

HIGH SCHOOL STUDENTS AND SCHOOL START TIMES

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In the following report, Hanover Research reviews literature examining the relationship between high school start times and student outcomes. We also discuss several strategies for addressing obstacles commonly associated with high school start time changes.

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EXECUTIVE SUMMARY AND KEY FINDINGS

INTRODUCTION

In recent years, numerous districts have considered delaying high school start times to better align with adolescent sleep cycles. While the literature suggests that delayed start times may benefit adolescents, districts often face obstacles when implementing such changes. In **Section I** of this report, Hanover Research examines national and international trends in school start times, as well as the impact of school start times on a variety of academic and non-academic student outcomes. In **Section II**, we present evidence-based strategies to assist districts in overcoming challenges commonly associated with school start time changes.

KEY FINDINGS

- **The American Academy of Pediatrics recommends a start time of 8:30 a.m. or later for adolescent students.** However, the Centers for Disease Control and Prevention estimated a national average start time of 7:59 a.m. for high schools during the 2011-2012 school year. On average, middle, high, and combined schools in Pennsylvania started at 7:48 a.m., with nearly two-thirds of schools that serve adolescents starting before 8:00 a.m.
- **Evidence that school start times impact adolescent academic achievement remains inconclusive.** The research base includes studies examining a variety of academic outcomes, including standardized test scores, course grades, and grade point averages. However, whereas some studies find positive effects associated with later start times, other studies reveal mixed effects. Meanwhile, other studies observe no effects. Such variation in findings may reflect the studies' methodological limitations, including the inability to observe and control for the range of other factors that also influence academic outcomes.
- **Research suggests that later school start times enable middle school and high school students to receive more sleep.** A 2013 study found that high school students generally did not change bedtimes after a school start time shift, resulting in increased sleep almost equivalent to the start time delay (i.e., 25 minutes). Similarly, a 2010 study found that a 30-minute school start time delay increased total sleep time by an average of 45 minutes – due to the combined impact of the change in school schedule and the shift in student bedtimes.
- **Although later school start times may decrease tardiness, the effect on attendance rates appears uncertain.** Despite finding no positive impact on attendance, a 2007 study of middle school students concluded that later school start times decrease tardiness. Specifically, tardiness proved four times more likely in early-starting schools than in late-starting schools. A 2014 study of high school students detected mixed signals in attendance rates post-start time delays; however, the same study revealed an overall reduction in tardiness.

- **District administrators often cite transportation issues as the primary obstacle to school start time changes.** Districts that use a tiered bus schedule usually change start times across all schools or develop alternative transportation strategies, such as flipping elementary school and high school schedules or creating shared bus routes for middle school and high school students. In addition, some districts, particularly in urban areas, subsidize students' use of public transportation to and from school.
- **Proposed changes to school start times may raise concerns among stakeholders, including students, parents, community members, and district and school personnel.** Such concerns may relate to potential effects on work schedules, childcare availability, traffic patterns, extracurricular activities, and family time. To obtain stakeholder buy-in, district administrators should incorporate stakeholder feedback when making and implementing key schedule-related decisions.

SECTION I: SCHOOL START TIMES AND STUDENT OUTCOMES

After discussing the debate surrounding delayed school start times for adolescents, this section summarizes research findings regarding the impact of school start times on a variety of academic and non-academic student outcomes.

BACKGROUND

Optimal school start times have been debated at the national and local levels for more than a decade. In August 2014, the American Academy of Pediatrics (AAP) released a policy statement that heightened the national attention paid to the issue. In the policy statement, AAP identified insufficient sleep in adolescents as a public health issue, recognizing early school start times as “a key modifiable contributor” to chronic sleep loss. The AAP recommended that districts delay school start times for adolescents to 8:30 a.m. or later in order to improve students’ health, safety, and academic outcomes.¹ More recently, a supplementary report by the Centers for Disease Control and Prevention (CDC) supported the AAP recommendation for later school start times, reiterating that the widespread lack of sleep among adolescent students is a “substantial public health concern.”²

The recent emphasis placed on middle school and high school start times and student sleep stems from research regarding the unique sleep needs of adolescents. Experts postulate that aging impacts the amount of sleep required and the way people regulate their sleep. In an article published in the *Journal of Adolescent Health*, Ronald E. Dahl and Daniel S. Lewin specify that four areas of sleep are systematically altered during the transition from childhood into adolescence:³

- There is a decrease in the duration of non-REM and REM sleep
- A more adult-like pattern of REM sleep develops
- There are increases in daytime sleepiness
- There is a shift in the circadian pattern toward a more owl-like tendency for later bedtimes and wake-up times

Though all four changes are important, the shift in the circadian pattern is most notable with regard to school start times. The circadian rhythm regulates the timing associated with waking and sleeping during a daily cycle. During puberty, biological circadian changes occur,

¹ “School Start Times for Adolescents.” American Academy of Pediatrics, 2014. p. 647.

<http://pediatrics.aappublications.org/content/pediatrics/early/2014/08/19/peds.2014-1697.full.pdf>

² Wheaton, A.G., G. A. Ferro, and J. B. Croft. “School Start Times for Middle School and High School Students- United States, 2011-12 School Year.” Centers for Disease Control and Prevention, August 2015.

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6430a1.htm?s_cid=mm6430a1_w

³ Bullet points taken verbatim from: Dahl, R. and D. Lewin. “Pathways to Adolescent Health: Sleep Regulation and Behavior.” *Journal of Adolescent Health*, 2002. p. 177.

<http://www.sciencedirect.com/science/article/pii/S1054139X02005062#>

causing teens to develop a preference for staying up and sleeping in later.⁴ According to the National Sleep Foundation, widespread sleep deprivation among adolescents is “largely driven by a conflict between teens’ internal biological clocks and the schedules and demands of society.”⁵

SCHOOL START TIMES

UNITED STATES

The previously-mentioned report published by the CDC examined U.S. Department of Education (ED) data from the Schools and Staffing Survey (SASS). The report noted an estimated national average start time for middle, high, and combined schools of 8:03 a.m. during the 2011-2012 school year. Moreover, in 42 states, between 75 and 100 percent of public schools serving adolescents had start times earlier than 8:30 a.m. Overall, only 17.7 percent of middle, high, and combined schools complied with the AAP’s recommended start time of 8:30 a.m. or later. At the high school level, in particular, the average start time was 7:59 a.m., with more than 40 percent of high schools reporting start times before 8:00 a.m.⁶ Figure 1.1 illustrates the distribution of school start times, overall and by level.

Figure 1.1: School Start Times by School Level (2011-2012)

SCHOOL LEVEL	AVERAGE START TIME	PERCENTAGE DISTRIBUTION OF MIDDLE, HIGH, AND COMBINED SCHOOL START TIMES			
		Before 7:30 a.m.	7:30 a.m. – 7:59 a.m.	8:00 a.m. – 8:29 a.m.	8:30 a.m. or later
Total	8:03 a.m.	6.7%	31.9%	43.7%	17.7%
Middle	8:04 a.m.	4.8%	35.9%	40.4%	18.9%
High	7:59 a.m.	9.5%	33.0%	43.1%	14.4%
Combined	8:08 a.m.	3.5%	21.6%	51.5%	23.4%

Source: Centers for Disease Control and Prevention⁷

Notably, school start times varied across states. The data revealed that Alaska and North Dakota had the highest percentages of schools reporting start times of 8:30 a.m. or later (76.8 percent and 78.5 percent, respectively), and both states also had the latest average school start times. Conversely, Louisiana maintained the earliest average school start time (7:40 a.m.), with 83 percent of middle, high, and combined schools beginning before 8:00 a.m. Figure 1.2 presents the relevant school start time information for Pennsylvania, as well as for Alaska, Louisiana, and North Dakota.⁸

⁴ Ibid.

⁵ “Backgrounder: Later School Start Times.” The National Sleep Foundation. <https://sleepfoundation.org/sleep-news/backgrounder-later-school-start-times>

⁶ Wheaton, A.G., G. A. Ferro, and J. B. Croft. “School Start Times for Middle School and High School Students- United States, 2011-12 School Year.” Op. cit.

⁷ Tabled adapted from: Ibid., pp. 3-4.

⁸ Ibid.

Figure 1.2: School Start Times by State (2011-2012)

STATE	AVERAGE START TIME	PERCENTAGE DISTRIBUTION OF MIDDLE, HIGH, AND COMBINED SCHOOL START TIMES			
		Before 7:30 a.m.	7:30 a.m. – 7:59 a.m.	8:00 a.m. – 8:29 a.m.	8:30 a.m. or later
Alaska	8:33 a.m.	0.0%	11.6%	11.6%	76.8%
Louisiana	7:40 a.m.	29.9%	53.1%	12.1%	*
North Dakota	8:31 a.m.	0.0%	2.8%	18.7%	78.5%
Pennsylvania	7:48 a.m.	13.0%	51.3%	32.6%	3.1%

Source: Centers for Disease Control and Prevention⁹

*Denotes a reporting standard that was not met (standard error ≥0.5 or a response rate <50%)

A recent study published by the Center for Applied Research and Educational Improvement at the University of Minnesota suggests that adolescent students in the United States also favor delayed start times. More than 75 percent of high school students surveyed cite an ideal school start time of 8:30 a.m. or later, and more than 50 percent of students support start times of 9:00 a.m. or later. Figure 1.3 presents high school students’ perceptions of ideal start times, based on a survey of high school students in Minnesota, Colorado, and Wyoming.¹⁰

Figure 1.3: Students’ Perceptions of Ideal Start Times

IDEAL START TIME	PERCENTAGE OF RESPONDENTS
7:00 a.m.	3.2%
7:30 a.m.	5.1%
8:00 a.m.	16.3%
8:30 a.m.	24.8%
9:00 a.m.	35.8%
Later than 9:00 a.m.	14.8%

Source: Center for Applied Research and Educational Improvement¹¹

INTERNATIONALLY

International high school start time data remain fairly limited. The Robert Schuman Foundation notes that comparing school times in Europe, in particular, is especially difficult due to the prevalence of local autonomy in most countries.¹² Despite this caveat, a 2014 Scientific American article suggests that the European equivalent to high school “rarely begins before 9:00 a.m.”¹³ Interestingly, a similar debate over high school start times is

⁹ Tabled adapted from: Ibid., pp. 3-4.

¹⁰ Wahlstrom, K.L. et al. “Examining the Impact of Later High School Start Times on the Health and Academic Performance of High School Students: A Multi-Site Study.” Center for Applied Research and Educational Improvement, February 2014. p. 25. https://www.spps.org/uploads/final_version_3-11-14_start_time_report.pdf

¹¹ Table adapted from: Ibid., p. 25.

¹² Kamette, F. “Organisation of School Time in the European Union.” Robert Schuman Foundation, September 2011. p. 1. <http://www.robert-schuman.eu/en/doc/questions-d-europe/qe-212-en.pdf>

¹³ Fischetti, M. “Sleep Teens: High School Should Start Later in the Morning.” Scientific American, August 2014. <http://blogs.scientificamerican.com/observations/sleepy-teens-high-school-should-start-later-in-the-morning/>

occurring in Britain, with some experts advocating for school start times as late as 11:00 a.m. for older adolescents.¹⁴

Hanover Research reviewed the available literature and ascertained approximate school start times across 11 countries (Figure 1.4). It is important to note that these generalized start times apply to all school-aged children in each country, not just adolescents at the high school level.

Figure 1.4: International School Start Times

COUNTRY	APPROXIMATE SCHOOL START TIME
Australia	9:00 a.m.
Brazil	7:00 a.m.
China	7:30 a.m.
England and Wales	9:00 a.m.
France	8:00 a.m.
Germany	7:30 a.m. – 8:30 a.m.
Kenya	8:00 a.m.
Netherlands	8:30 a.m.
Russia	8:30 a.m.
South Korea	8:00 a.m.
Spain	9:00 a.m. – 10:00 a.m.

Source: Robert Schuman Foundation and Mark Hughes¹⁵

EFFECTS OF LATER SCHOOL START TIMES

As mentioned previously, research suggests that adolescence is marked by biological changes impacting sleep regulation and the amount of sleep required. Accordingly, the literature examining the impact of school start times tends to study adolescents at all ages. As a result, this section includes numerous research studies that assess the effects of school start times on students at both the middle school and high school levels.

ACADEMIC ACHIEVEMENT

Research on the relationship between school start times and student achievement is inconclusive, with different studies indicating positive, mixed, or no statistically-significant effects. However, the methodologies typically used in such studies complicate efforts to demonstrate causality. Most studies are correlational in nature and, thus, unable to provide empirical proof that changes in start times lead to differences in student achievement.¹⁶

¹⁴ Barnett, D. "Start school day at 11 am to let students sleep in, says expert." The Guardian, September 2015. <http://www.theguardian.com/science/2015/sep/08/start-school-later-11am-students-sleep>

¹⁵ [1] Kamette, F. "Organisation of School Time in the European Union." Op. cit.
[2] Hughes, M. "School Years around the World." Infoplease. <http://www.infoplease.com/world/statistics/school-years.html>

¹⁶ Carrell, et al. "A's from Zzzz's? The Causal Effect of School Start Time on the Academic Achievement of Adolescents." University of California at Davis, October 5, 2010. p. 63. <http://www.econ.ucdavis.edu/faculty/scarrell/sleep.pdf>

Likewise, the available research on school start times tends to focus on one school or district, making it difficult to generalize the results.¹⁷

POSITIVE EFFECTS

Several recent studies suggest that later start times for adolescents can positively impact academic performance. A 2012 study by economist Finley Edwards found that later start times improved the performance of middle school students on standardized tests in both reading and mathematics. Specifically, **Edwards found that starting school one hour later was associated with increases in standardized test scores equal to 1.8 percentile points in mathematics and 1.0 percentile point in reading.** He also determined that the benefits of later start times were more pronounced among low-performing students, as the effects were twice as large for students who scored in the bottom third than for those who scored in the top third of test takers. The positive effects also persisted into high school: Edwards analyzed Grade 10 comprehensive exams measuring growth in reading and mathematics, finding that a one-hour later start time in middle school was associated with 2.0- and 1.6-percentile point increases in high school mathematics and reading, respectively.¹⁸

Additional research has identified positive effects associated with making school start times later, along with negative effects associated with making school start times earlier. A 2005 study by Arlington Public Schools (APS) evaluated the districtwide high school start time change from 7:30 a.m. to 8:15 a.m. To accommodate transportation needs, APS also shifted the middle school start time earlier—from 8:10 a.m. to 7:50 a.m. Overall, the evidence indicated positive effects on the grade point averages of high school students and some academic declines at the middle school level. Ultimately, the district concluded, “this change came at the expense of middle school students (many of whom are also adolescents), and a more effective approach might have been to shift elementary start times.”¹⁹

Other studies also demonstrate a positive relationship between delayed start times and achievement for high school students. In a 2012 study of high school students in Chicago Public Schools, Cortes, Bricker, and Rohlfs evaluated the effects of course schedules on grades and standardized test scores. **The findings revealed that first period courses were**

¹⁷ Keller, P., et al. “Earlier School Start Times as a Risk Factor for Poor School Performance: An Examination of Public Elementary Schools in the Commonwealth of Kentucky.” *Journal of Educational Psychology*, June 16, 2014. p. 237. <http://www.apa.org/pubs/journals/releases/edu-a0037195.pdf>

¹⁸ Edwards, F. “Early to rise? The effect of daily start times on academic performance.” *Economics of Education Review*, 31, 2012. p. 970. <http://teensneedsleep.files.wordpress.com/2011/04/edwards-early-to-rise-the-effect-of-daily-start-times-on-academic-performance-published-version.pdf>

¹⁹ “Impact of 2001 Adjustments to High School and Middle School Start Times.” Arlington Public Schools, June 2005. p. 19. <http://www.fcps.edu/fts/taskforce07/documents/arlington605.pdf>²⁰ Cortes, K., J. Bricker, and C. Rohlfs. “The Role of Specific Subjects in Education Production Functions: Evidence from Morning Classes in Chicago Public High Schools.” *The B.E. Journal of Economic Analysis & Policy*, 12:1, 2012. <http://users.nber.org/~cortesk/bejeap2012.pdf>

associated with lower course grades and test scores.²⁰ The impact of first-period courses was especially pronounced for certain student subgroups and academic subjects, as the authors found that this effect “became greater as the amount of exposure increased over the course of the academic year for black students.”²¹ Notably, early morning mathematics courses also seemed to impact other subjects, in addition to having long-term adverse effects. For example, Cortes and her colleagues found that first-period mathematics courses negatively affected students’ reading test scores. Likewise, the study discovered that first-period Algebra I courses were associated with lower grades in Algebra II.²² In conclusion, the authors recommend that “math classes for at-risk students should be scheduled after first period and that math teachers’ preparation time should be scheduled during first period.”²³

A 2010 study by Carrell et al. also observed the impact of first period on the course grades of first-year students at the United States Air Force Academy (USAFA). The study found “a positive causal relationship between start time and academic performance for the students at USAFA,” with earlier course times negatively affecting students’ course grades.²⁴ **Not only did these students perform worse in their first-period classes, they also performed worse in all of their courses.** However, the researchers found that the negative effects diminished as start times were moved later, from 7:00 a.m. to 7:50 a.m.²⁵ While this study examined the behavior of high-achieving college students, Carrell et al. contend that their results can be generalized to high school students, since first semester college students are adolescents and have the same sleep patterns as high school-aged teens. Moreover, the authors suggest that their use of the USAFA sample, an elite group of high-achieving students with a preference for a regimented lifestyle, provides even stronger evidence for the adverse effects of early start times. If the elite USAFA students’ performance was negatively impacted by early start times, it is likely that early start times would particularly affect the performance of average students.²⁶

MIXED OR NO EFFECTS

Although some literature attributes positive academic effects to delayed school start times, several studies also reveal mixed or no statistically-significant effects. For example, a 2014 study by Kyla L. Wahlstrom et al. at the University of Minnesota obtained mixed results when evaluating the effects of later school start times on the academic performance of 9,000 high school students in eight high schools across Minnesota, Colorado, and Wyoming.²⁷ Wahlstrom et al. analyzed students’ mean grade point averages (GPAs) in core

²⁰ Cortes, K., J. Bricker, and C. Rohlfs. “The Role of Specific Subjects in Education Production Functions: Evidence from Morning Classes in Chicago Public High Schools.” *The B.E. Journal of Economic Analysis & Policy*, 12:1, 2012. <http://users.nber.org/~cortesk/bejeap2012.pdf>

²¹ Ibid., p. 22.

²² Ibid., p. 30.

²³ Ibid., p. 32.

²⁴ Carrell, et al. “A’s from Zzzz’s? The Causal Effect of School Start Time on the Academic Achievement of Adolescents.” Op. cit., p. 74.

²⁵ Ibid., p. 73.

²⁶ Ibid., p. 63.

²⁷ Wahlstrom, et al., “Examining the Impact of Later School Start Times on the Health and Academic Performance of High School Students: A Multi-Site Study.” Op. cit., pp. 8-10.

subject areas or grades in individual courses²⁸ and found that the grades of students from most of the sampled high schools increased following the start time delay; **however, the results also revealed that three high schools included in the analysis experienced both increases and decreases in student grades.** The authors concluded that although “there are empirically-based positive outcomes for adolescents whenever the start time of their high school is moved to a later time,” these outcomes are not a universal guarantee.²⁹

A 2011 study by economist Peter Hinrichs observed the relationship between high school start times and student achievement in two Minnesota school districts, St. Paul Public Schools and Minneapolis Public Schools. St. Paul Public Schools had a high school start time of 7:30 a.m., while Minneapolis Public Schools previously implemented a high school start time of 8:40 a.m. **Hinrichs evaluated ACT test scores across both districts and found no statistically-significant differences in student achievement.**³⁰

Within the same study, Hinrichs also evaluated a broader sample of data from high schools in Kansas and Virginia to measure the effects of start times on state test scores.³¹ The results from Kansas supported his findings from Minnesota; **he found that school start times had no effects on state test scores in reading, mathematics, social studies, and science, even after controlling for gender and free/reduced-price lunch status.** Hinrichs notes that he conducted a similar analysis using Virginia data, the results of which corroborated the Kansas and Minnesota findings.³²

Hinrichs proposes the following reasons why school start times may not impact adolescent students’ performance on standardized tests:³³

- While early start times may cause students to lose sleep and learn less per unit of time, they may learn more outside of school by being awake longer.
- Students may be able to adapt to early start times by re-optimizing sleep patterns, such as catching up on sleep over the weekend.
- Students may adapt to early schedules with environmental and chemical stimulation, such as caffeine.
- Though students’ biological clocks may lead them to perform better later in the day, teachers may perform better earlier in the day, having a counteracting effect.

²⁸ These authors examined total GPA of for math, English, social studies, and science in first- or third- period classes for all schools except for Mahtomedi and South Washington County high schools. For these schools, the authors were able to examine grades by course.

²⁹ Ibid., p. 52. ³⁰ Hinrichs, P. “When the Bell Tolls: The Effects of School Starting Times on Academic Achievement.” *Education Finance and Policy*, 6:4, Fall 2011.

<https://www.aeaweb.org/aea/2011conference/program/retrieve.php?pdfid=60>

³⁰ Hinrichs, P. “When the Bell Tolls: The Effects of School Starting Times on Academic Achievement.” *Education Finance and Policy*, 6:4, Fall 2011. <https://www.aeaweb.org/aea/2011conference/program/retrieve.php?pdfid=60>

³¹ The use of these data avoided the selection bias that is present in using ACT scores.

³² Ibid.

³³ Bulleted points adapted from: Ibid., pp. 15-16.

- Later start times could result in less time spent with parents in the morning, without affecting the amount of time spent with parents in the afternoon or evening.
- Before-school activities might nullify the effects of later start times.
- With later start times, students may miss instructional time in the afternoon due to early dismissal for athletic and extracurricular activities.

Hinrichs' findings substantiate earlier research conducted by Wahlstrom in 2002. In the study, Wahlstrom evaluated data from Minneapolis Public Schools after the district changed the start time of seven high schools from 7:15 a.m. to 8:40 a.m. **Analyzing students' letter grades in courses three years before and three years after the change, Wahlstrom identified an upward trend, but no statistically-significant differences, as a result of the later start time.**³⁴ However, Wahlstrom highlighted the limitations of using letter grades as a measure of student achievement, as "grading is often a subjective action by teachers."³⁵ Wahlstrom used neither SAT nor ACT scores as an alternative measure of student achievement, specifying that the students who take such exams tend to be more academically gifted than their counterparts and "have study habits that supersede any tiredness they experience."³⁶

ATTENDANCE AND TARDINESS

A number of studies have focused on the impact of delayed school start times on other student outcomes, including attendance and tardiness. Many studies hypothesize that later high school start times will improve attendance and reduce tardiness, but findings in the research literature are somewhat mixed.

Wahlstrom's 2002 study, conducted in Minneapolis Public Schools, also evaluated high school student attendance rates. In her research, Wahlstrom examined student attendance data for the two years prior to and the three years after the start time delay (from 7:15 a.m. to 8:40 a.m.). The findings did not indicate any statistically-significant changes in average attendance rates following the start time delay for students who were continuously enrolled in the same high school for two or more years. However, average attendance rates for discontinuously-enrolled students in Grades 9 through 11 did increase. In contrast, attendance among continuously- and discontinuously-enrolled students in Grade 12 was not significantly different after the delayed start time. Wahlstrom hypothesizes that this may have occurred because those students who remained in school until Grade 12 were committed to graduating, regardless of the school start time.³⁷

³⁴ Wahlstrom, K. "Changing Times: Findings From the First Longitudinal Study of Later High School Start Times." *National Association of Secondary School Principals Bulletin*, 86:633, December 2002.
<http://teensneedsleep.files.wordpress.com/2011/04/wahlstrom-changing-times-findings-from-the-first-longitudinal-study-of-later-high-school-start-times.pdf>

³⁵ *Ibid.*, p. 11.

³⁶ *Ibid.*

³⁷ *Ibid.*, p. 8.

Wahlstrom et al.'s 2014 study conducted in Minnesota, Colorado, and Wyoming further examined high school attendance rates and tardiness following school start time changes. The analysis revealed some statistically-significant increases in attendance rates when comparing students in the same grade level before and after the start time delay. However, when observing the same students from year-to-year, attendance rates actually decreased. With respect to tardiness, **the findings suggested that the majority of schools experienced at least some decline in tardiness overall**, and the schools with the greatest start time delays tended to have the largest declines in student tardiness.³⁸

A 2007 study by Wolfson et al. also analyzed attendance and tardiness at the middle school level, and the findings were consistent with those of Wahlstrom et al.'s 2014 study. Despite finding no positive impact on attendance among middle school adolescents, Wolfson et al. concluded that tardiness was almost four times more likely in early-starting than in late-starting schools.³⁹ Conversely, economist Finley Edwards' 2011 study on middle schools in North Carolina determined that students who started school one hour later had 1.3 fewer absences during the school year.⁴⁰

PHYSICAL, SOCIAL, AND EMOTIONAL WELL-BEING

A substantial body of evidence examines the non-academic outcomes that accompany later school start times. Overall, these studies suggest that delayed school start times for adolescents can positively impact sleep, mood, and attentiveness.

SLEEP

With respect to sleep, much of the literature suggests that later school start times result in more sleep for adolescent students.⁴¹ A 2013 study by Boergers, Gable, and Owens evaluated the sleep-wake behaviors of high school students following a 25-minute delay in their school start time from 8:00 a.m. to 8:25 a.m. The study revealed that students' bedtimes remained largely unchanged, while wake times were delayed by roughly 24 minutes; therefore, students were actually receiving more sleep. **Specifically, the percentage of students receiving eight or more hours of sleep each night increased from 18 percent to 44 percent following the 25-minute delay.** The findings also pointed to a significant decrease in the signs of daytime sleepiness, including falling asleep in class and tardiness.⁴²

³⁸ Wahlstrom et al., "Examining the Impact of Later High School Start Times on the Health and Academic Performance of High School Students: A Multi-Site Study," Op. cit.

³⁹ Wolfson, A., Spaulding, C. Dandrow, and E. Baroni. "Middle School Start Times: The Importance of a Good Night's Sleep for Young Adolescents." *Behavioral Sleep Medicine*, 2007. <http://www.ncbi.nlm.nih.gov/pubmed/17680731>

⁴⁰ Edwards, F. "Early to rise? The effect of daily start times on academic performance." *Economics of Education Review*, 31, 2012. p. 983. <http://teensneedsleep.files.wordpress.com/2011/04/edwards-early-to-rise-the-effect->

⁴¹ Wolfson, A., Spaulding, C. Dandrow, and E. Baroni. "Middle School Start Times: The Importance of a Good Night's Sleep for Young Adolescents." Op. cit.

⁴² Boergers, J., C. Gable, and J. Owens. "Later School Start Time is Associated with Improved Sleep and Daytime Functioning in Adolescents." *Journal of Developmental & Behavioral Pediatrics*. 2013. <http://www.gwern.net/docs/melatonin/2014-boergers.pdf>

Similarly, a 2010 study conducted by Judith A. Owens et al. observed the impact of a Rhode Island high school's 30-minute start time delay, from 8:00 a.m. to 8:30 a.m., in order to measure the effects on adolescents' sleep, mood, and behavior. Following the time change, survey data indicated that students woke up later in the day and went to bed earlier. Consequently, **the average amount of reported sleep on school nights increased by 45 minutes, and the percentage of students receiving at least eight hours of sleep per night increased from 16.4 percent to 54.7 percent.** Students also experienced more sleep satisfaction, as evidenced by the reduction in daytime sleepiness behavior, such as fatigue and tiredness.⁴³

Supplementary research on younger adolescents yields similar findings, suggesting that middle school students also tend to receive more sleep as a result of later school start times. A 2007 study by Amy R. Wolfson et al. examined the sleep patterns of students in two public middle schools in New England. One middle school began at 7:15 a.m., while the other school middle started at 8:37 a.m. **The findings suggest that students in the late-starting school woke up more than an hour later than students in the early-starting school; on average, the former students received an additional 50 minutes of sleep each night.**⁴⁴ However, contrary to the findings of Boergers et al., the middle school students at the late-starting school also reported later bedtimes than those of their peers attending the early-starting school.⁴⁵

ATTENTIVENESS, MOOD, AND BEHAVIOR

Numerous studies examine the relationship between school start times and student attentiveness and concentration. In addition, researchers also have explored the effect that sleep has on students' mood and behavior while at school. Overall, the literature indicates that delayed start times have positive impacts in these areas, due to the increased amount of sleep that students receive.

The aforementioned study by APS measured the attentiveness of both middle school and high school students before and after the district's bell schedule changes that delayed high school start times by 45 minutes and moved middle school start times 20 minutes earlier. To measure student attentiveness, APS administered a survey to students and teachers that inquired about students' readiness to start school, as well as preparedness for, alertness during, and participation in first period. The responses from high school students did not change substantially after the start time delay; however, a larger percentage of high school students reported high levels of participation. In contrast, a notably smaller percentage of middle school students reported preparedness, alertness, and participation (Figure 1.5).⁴⁶

⁴³ Owens, J.A. et al. "Impact of Delaying School Start Time on Adolescent Sleep, Mood, and Behavior." *The Journal of the American Medical Association*. 2010. <http://archpedi.jamanetwork.com/article.aspx?articleid=383436>

⁴⁴ Wolfson, A., Spaulding, C. Dandrow, and E. Baroni. "Middle School Start Times: The Importance of a Good Night's Sleep for Young Adolescents." Op. cit.

⁴⁵ Ibid.

⁴⁶ "Impact of 2001 Adjustments to High School and Middle School Start Times." Op. cit., pp. 12-18.

Figure 1.5: Student Survey Responses

QUESTION	ALL OF THE TIME		SOME OF THE TIME		NONE OF THE TIME		NO RESPONSE	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
High School Students								
Ready to start school	20%	18%	52%	63%	22%	18%	7%	1%
Alert during first period	22%	20%	52%	64%	18%	16%	8%	1%
Prepared for first period	41%	47%	46%	49%	6%	4%	7%	1%
Participated in class discussions during first period	31%	42%	52%	47%	10%	9%	7%	1%
Middle School Students								
Ready to start school	35%	20%	51%	55%	7%	19%	7%	7%
Alert during first period	31%	14%	50%	63%	12%	17%	7%	6%
Prepared for first period	62%	53%	30%	40%	2%	2%	7%	5%
Participated in class discussions during first period	44%	35%	46%	55%	4%	5%	6%	6%

Source: Arlington Public Schools⁴⁷

Note: After the start time change, high schools started later while middle schools started earlier than previous years.

Figure 1.6: Percent Teacher Responses on Student Attentiveness

QUESTION	STRONGLY AGREE		AGREE		DISAGREE		STRONGLY DISAGREE		NO OPINION		NO RESPONSE	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
High School Teachers												
Alert during first period	1%	12%	25%	41%	38%	17%	9%	11%	22%	24%	6%	5%
Prepared for first period	3%	10%	34%	41%	28%	20%	6%	8%	23%	16%	6%	6%
Participated in class discussions during first period	3%	13%	43%	47%	17%	14%	5%	4%	24%	15%	7%	7%
Middle School Teachers												
Alert during first period	10%	11%	50%	35%	11%	17%	3%	18%	25%	16%	1%	3%
Prepared for first period	8%	5%	55%	46%	10%	31%	1%	8%	26%	18%	1%	1%
Participated in class discussions during first period	10%	10%	58%	50%	7%	16%	0%	7%	24%	17%	2%	1%

Source: Arlington Public Schools⁴⁸

Note: After the start time change, high schools started later while middle schools started earlier than previous years.

Meanwhile, after the start time delay, more high school teachers “strongly agreed” and “agreed” that their students were alert during, were prepared for, and participated in first

⁴⁷ Table adapted from: Ibid.

⁴⁸ Table adapted from: Ibid.

period. Middle school teachers' responses were less favorable, in line with middle school students' responses. Middle school teachers reported that students were neither as alert nor as prepared after the school start time delay. Middle school teachers also noticed a decline in participation (Figure 1.6).⁴⁹

Similarly, the 2002 study by Wahlstrom also surveyed teachers to assess the changes in high school students following a delay in school start times. **Teachers involved in the study reported higher levels of student alertness after the implementation of later start times. A majority of principals indicated (through interviews) that they also observed a positive change in student moods and behavior.** In fact, five out of eight principals dealt with fewer disciplinary referrals following the changes. Additional interviews with school counselors and parents conveyed similar feelings, with parents claiming that their high school children were "easier to live with."⁵⁰

Boergers et al. further examined changes in student moods before and after a 25-minute delay in start times, finding that inadequate sleep was associated with greater levels of depression, sleepiness, and caffeine consumption. Notably, after the changes in start times, outcomes in each of these areas improved as more students reported longer durations of sleep.⁵¹

⁴⁹ Ibid.

⁵⁰ Wahlstrom, K. "Changing Times: Findings From the First Longitudinal Study of Later High School Start Times." Op. cit.

⁵¹ Boergers, J., C. Gable, and J. Owens. "Later School Start Time is Associated with Improved Sleep and Daytime Functioning in Adolescents." Op. cit.

SECTION II: SCHOOL START TIME CHANGES AND DISTRICT CHALLENGES

This section presents evidence-based strategies for overcoming challenges commonly associated with changing high school start times.

IDENTIFYING COMMON CHALLENGES

Many districts acknowledge the benefits of later start times for adolescents, but logistical or financial constraints may prevent districts from making the shift. Indeed, the National Sleep Foundation identifies eight major obstacles faced by districts that attempt to delay high school start times (Figure 2.1).

Figure 2.1: Challenges Associated with Changes to School Start Times

LOGISTICAL CHALLENGE	DESCRIPTION
Transportation	Although transportation challenges vary, districts often cite concerns such as scheduling, costs, recruitment of bus drivers, and routing difficulties when considering changes to school schedules.
Extracurricular Activities	Students and parents argue that later release times result in fewer opportunities for after-school activities, especially during daylight hours. They also question the availability of school resources (e.g., more teams vying for the same gym or field during the same limited time intervals). In addition, later release times may require students to leave class early to attend extracurricular events or games.
Impact on Other Students	The majority of districts focus on school start time delays for adolescent students, but many question the impact that changes may have on the younger students whose start times are often also changed as a result.
Reduced Access to Community Resources	Some argue that following a later release, students will have less time to access community resources, such as the library.
Effects on Teachers	Many teachers, administrators, and coaches fear a reduction in the amount of time available to spend with their own families.
Stress on Family Routines	The families of students that will be affected by changes in school start times are resistant because of the effects it will have on their daily routines and schedules.
Community Opinions	Often, the community is not familiar with the research-based benefits associated with later school start times, and they are resistant to proposed changes.
Student Resistance	Students also may be accustomed to a specific schedule and resistant to proposed changes.

Source: National Sleep Foundation⁵²

Other research echoes such findings. In 2014, the Children’s National Medical Center (CNMC) conducted a national survey of districts that had recently enacted changes to bell schedules. Respondents were asked to rank their district’s challenges on a scale from 1 to 5,

⁵² “Eight Major Obstacles to Delaying School Start Times.” National Sleep Foundation. <http://sleepfoundation.org/sleep-news/eight-major-obstacles-delaying-school-start-times>

with 1 being the primary concern within the district.⁵³ The survey results were weighted to “give more credence to higher-ranked options,” and the most prominent concerns across districts, in order, were:⁵⁴

1. Traffic flow at school
2. Changes in parents’ work schedules
3. After-school extracurricular program attendance
4. Changes in teachers’ work schedules
5. Before-school athletics practices and schedules

Districts can use a number of approaches to overcome these, and other, challenges. The remainder of this section provides an overview of district- and school-level strategies for managing with the complications associated with transportation, extracurricular activities, and stakeholder support.

MANAGING TRANSPORTATION ISSUES

Transportation issues are often cited as the primary obstacle districts face in changing school schedules. Districts commonly manage transportation using a tiered bus system in which the same buses transport elementary, middle, and high school students at staggered time intervals. A tiered bus system often minimizes transportation costs by saving money on the number of buses and bus drivers in the district. In such a transportation system, a change in school start times at the middle and/or high school level is likely to impact elementary school start times as well. Furthermore, districts also face transportation challenges related to the length of transit time, the number of hours worked by bus drivers, the impact that buses may have on commuter traffic, and the availability of buses for the transportation needs of after-school extracurricular activities.⁵⁵

To address the problems associated with bus transportation, some districts implement a “direct flip” approach, swapping high school start times with middle school or elementary school start times. Most often, the flip occurs between elementary schools and high schools, because younger children have a tendency to wake up earlier in the morning.⁵⁶ While this solution may be the most feasible logistically, it may pose additional problems for districts. Parents of elementary school students may protest the change based on the possible negative impact that earlier start times may have on younger students. For example, if elementary students have to go to bed earlier to obtain the recommended amount of sleep for their age groups, then parents may have less time to spend with their younger children after work. Another common concern relates to the safety of young elementary school students who have to wait in the dark to catch a bus to school in the

⁵³ “School Start Time Change: An In-Depth Examination of School Districts in the United States.” The Children’s National Medical Center’s Blueprint for Change Team, April 2014. pp. 11-13.
<http://www.fcps.edu/supt/update/1415/Blueprint-Change-School-Start-Time-Change-ReportFinal4-14-14.pdf>

⁵⁴ Bulleted points taken verbatim from: Ibid., p. 13.

⁵⁵ Blazer, C. “Delayed High School Starting Times.” Miami Dade County Public Schools Research Services, October 2009. pp. 2-3. <http://files.eric.ed.gov/fulltext/ED544704.pdf>

⁵⁶ “Eight Major Obstacles to Delaying School Start Times.” National Sleep Foundation. Op. cit.

morning.⁵⁷ As such, the National Sleep Foundation specifies that a “direct flip cannot work unless all start times are reasonable.”⁵⁸

In some instances, districts decide to change start times across all school levels. For example, Arlington Public Schools, discussed in Section I: shifted high school start times from 7:30 a.m. to 8:15 a.m.; moved middle school start times from 8:10 a.m. to 7:50 a.m.; and adjusted elementary school start times from 8:10 a.m. and 8:50 a.m. to a three-tiered system (i.e., 8:00 a.m., 8:25 a.m., and 9:00 a.m.).⁵⁹

Importantly, these transportation issues may pose greater challenges for suburban districts than urban districts, as students in suburban districts must travel farther distances to attend neighborhood schools.⁶⁰ Urban districts also typically have the option of using public means of transporting older students, thereby mitigating some of the logistical issues surrounding district-provided bussing. In fact, certain districts even cite cost savings associated with the purchase of public bus passes for students, because such purchases have led to a reduction in the number of district-owned buses for transporting students.⁶¹

For example, Denver Public Schools (DPS) successfully integrated the use of public transportation as a means for high school students to get to school. To accomplish this shift, DPS officials created a transportation plan that provided free bus passes to students who lived more than 3.5 miles from their school and students who attended magnet schools throughout the district. The new transportation plan most noticeably increased the number of district high school students reliant on public transit; however, it also provided public transportation for younger students and special subpopulations. Through this approach, the district eliminated the need for 60 buses and saved \$750,000 in transportation costs.⁶²

MAINTAINING EXTRACURRICULAR ACTIVITIES

The logistics of extracurricular activities are also commonly cited as obstacles to prospective changes in high school start times. Indeed, by **often resulting in a later release time, a later start time has the potential to reduce the time available after school for extracurricular activities or events.** The reduction in after-school time also may create competition for facilities, such as gyms and fields. Further, later release times may require middle school

⁵⁷ Phillips, A. “Early school start times in question due to alarming impact on teens.” Milwaukee Journal Sentinel, February 2014. <http://www.jsonline.com/news/education/early-school-start-times-in-question-due-to-alarming-impact-on-teens-b99201024z1-245855461.html>

⁵⁸ “Eight Major Obstacles to Delaying School Start Times.” National Sleep Foundation. Op. cit.

⁵⁹ “School Start Time Change: An In-Depth Examination of School Districts in the United States.” The Children’s National Medical Center’s Blueprint for Change Team. Op. cit., p. 23.

⁶⁰ Cline, J. “Do Later School Start Times Really Help High School Students?” Psychology Today, February 2011. <https://www.psychologytoday.com/blog/sleepless-in-america/201102/do-later-school-start-times-really-help-high-school-students>

⁶¹ “Eight Major Obstacles to Delaying School Start Times.” National Sleep Foundation. Op. cit.

⁶² “School Start Time Change: An In-Depth Examination of School Districts in the United States.” The Children’s National Medical Center’s Blueprint for Change Team. Op. cit., pp. 19-20.

and high school students to leave class to attend an event or competition, resulting in decreased instructional time.⁶³

Interestingly, the National Sleep Foundation reports that **districts that change school start times experience few problems related to student participation in school-based extracurricular activities.**⁶⁴ Likewise, Wahlstrom's 2002 analysis of high schools in Minneapolis Public Schools found that, while after-school activities, such as practices and rehearsals, were shortened due to later start times, participation levels did not change. However, the study also concluded that "coaches and activity leaders were generally supportive of the change because they saw students who were less tired and seemingly more mentally alert at the end of the day."⁶⁵

Generally, small delays of 30 to 45 minutes are manageable for districts in their coordination and rescheduling of school-based extracurricular activities. Many districts also have developed creative scheduling solutions that provide additional time for extracurricular involvement.⁶⁶ For example, after implementing later middle school and high school start times, Bedford County Public Schools in Virginia created early online classes and offered early dismissal for athletes.⁶⁷ Additional strategies implemented by other districts nationwide include.⁶⁸

- Adding a 0 period to increase scheduling flexibility (some used this time for remediation, enrichment, teacher conference periods, testing, or to provide additional options for students with specialized curricular needs. 0 periods are part of the teacher's contracted day).
- Taping athletes on the bus ride to the competition to save time.
- Adding lights to the fields and tennis courts (some used mobile lights that could be moved depending on season and venue).
- Holding some practices before school.
- Scheduling athletes in a PE class at the end of the day and releasing them early to go to competitions/games.
- Releasing students early on game days.
- Replacing after-school remediation with during school (e.g., lunch) or before school help, so athletes could proceed directly to practice instead of having a gap between dismissal and practice.

⁶³ "Eight Major Obstacles to Delaying School Start Times." National Sleep Foundation. Op. cit.

⁶⁴ Ibid.

⁶⁵ Wahlstrom, K. "Changing Times: Findings from the First Longitudinal Study of Later High School Start Times." Op. cit. p. 16.

⁶⁶ Payne, P. "Report from SLEEPinFairfax: Successful Practices and Approaches to Changing School Start Times." Start School Later. <http://www.startschoollater.net/successful-approaches-thanks-to-sleepinfairfax.html>

⁶⁷ "School Start Time Change: An In-Depth Examination of School Districts in the United States." The Children's National Medical Center's Blueprint for Change Team. Op. cit., pp. 10.

⁶⁸ Bulleted points take verbatim with minor adjustments from: Payne, P. "Report from SLEEPinFairfax: Successful Practices and Approaches to Changing School Start Times." Op. cit.

Unfortunately, **non-school-based extracurricular participation and student work schedules may be negatively influenced by later school start times.** However, research suggests that, with increased amounts of sleep, students may finish their homework faster and, as a result, have additional time after school to participate in community-based extracurricular activities. Regarding the potential impact on student work schedules, the National Sleep Foundation offers the following:⁶⁹

...studies have shown that employers indicate a change in start times has not affected their business or the number of hours their student employees can work. They indicate that extra help is not usually needed until school gets out anyway, so they can easily adjust to the new schedule. Other researchers have found that students who are employed for more than 15 hours per week are negatively impacted academically, so working fewer hours may be better for students who don't rely on the income for substantive needs.

The literature further recommends that districts work include all community stakeholders in the decision-making process in an attempt to gather relevant input about the potential, wide-reaching effects of any future changes to school schedules.⁷⁰

LIMITING EFFECTS ON TEACHERS, STUDENTS, AND FAMILIES

Students, school staff, and families typically have existing schedules and obligations that may be adversely impacted by any adjustments to school start times. Community stakeholders in districts considering school start time changes often express apprehensions related to work schedules, childcare, student drop off/pick up, necessary household chores, extracurricular activities, family time, and meal preparation.⁷¹

The adverse effects on teacher, student, and family schedules have the potential to derail a district's proposal for later high school start times. For example, Pinellas County Schools had to forgo a plan to shift high school start times from 7:05 a.m. to 9:00 a.m. after a community poll revealed that most parents opposed the change.⁷² In some cases, however, community involvement in the decision-making process may bolster public support for the schedule change. The National Sleep Foundation notes that community members can adjust more easily to school start time changes if they are informed and given adequate time to prepare. Districts may gather community feedback through a variety of means including hotlines, message boards, or public meetings.⁷³

In an attempt to limit the effect on teacher and parent schedules, some districts have explored flexible scheduling options for students. Two Florida districts, Marion County Public Schools and Santa Rosa County School District, offered rolling arrival times across district middle schools and elementary schools. Likewise, other districts have implemented

⁶⁹ "Eight Major Obstacles to Delaying School Start Times." National Sleep Foundation. Op. cit.

⁷⁰ Blazer, C. "Delayed High School Starting Times." Op. cit., p. 15.

⁷¹ Ibid., p. 13.

⁷² Ibid.

⁷³ "Eight Major Obstacles to Delaying School Start Times." National Sleep Foundation. Op. cit.

a zero period or scheduled classes before the technical start of the school day. For example, after encountering community resistance to delayed school start times, West Hartford Public Schools in Connecticut adopted a flexible start time, which gave students the option of coming to school at 8:15 a.m. (the start of second period) or 7:30 a.m. (the beginning of first period). First period was converted into a study hall, with a dismissal time of 2:15 p.m. for all students.⁷⁴

As an alternative to major changes in school dismissal times, other districts have identified simple ways to conserve time throughout the school day. For example, Mahtomedi Public Schools in Minnesota shortened the time between classes to account for a 30-minute start time delay from 7:30 a.m. to 8:00 a.m.⁷⁵

⁷⁴ "School Start Time Change: An In-Depth Examination of School Districts in the United States." The Children's National Medical Center's Blueprint for Change Team. Op. cit., p. 18.

⁷⁵ Ibid. p. 8.

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