extracurricular activities (Millman et al., 2005). Not keeping to a circadian rhythm can have a range of dire impacts as well, including daytime sleepiness, problems with school performance, attention deficiency and hyperactivity, mood disturbances, and drowsiness while driving (Millman et al., 2005). The external factor that has perhaps had the largest effect on adolescent circadian rhythms is early school times, which need to be changed as they are negatively impacting students' brain function and overall wellbeing. Through investigation of published works on how early school times harm adolescent students' sleeping patterns through social jet lag and loss of sleep, reduced executive function, and risk behavior, I conclude that there is an urgent need to adjust school schedules to be a better match for adolescent natural circadian rhythms.

Social Jet Lag & Loss of Sleep

Most adolescents are students, and school around the world usually begins in the morning. Some students have to wake up even earlier if they commute to school. The difference between a person's social and biological clocks has been termed "social jet lag," and teenagers are likely to experience large lags due to early school times.

It is because of social jet lag that many students are likely to sleep in on weekends, when they do not have school. The issue with "catching up" on sleep over the weekends, though, is that sleep that is lost cannot be made up. Arcady Putilov and Evgeniy Verevkin (2018) conducted a study on the concept of sleeping in for Frontiers in Society, and chose to reseach adolescents because they are susceptible to social jet lag since their sleep times are later than younger people, their sleep duration is longer than older people, and the time they wake up on weekdays is the same as the time of younger people. They created simulations of bedtimes and risetimes for different age groups based on of the data of sleeping patterns of 160 participants, most of which were school-age. Their findings, based on the fact that no "sleep debt" was accumulated for the participants, were that being able to catch up sleep on weekends or vacation is indeed a myth, and that "what people think is their weekend extra sleep is exactly what would be expected to be just a normal sleep" (Putilov & Verevkin, 2018). To put it another way, adolescents sleeping in on days off are not catching up on sleep, but rather are sleeping according to their circadian rhythms, but a result is that the sleep that students lose on a daily basis cannot be made up.

One can argue, however, that students can sleep earlier on a day-to-day basis in order to ensure they get the right amount of sleep. However, that claim can be disproved through additional studies conducted on how school times affect adolescent day-to-day sleeping. One

such study, by S.J. Crowley (2018) for SLEEP, compared adolescents' and adults' abilities to sleep at certain times of day. They put 44 adolescents in a laboratory for 3 days, with no time cues, and shifted between light and dark conditions every two hours. They found that, while both age groups tended to have a "forbidden zone" in the evenings, adolescents "had more difficulty sleeping during the forbidden zone despite lying in bed in the dark with no knowledge of time nor access to phones, computers, televisions and so on" (Crowley, 2018). The "forbidden zone" is a result of the circadian rhythm, where although someone may have been awake for a prolonged period of time, it is a period of time where they do not feel tired. Reading into Crowley's results, the fact that teenagers were unable to sleep during the time they were "supposed" to sleep in order to get the appropriate amount of rest before school is an indication that school schedules go against the natural circadian rhythms of adolescents, which minimizes the amount of sleep students are able to get.

Reduced Executive Function

Being in tune with circadian rhythm on a daily basis rather than only on weekends is important specifically for adolescents since their executive functions perform the best during their most optimal times as determined by the circadian rhythm. Constanze Hahn and six associates (2012) investigated executive function by asking adolescents for their "preferred" times of day, and then giving them tasks to determine executive functions at certain times. A comparison of both sets of data revealed that "participants tested at their optimal time performed better on a composite measure of [executive function], as well as on individual measures of affective decision-making (the Iowa Gambling Task) and working memory (the SOP task, concrete version)" (Hahn et al., 2012). In other words, the subjects were able to complete their tasks to their best ability when it was at their preferred times. The idea of "preferred" times

should be applied to adolescents in school since, most of the time, students have to begin work at nonoptimal times, so they are likely to not perform as well.

Risk Behavior

The other issue Hahn et al. (2012) addresses in their report for Dev Sci is the growth of adolescents, as school times start earlier but optimal functioning times become later. They note that children growing into adolescence experience greater autonomy in their lives, which means that they are more able to engage in risky behaviors. The impacts of a lack of sleep on executive function means that adolescents are likely to lead to "impulsive acts and errors in judgment" (Hahn et al., 2012). So, not only does a lack of sleep impact the success of students in school, it can prove a danger to adolescents.

In regards to a specific type of risk behavior, B.P. Hasler, W. Ngari, and D.B. Clark (2018) sought to explore how weekend alcohol use impacted the circadian rhythms of adolescents in a study published in SLEEP. According to the researchers, past studies have suggested that sleep disturbances are linked with increased substance involvement, supporting the idea that adolescents that sleep less are more likely to engage in risky behaviors. Using methods of surveying 31 late adolescents, Hasler et al. found that there was actually no correlation between alcohol use and sleep patterns, contrasting to their predictions. Regardless of how alcohol affects sleeping patterns, however, the correlation between sleep disturbances and substance involvement among adolescents still stands. Yet, the study does bring light to the nuances of circadian rhythms and how not following them can have varying consequences.

Solution

Social jet lag and loss of sleep, reduced executive function, and heightened risk behavior are among the issues caused by the early school day for adolescents. The solution, then, would

be to have a later school day in order to better cater to adolescents' natural schedules. Not only would students then be able to perform better in school, keeping to a proper schedule could also be better for adolescent health in the long term. Greater choice in scheduling is also an option for improving adolescent wellbeing, and has been employed in college studies successfully.

The idea of a later school day is not new, and the "Start School Later" movement is fighting for exactly that. Even the Centers for Disease Control and Prevention (2018) agree that schools all over the United States begin too early, and the effects have been detrimental to students. The effort is essentially to prioritize the health of students, but by prioritizing health they are actually also prioritizing learning. For parents, the CDC recommends contacting local school officials to push for later school start times (CDC, 2018).

In sum, then, an early school day greatly impacts adolescent's sleeping patterns. Through analysis of published works, I found that early wake up times negatively impact students including through social jet lag and loss of sleep, reduced executive function, and increased risk behaviors. The best way to address these issues would be to move the school day to later in the day in order to better fit adolescent circadian rhythms. A problem, however, remains that different students may have different circadian rhythms, begging for greater research in the field and possible student inputs. With a school day better suited for every age group, education can only improve for the future.

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