

# *The Impacts of Delaying School Start Time on Sleep and Academic Performance in the Adolescent Population*

Zhongyuan Bao<sup>1,a,\*</sup>

<sup>1</sup>Hefei No.8 Senior High School, Hefei, Anhui, China, 230071

a. lipingcn888@hotmail.com

\*corresponding author

**Abstract:** Sleep has a significant impact on the physical and mental health of adolescents. However, most adolescents face sleep deprivation and a range of adverse consequences. The policy of delaying the start of school has gained the attention of many researchers in the last two decades in response to the problem of improving sleep quality and increasing the total number of hours of sleep among adolescents. This paper assesses the influences of delayed school start times on adolescent sleep and related outcomes, identifies the limitations and shortcomings of this policy implementation, and the available research data, provides a comprehensive analysis of the impacts of delayed school start times, and offers suggestions for the future direction and prospects of this policy implementation.

**Keywords:** school start times, adolescence, school health, sleep, sleep loss

## 1. Introduction

In adolescence, our circadian rhythm system is delayed, and some studies consistently describe the trend of adolescents delaying the sleep stage [1, 2]. Twelfth graders typically go to bed after 11 p.m. on weekdays; 12- to 14-year-olds tend to fall asleep about 20 minutes later than 9- to 11-year-olds, and 24 minutes later for 15- to 18-year-olds. In addition, some external factors (such as heavy learning pressure, electronic media use, caffeine intake, etc.) worsen adolescents' sleep delay. Social expectations also play a certain role, especially the start time when students are required to get up early. Not only do these lead to sleep deprivation, but they can also cause "social jet lag", a state of circadian rhythm disruption, if the adolescent is forced to wake up before the circadian cycle [3]. Another worrying fact is that sleep duration for teenagers has been declining over the last century [4]. Meta-analysis estimates showed that overnight sleep duration decreased from 9.68 hours (3-5 years age group) to 8.05 and 7.4 for the 12-14 and 15-18 years age groups, respectively [5].

Adolescent sleep deprivation is a public health issue that has a significant physical and psychological impact on this population. Given the strong relationship between school start times and adolescents' morning wake-up times, a growing number of school systems around the world are implementing programs to delay school start times in order to reduce the negative effects of sleep deprivation on adolescents. The American Academy of Sleep Medicine has also issued a statement in support of implementing later school hours, calling for middle and high school teens to start school after 8:30 a.m. Fortunately, many studies on later school start times over the decades have shown the impact of this policy on improving sleep quality and increasing sleep time for

adolescents, as well as on academic performance, attendance, and reducing teenage motor vehicle accidents, so many schools around the world have implemented later school start times and the positive impact of this policy has brought many benefits to students.

This paper assesses the impacts of delayed school start times on adolescent sleep and related outcomes, identifies the limitations and shortcomings of this policy implementation, and the available research data, provides a comprehensive analysis of the effects of delayed school start times in order to provide an up-to-date overview of the existing supporting literature on this topic as well as its related critical studies. More specifically, it intends to provide some useful insights and recommendations for future research to guide the direction and implementation of an acceptable change in school schedules.

## **2. The Impact of Delaying School Start Time on Sleep and Academic Performance in the Adolescent Population**

### **2.1. Impact on Sleep Quality**

Delaying the start of school is an intervention that allows adolescents to better adapt to the delayed and altered sleep patterns of the stages of sleep and effectively addresses the biological factors that affect sleep. It allows adolescents to sleep according to their time type, thus allowing adolescents to maintain good sleep quality and adequate total sleep time despite the late phase characteristics. As the policy was implemented primarily to address sleep deprivation among adolescents, most researchers have focused on the interrelationship between school start times and sleep variables. In a study of 375 girls in grades 7-10 at a girls' secondary school in Singapore, school bedtime at night was delayed by 9.0 minutes due to a monthly delay in school start time from 7:30 a.m. to 8:15 a.m. After 9 months, wake-up time was delayed by 31.6 minutes, the change (increase) in TIB (time in bed) was constant, and TST (total sleep time) was raised by 10 minutes relative to baseline [6].

Although the results of this study showed a significant positive impact of delaying the start of school on increasing sleep duration, it limited the gender of the subjects, making the findings not generalizable. Another study presented means and standard deviations for the study variables for males and females [7]. Female teenagers went to bed earlier during the school day and on weekends compared to males. They had higher daytime fatigue and lower behavioral persistence. Because females begin early puberty earlier than males, they typically go to sleep earlier than males (17 vs. 21 years of age). Therefore, the experimental findings obtained from female subjects cannot be applied to male adolescents.

Following this, in 2019, Lucas M. Neuroth and his colleagues conducted a cross-sectional study of 46,537 ninth- through twelfth-grade high school students in Colorado [8], USA, and found that for every 15-minute delay in the start of school, students' total sleep time was 4.6 (3.4-5.9) minutes longer. Therefore, ignoring individual differences and delaying the start of school can be effective in increasing the amount of sleep adolescents get, improving adolescent sleep deprivation as well as reducing the number of illnesses adolescents acquire due to the loss of sleep.

### **2.2. Impacts on Test Scores and GPA (Grade Point Average)**

Of particular interest to parents, schools, and adolescents themselves is the academic achievement; however, there are several confounding factors in assessing whether a delayed school start affects academic achievement. Firstly, tests held at grade or class level are not standardized and vary by schools, teachers, and subjects. This limits the sample size of studies on whether adolescents' academic performance is affected by school start times, making specific studies limited. Finally, students who do well academically prior to the delayed start of school do not have much room for

improvement, so it is impossible to determine whether the specific contributing factor to fluctuations in performance is the timing of school. However, because of these limitations, some evidence suggests a positive relationship between academic performance and later school start times.

One report found that the average student's math and reading test scores could be improved by 3% if the start of school time was delayed by one hour [9]. The influences of delayed school start times on adolescent test scores can persist through the tenth grade. These results suggest that a later start time may be a very effective method to improve students' academic performance. In the following studies, the researchers also found that Quantile regression results show that delayed school start time has a stronger impact on the lower end of the test score distribution, suggesting that this policy may be particularly effective in meeting minimum competency requirements.

In one study, researchers assessed student course grades in math, English, social studies, and science and converted students' course grades into unweighted scores (0-4). This allowed the researchers to understand how the timing of the start of school affected the overall grade point average (GPA). Although high school students' first-period grades were slightly higher if they started school at 8:30 a.m. or later, by an average of 0.05 quality points, it was seen that the relationship between later start times and student academic performance was not significant [10].

### **2.3. Less Motor Vehicle Crashes Caused**

The mental alertness gained during sleep is also critical to the operation of a motor vehicle, as sleep-deprived adolescents' fine-motor skills and reaction time are affected; also, sleep-deprived adolescents have reduced reaction and avoidance skills for moving vehicles, significantly increasing the likelihood of a crash.

A study assessed changes in motor vehicle crash rates and sleep habits before and after a one-hour delay in school start time among adolescents in a county school district in Kentucky using a questionnaire. Results showed that the average crash rate for teen drivers in this area decreased by 16.5% over the two years of delayed school start ( $p < 0.01$ ). In addition, several other studies have shown similar results, namely that delaying the start of school does significantly reduce the probability of teenage car crashes [11]. This effect is important because fewer accidents mean fewer injuries and better safety for teens. Significantly reduced teenage motor vehicle crash rates mean that society can save a lot of human and monetary costs, as the significantly reduced crash rates prevent families from spending money on medical care and property damage, and the community from having to bear the cost of health insurance.

### **2.4. Other Outcomes**

#### **2.4.1. Economic Benefits**

It is undeniable that delaying teenage school hours will be accompanied by changes in transportation patterns, such as re-routing or reallocating time in the tiered transportation system (some school districts will have different school hours for elementary, middle, and high school students to save on transportation costs), so some may disagree with this policy, but the benefits of education and the economic benefits still far outweigh the costs of implementing this policy in the long run. A study by Marco Hafner et al. estimated the economic changes that a delayed school start could bring to 47 U.S. states, including benefits from improved student academic performance and fewer accidents. The study's calculations of benefits and costs suggest that delaying the start of school is a strategy that can have a significant impact on the U.S. economy. They show that the cumulative economic benefits of a delayed school start can be substantial in a relatively short period following policy adoption [12].

### 2.4.2. Attendance Improved

Delaying the school day is likely to improve student attendance. It is easy to see how this is true because getting up early is a reluctant thing for teenagers. If the school day is delayed, adolescents will not have to face the challenge of waking up early, and there will be a corresponding decrease in tardiness and unwillingness to attend morning classes. For example, Pamela Malaspina McKeever and Linda Clark conducted a study using data from a repository of 29 schools and eight school districts to count attendance rates for two periods (before and after the delay). The results showed that student attendance significantly increased after the implementation of a start time after 8:30 a.m [13].

Attendance is the basis for students to get good grades, only by being in class can they learn and get good grades on exams, and their GPA will increase due to increased attendance. Therefore, the delayed start time policy fundamentally contributes to the improvement of students' academic performance. However, the limitation here is that it does not increase the academic performance of students who have perfect attendance, and since students who hardly miss classes are the majority in many schools, the benefits of later start times in terms of attendance may only reach a small percentage of youth.

## 3. Conclusion

In summary, the implementation of the delayed school start times policy has many benefits for youth, and even if some of the effects are not yet known to exist, the benefits of this policy are sufficiently important for the community to take notice. One of the big challenges the district will face is to communicate with community stakeholders (e.g., students, student guardians, school teachers, and school administrators, bus drivers, officials, etc.) the scientific basis for delaying the start of school times, such as the threat that sleep deprivation poses to health, academic success, and safety, and the potential advantages to the youth of delaying school hours. Because gaining the support of all stakeholders and making the adjustments to formally implement this policy is no small undertaking, delaying school hours can take a long time to accomplish in a community, which is something all community members need to be prepared for.

At the same time, for many districts with grade-separated transportation systems, while delaying the start of high school, they must also increase the start of elementary or middle school to accommodate the adjusted grade-separated transportation system in order to avoid traffic congestion and more traffic accidents. Although students at relatively young ages do not experience delays in the sleep-wake cycle, the new schedule may affect their academic performance and physical health due to the delayed school start times. Therefore, future research needs to build evidence base on the effects of school start times in elementary and secondary schools[14]. It follows that future research should also focus on the impacts of delayed school hours for adolescents on children and how good or bad these potential effects are.

There is much evidence that delaying the start of school is a policy that can be widely used, but it is almost impossible to completely improve the sleep deprivation of adolescents using only this policy. Adolescent guardians, schools, and society need to take the public health issue of adolescent sleep deprivation seriously. Parents of teens should monitor their teens' adoption of a more scientific schedule, otherwise, the effects of delaying school hours will be greatly diminished, as students will likely rely on the policy to provide more sleep during the day and sleep later at night accordingly. Moreover, in many regions with high academic pressure, such as cities in China and Singapore, it is the reduction of academic tasks and students' academic pressure that should be the most important thing to implement. Adolescents who have too much stress tend to be more anxious and do not get good quality sleep.

## References

- [1] Liu X, Liu L, Wang R. (2003) *Bed sharing, sleep habits, and sleep problems among Chinese school-aged children.* *Sleep.* Nov 1; 26(7):839-44.
- [2] Crowley S. J, Acebo C., Carskadon M. A. (2007) *Sleep, circadian rhythms, and delayed phase in adolescence.* *Sleep Med.* September, 8(6):602-12.
- [3] Roenneberg T., Allebrandt K. V, Merrow M., Vetter C. (2012) *Social jetlag and obesity.* *Curr Biol.* May 22;22(10):939-43.
- [4] Keyes KM, Maslowsky J, Hamilton A, Schulenberg J. (2015) *The great sleep recession: changes in sleep duration among US adolescents, 1991-2012.* *Pediatrics.* Mar;135(3):460-8.
- [5] Galland B. C., Short M. A., Terrill P., Rigney G., Haszard J. J., Coussens S., Foster-Owens M., Biggs S. N. (2018) *Establishing normal values for pediatric nighttime sleep measured by actigraphy: a systematic review and meta-analysis.* *Sleep.* Apr 1;41(4).
- [6] Lo J. C., Lee S. M., Lee X. K., Sasmita K., Chee NIYN, Tandi J., Cher W. S, Gooley J. J, Chee MWL. (2018) *Sustained benefits of delaying school start time on adolescent sleep and well-being.* *Sleep.* Jun 1;41(6):zsy052.
- [7] Perkinson-Gloor N, Lemola S, Grob A. (2013) *Sleep duration, positive attitude toward life, and academic achievement: the role of daytime tiredness, behavioral persistence, and school start times.* *J Adolesc.* Apr;36(2):311-8.
- [8] Neuroth L.M, Ma M, Brooks-Russell A, Zhu M. (2021) *The Relationship of School Start Times, Sleep Duration and Mental Health among a Representative Sample of High School Students in Colorado, 2019.* *Int J Environ Res Public Health.* May 26;18(11):5708.
- [9] Edwards, F. (2012). *Early to rise? The effect of daily start times on academic performance.* *Economics of Education Review,* 31(6), 970–983.
- [10] Thacher P.V., Onyper S.V. (2016) *Longitudinal Outcomes of Start Time Delay on Sleep, Behavior, and Achievement in High School.* *Sleep.* Feb 1;39(2):271-81.
- [11] Danner F, Phillips B. (2008) *Adolescent sleep, school start times, and teen motor vehicle crashes.* *J Clin Sleep Med.* Dec 15;4(6):533-5.
- [12] Hafner M, Stepanek M, Troxel W. M. (2017) *The economic implications of later school start times in the United States.* *Sleep Health.* Dec;3(6):451-457.
- [13] Bowers JM, Moyer A. (2017) *Effects of school start time on students' sleep duration, daytime sleepiness, and attendance: a meta-analysis.* *Sleep Health.* Dec;3(6):423-431.
- [14] Perkinson-Gloor N, Lemola S, Grob A. (2013) *Sleep duration, positive attitude toward life, and academic achievement: the role of daytime tiredness, behavioral persistence, and school start times.* *J Adolesc.* Apr;36(2):311-8.