



Research Review: Grade Configurations

Prepared for Westport Public Schools

FEBRUARY 2019

RICHARD LEMONS

Connecticut Center
for School Change

System Success = Student Success

Context of Grade Level Configurations

The most common configuration in the United States is K-6, 7-8, 9-12. A small fraction of students attend schools comprised of grades K-8, 6-12 or K-12.

Over the last several decades, theorists have advocated for and districts have experimented with numerous different configurations.

In recent years, several large districts (Cincinnati, Cleveland, Milwaukee, New York City, Philadelphia, Portland, etc.) have converted middle schools to K-8 configurations.

Some districts experiment with middle grades configurations as a means of dealing with elementary enrollment fluctuations or financial constraints.

Context of Research

Research on grade configurations tends to focus on middle school configuration (K-6 vs K-8 configurations), as opposed to various early grade configuration options (K-2 vs K-5 configurations).

Most research does not come from districts similar to Westport, CT. Some of the most cited studies draw from NC, FL, and NY districts. These are more expansive and heterogeneous populations. In the majority of these studies, findings are not disaggregated for students of different socio-economic levels.

Finding #1: Research on grade configurations is imperfect and incomplete.

“Research has not provided definitive answers to the myriad possible questions about grade span, but the questions have never gone away. They are questions which arise whenever school reform, increasing or declining enrollment, or financial considerations bring about a reorganization of existing schools, the building of new schools, or consolidation of districts.” Paglin and Fager (1997)

“The research base is very thin.” Howley

The existing literature is “ambiguous” on the transitional effect from elementary to middle schools, with several studies finding adverse effects and others finding limited impact on achievement. Kong, Zimmer and Engberg (2018)

Little empirical research directly addresses questions of 6-12 schools.

Finding #2: On average, transitions tend to have negative consequences on students.

There is evidence that, all things being equal, student mobility and moves between schools have negative consequences for students. South, Haynie, and Bose (2007); Ozek (2009); Hanushek, Kain, and Rivkin (2004); Schwartz et al.(2011).

Several studies demonstrate a negative impact of school transitions on student achievement. Alspaugh (1999); Bedard and Do (2005); Cook et al. (2008); Schwartz et al. (2011)

Recent students show entering middle school causes a sharp drop in student achievement relative to the performance of those remaining in K-8 schools. Rockoff, J. & Lockwood, B. (2010); Schwerdt, G. & West, M.R. (2011)

Each time students experience transitions between schools they experience increased feelings of anonymity. Paglin & Fager (1997)

Studies have shown that middle school transitions are associated with increased behavioral problems and declines in academic achievement. Allspaugh (1998); Byrnes & Ruby (2007); Cook et al. (2008)

Studies suggests that the transition to high school also results in a small drop in achievement, but less than the impact of transitioning in middle school. Schwerdt, G. & West, M.R. (2011).

Finding #3: Traditional middle schools, on average, have a negative impact on students.

Attending traditional middle schools, on average, seems to have adverse consequences for American students. Schwerdt, G. & West, M.R. (2011); Jacob, B. & Rockoff, J. (2011).

Middle school students report a relatively high level of stress in the social complexity of middle school life. Elias et al. (1985).

Studies suggest that middle schools do not appear to be better for low-achieving students. Jacob, B. & Rockoff, J. (2011).

Students with underdeveloped or maladaptive self-regulatory skills report increased pressure as they transition to middle schools. Rudolph et al (2001).

Traditional middle school configurations also seem to have negative effects on special needs students, though the effects tend to be in the first year of transition. Nelson (2013).

Finding #4: The negative impact of middle schools transitions appears to be greater for students of poverty and students with lower initial academic achievement.

Grade configuration has a larger effect on the math scores of traditionally disadvantaged subgroups (particularly African American students) than on other students. Schwerdt, G. & West, M.R. (2011).

The impact on ELA performance seems similar across subgroups.

Some studies have shown that high-poverty K-8 schools perform better than high-poverty middle schools. Silvernail (2014)

Rockoff and Lockwood (2010) find that students with lower initial academic achievement do worse in traditional middle schools.

Finding #5: While in the minority, there are studies that call into question positive effects of K-8 school configurations.

Some studies, though smaller in number, find neutral or positive effects of middle school configuration. Weiss and Kipnes (2006); Lippold et al. (2013).

A recent study also found a statistically significant adverse effect for middle school students in the transition year of grade 6, but unlike past studies did not find lingering effects beyond the transition year. Kong, Zimmer, & Engberg (2018).

Of late, there are researchers who suggest that some of the effects of middle schools when compared to K-8 schools may be non-randomness of student selection of type of school. Kong, Zimmer, & Engberg (2018);

Finding #6: Research Suggests Some Advantages of K-8 and 9-12 or K-12 Configurations.

Some research has shown that K-12 schools did as well or better on achievement tests as students in separate elementary, middle or high schools. Franklin & Glascock (1996); Bickel, Howley, Williams, & Glascock (2000).

Students in high poverty areas also did better in the K-12 schools. Franklin & Glascock (1996)

Finding #7: School Size Research is Ambiguous as Relates to Configuration Questions.

Grade configuration has implication for school size.

Research is ambiguous about the impact of school size on student outcomes. Hanover Research (2016).

Some findings suggest that small school settings have positive effects on student achievement and socio-emotional development. Darling-Hammond, et al. (2007).

Other studies suggest that those effects are minimal. Bangser, G. et. al. (2012). Darling-Hammond, et al. (2012).

The Gates Foundation's effort to transform large, comprehensive high schools into small high schools did not, despite vast resources and a specific theory of change, have significant positive effects for students. Strauss, V. (2014).

Other research suggests that larger school settings provide certain economies of scale, enabling more curricular and extracurricular variety and choice for students. Bowles and Bosworth (2002).

Finding #8: Costs of School Configurations.

The real costs of different grade configurations vary widely across districts because of various contextually-dependent variables (ex: how much money is spent on busing). Howley (2016).

Researchers suggest that disentangling local school budgets makes it challenging to definitively answer the question of which configurations are most cost effective.

A small number of studies suggests that there are cost savings in smaller schools with wider grade spans (K-12). Howley.

Some studies suggest there is little evidence that middle schools are cost effective structures for educating adolescents. Rockoff & Lockwood (2010).

Some studies point the shear complexity of determining real costs of different grade configurations or school size. Bickel et al. (2000).

Implications

“We should stop fretting about precisely which grade-span configuration might be ideal. One-size-fits-all prescriptions inevitably not only fall far short of the ideal, they’ve been doing consistent damage for much of recorded history.” Howley.

Evidence available does not suggest that reconfiguring alone will enhance student academic performance. Research tends to compare K-6 and K-8 schools, not the impact of moving from one configuration to another.

There is no single grade configuration that guarantees positive academic and social effects for students. Paglin and Fager (1997).

Fifty years of research on effective and high-improvement schools consistently indicate certain predictors of school quality: classroom instructional practice, leadership, strong professional community and culture, school climate, parent and community engagement. Bryk et al. (2010); Edmonds (1979); Purkey and Smith (1983).

Regardless of grade configuration, districts and schools should pay careful attention to the transition experience of young people, making sure they have well-designed and intentional academic and social supports.

Works Cited

- Allspaugh, J. W. (1998). "Achievement Loss Associated with the Transition to Middle School and High School." *Journal of Educational Research*. 92(1): 20-25.
- Allspaugh, J.W. (1999). "The Interaction Effect of Transition Grade to High School and Grade Level upon Dropout Rates." Montreal.: American Educational Research Association. (ERIC Document No. ED431066).
- Bangser, G. et. al. "Urban Education that Works: Moving Past School-Type Debates and Embracing Choice." Princeton University: The Woodrow Wilson School's Graduate Policy Workshop, January 2012, pp. 8-9.
- Bedard, K., and C. Do. 2005. "Are Middle Schools More Effective? The Impact of School Structure on Student Outcomes." *Journal of Human Resources*, 40(3): 660-682
- Bickel, R., Howley, C., Williams, T, & Glascock, C. (2000). "High School Size, Achievement Equity, and Cost: Robust Interaction Effects and Tentative Results." ERIC.
- Bowles, T. & Bosworth, R. (2002) "Scale Economies in Public Education: Evidence from School Level Data." *Journal of Education Finance*.Vol. 28, No. 2, pp. 285-299.
- Byrnes, V., & Ruby, A. (2007). "Comparing Achievement between K-8 and Middle Schools: A Large-Scale Empirical Study." *American Journal of Education* 114 (1): 101-135.
- Cook, P. J., et al. (2008). "The Negative Impacts of Starting Middle Scholl in Sixth Grade." *Journal of Policy Analysis and Management* 27 (1): 104-121
- Darling-Hammond, L., Milliken, M. and Ross, P. "High School Size, Structure, and Content: What Matters for Student Success?" *Brooking Papers on Education Policy*, 2006-2007.
- Darling-Hammond, L., Aness, J., and Ort, S. W. "Reinventing High School: Outcomes of the Coalition Campus Project." *American Educational Research Journal* 39, 3 (Fall 2002): p. 639.

Works Cited

Eccles, J., Midgley, C., Alder, T. F. 1984. "Grade Related Changes in the School Environment: Effects on Achievement Motivation". In: Nicholls, J. G. (Ed.), *The Development of Achievement Motivation. Advances in Motivation and Achievement*, Vol, 3. Greenwich, CT, JAI.

Edmonds, R. 1979). "Effective schools for the Urban Poor." *Semantic Scholar*.

Hanushek, E. A., Kain, J. F. and Rivkin, S. G.. 2004. "Disruption vs. Tiebout Improvement: the Costs and Benefits of Switching Schools." *Journal of Public Economics*, 88(9-10): 1721-1746.

Franklin, B. J. & Glasscock, C. H. (1996, October). "The Relationship Between Grade Configuration and Student Performance in Rural Schools." Paper presented at the Annual Conference of the National Rural Education Association, San Antonio, TX. (ERIC Document No. ED403083)

Howley, C. "Grade Span Configurations". *School Administrator*. <http://www.aasa.org/SchoolAdministratorArticle.aspx?id=10410>

Howley, C. (2016). Phone Interview. CCSC.

Jacob, B. A. & Rockoff, J.E. "Organizing Schools to Improve Student Achievement: Start Times, Grade Configurations, and Teacher Assignments." The Hamilton Project: Brookings Institute.

Hanover Research (2016). "Best Practices in School District Configuration." Self-Published Manuscript.

Lippold, M. A., Powers, C. J., Syvertsen, A. K. Feinberg, M. E. and Greenberg, M. T. 2013. "The Timing of School Transitions and Early Adolescent Problem Behavior." *The Journal of Early Adolescence*, 33(6): 821-844.

Works Cited

National Forum to Accelerate Middle Grades Reform (2008). "Policy Statement on Grade Configuration." WWW.mgforum.org.

Nelson, D. (2013). "The Effect of Grade Configuration on the Academic Achievement of Special Needs Students: The Case of New Jersey." Unpublished Dissertation, Seton Hall University.

Paglin, C. & Fager, J. (1997, July). "Grade Configuration: Who Goes Where" (online). Available: <http://www.aasa.org/publications/saarticledetail.cfm?itemnumber=2668>

Rockoff, J. & Lockwood, B. (2010). "Stuck in the middle."

Silvernail, D., Sloan, J., Paul, C., Johnson, A., Stump, E. (2014). "The Relationships Between School Poverty and Student Achievement in Maine." Main Education Policy Research Institute, University of Southern Maine.

Schwerdt, G. & West, M.R. (2011). "The Impact of Alternative Grade Configurations on Student Outcomes Through Middle and High school" IER and Harvard University.

Stewart C. Purkey and Marshall S. Smith. "Effective Schools: A Review." *The Elementary School Journal* Vol. 83, No. 4, Special Issue: Research on Teaching (Mar., 1983), pp. 426-452

Strauss, V. (2014). How much Bill Gates' Disappointing Small-Schools Effort Really Cost. *The Washington Post*.

Rudolph, K. D., Lambert, S. F., Clark, A. G., and Kurlakowsky, K. D. 2001. "Negotiating the Transition to Middle School: The Role of Self-Regulatory Processes." *Child Development*, 72(3): 929-946.

South, S. J., Haynie, D.L., and Bose, S. 2007. "Student Mobility and School Dropout". *Social Science Research*, 36(1): 68-94.

Xu, Z., Hannaway, J., and D'Souza S. 2009. "Student Transience in North Carolina: The Effect of Mobility on Student Outcomes Using Longitudinal Data." Washington, DC: National Center for Analysis of Longitudinal Data in Education Research, Working Paper 22.

About Our Services

The Center's core practice is partnering with districts and other organizations to strengthen their leadership, systems, and improvement strategies in service of improved and more equitable outcomes for students. We do this through coaching, consulting, and capacity building.



CT Center for School Change

www.ctschoolchange.org

151 New Park Ave. Suite 15

Hartford, CT 06106

860.586.2340

ccsc@ctschoolchange.org

Connecticut Center
for School Change

System Success = Student Success

This page has been intentionally left blank.

School Start Times

White Paper

Introduction

On November 29, 2017, Superintendent Colleen Palmer convened a working group for the purpose of exploring optimal school start times for all Westport Public School students. School Start Time Committee meetings were held monthly throughout the 2017-18 school year. **Appendix A** lists the committee members and their associated roles. On June 14, 2018, the committee recommended four possible school start time plans to the Superintendent. The committee reconvened in the fall to consider narrowing these possibilities to a single recommendation.

On October 18, 2018, the committee **recommended that all Westport K-12 public schools start no earlier than 8:00 a.m.** Rather than choosing to endorse a specific start time plan, the committee chose to make this recommendation due to the uncertainty surrounding Coleytown Middle School. More detailed considerations will be explored as the Board of Education makes decisions regarding short and long-term plans for the district's schools.

Mission and Guiding Principles

The committee convened with the following mission:

To review and study the impact of various school start times within the Westport Public Schools. The committee will consider the needs of and impact of various school start times on students, faculty, families, and the broader Westport community including budgetary and fiscal impact.

Recommendations should:

- Optimize the educational experience within the Westport Public Schools;
- Promote the health, academic performance, and quality of life for students, staff, and families; and
- Consider the needs of and impact on adjusting school start times for the broader Westport community.

As the committee developed recommendations, they considered the health of all of our students along with the logistical challenges that will need to be addressed in order to change school start times.

Discussion of Key Issues

Over the course of the meetings, two key questions guided our work:

- What does the research say about sleep and school start times?
- How would a change in school start times affect the school community and the wider Westport community?

The committee made their recommendation based on research, presentations, and in-depth discussions regarding the pros and cons of changing school start times. As a committee, we found the science and data about adolescent sleep needs and school start time compelling. We also

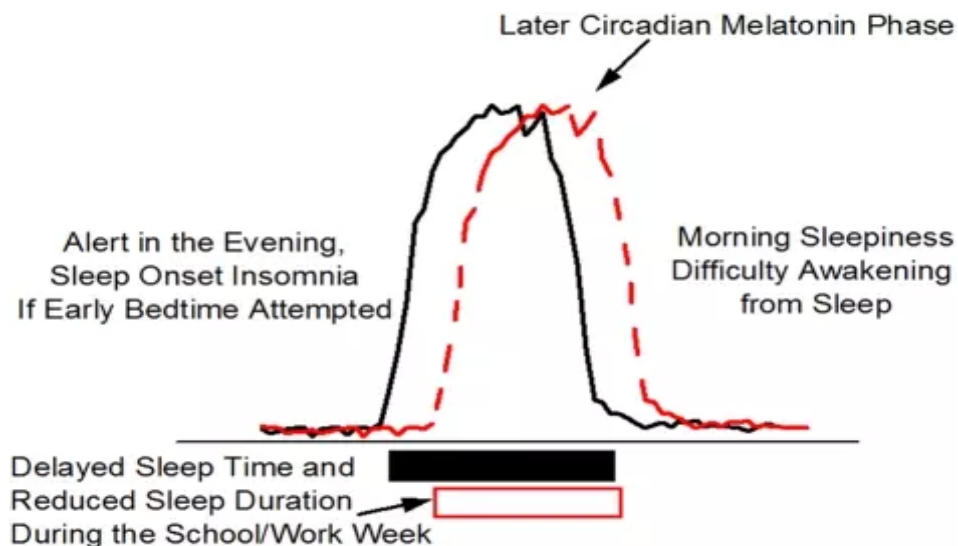
recognized the challenges that need to be addressed, both of which will be clarified in other segments of this paper.

Research Highlights

The American Medical Association, The Centers for Disease Control and Prevention, The American Academy of Child and Adolescent Psychiatry, The Society of Pediatric Nurses, the American Academy of Sleep Medicine, the Society of Behavioral Medicine, and the American Academy of Pediatrics, among other medical and educational organizations, all recommend healthy school start times and specifically that middle and high schools start class no earlier than 8:30 a.m. (**Appendix B**).

All pediatricians in Westport signed a letter stating that they agree with this recommendation and “view moving secondary school start times to 8:30 a.m. or later to be a practical and necessary public health measure” (**Appendix C**).

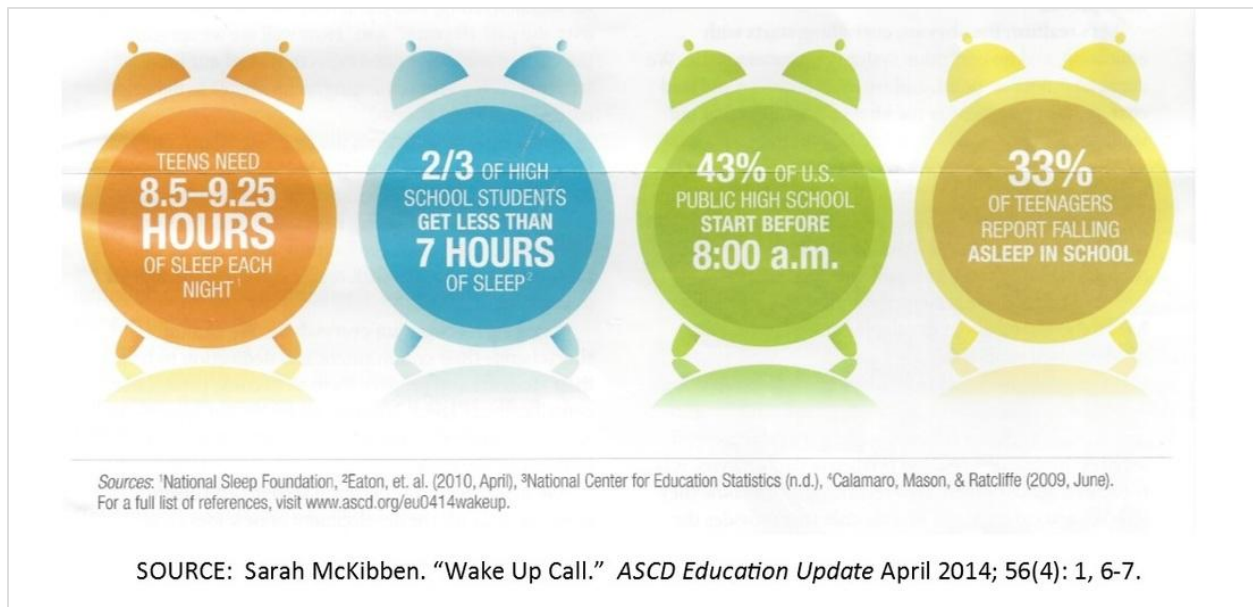
It is uncontroverted in the research community that students with later school start times get more sleep. Children’s sleep needs range from 8-11.5 hours per night depending on age and genetics. Given the neurobiologically induced shift in circadian rhythm that begins at the onset of puberty, it is beneficial for adolescent students to have a delayed start time. These biological changes are in direct conflict with earlier high school and middle school start times because adolescents are biologically programmed to wake at 8:00 am or later and get their best sleep between 11:00 p.m. and 8:00 a.m. The current early start times create a circadian misalignment for students who are adolescents as noted in the diagram below.



https://www.researchgate.net/figure/Delayed-Sleep-Phase-DSP-Delayed-sleep-phase-is-the-most-common-wakefulness-sleep_fig4_224821917

This consistent sleep deprivation creates a “social jet lag” associated with daytime sleepiness, poor academic performance, and depressed mood. Biological changes in adolescence are in direct conflict with earlier high school start times because adolescents are biologically programmed to awaken at 8:00 a.m. or later. Early wake times selectively rob teens of REM sleep, which is critical for learning, memory, emotional resilience, and higher cognitive functions like abstract thinking and creativity. Based on the research, it is the belief of this committee that a later start time will

improve attendance, decrease tardiness, improve academic performance and standardized test scores, and support the overall health, mental health and well being of students. (Dr. Judith Owens, School Start Times: Strategies Science, Oct. 16, 2018, Trinity College, Hartford, CT)



The following are bulleted statistics regarding adolescents and school start times (below stats taken from www.startschoollater.net except where otherwise noted):

- The average public high school in the U.S. starts at 7:59 a.m. (National Center for Educational Statistics (NCES), 2015-16 and NCES. 2011-12)
- More than half of licensed teens (56%) admit to having driven when feeling too tired to drive their best, and nearly one in 10 teens report that they have completely fallen asleep at the wheel. (SADD and Liberty Mutual Study, 2016)
- Insufficient sleep in teens is associated with obesity, migraines, and immune system disruption and with health risk behaviors including smoking, drinking, stimulant abuse, physical fighting, physical inactivity, depression, and suicidal tendencies.
- A major, multi-state study conducted by researchers at the University of Minnesota and the U.S. Centers for Disease Control and Prevention linked later high school start times to significant decreases in teen substance abuse.
- Switching middle school start times by 30 minutes or more to after 8 a.m. in Wake County, NC was associated with increased math and reading test scores.
- A study at the U.S. Air Force Academy showed first-year students starting classes after 8 a.m. performed better not only in their first classes but throughout the day.
- Sleep-deprived students work less productively and retain less information.
- Studies show that sleep significantly improves athletic performance and decreases the likelihood of injury. Students that sleep less than 8 hours per night are 68% more likely to get injured than athletes who sleep for 8 hours or more, and whether an adolescent gets enough sleep has been found to be more of an influence over whether a student-athlete gets injured than hours of practice, number of sports played, strength training regimens, gender, or coaching styles. <https://www.mnsleep.net/school-start-time-toolkit/why-improve-sleep-for-teenage-students/evidence-confirms-link-between-teen-sleep-biology-and-improved-outcomes/sports-related-injury-and-performance/>

- Bills to study, incentivize, or mandate healthy school start times have been introduced in at least 14 U.S. states--and so far at least 4 of them have passed.
- When schools have delayed the start of the school day, communities have seen reduced tardiness, sleeping in class, and car crash rates, as well as improved attendance, graduation rates, and standardized test scores
- With later school start times:
 - Bedtimes remain the same or in some students actually shift earlier
 - The later the school start times the greater the sleep amounts
 - Even a thirty minute delay results in improvements
 - Students with a later start time report less daytime sleepiness
 - Reduced car crash rates (CDC study 2014)

Implementation Challenges

The School Start Time Committee came together with varying opinions, but all participants recognized that establishing healthy school start times would come with challenges. Challenges to making this change were identified and possible solutions continue to be discussed.

- **Budgetary impact:** There are multiple ways to organize transportation needs to accommodate a delay in school start times. Maintaining the current bussing structure would have no budgetary impact. Changing to a two tier system would require an additional increase in transportation costs.
- **Transportation:** Parameters considered for students riding busses include bus ride time not to exceed sixty minutes and maintaining elementary aged students being picked up in the morning during daylight hours. School Bus Consultants (an outside organization) and Westport's Director of Transportation, Sandy Evangelista, spent a significant amount of time with the committee exploring bussing options and their feasibility. Major considerations included the time needed to effectively run bus tiers and the time that busses would arrive at bus stops, especially related to elementary students and civil twilight.
- **Athletics:** A later dismissal time at the HS would require additional travel time to away game sites which would likely impact the number of student athletes missing instructional minutes. In addition, fall outdoor team practice times may be compromised by the shortened daylight hours available after school. These concerns can be addressed through adjusting game start times whenever feasible and working with coaches to maximize practice time when there are fewer daylight hours.
- **Traffic patterns:** Concerns include the impact of traffic congestion in town with later start times. This will continue to be explored as more specific possibilities for start times at each school are developed.
- **After school community programs:** Outdoor programs using the same locations as after school programs may be impacted by later access to fields. For example, the delayed start time of school intramural programs would delay the start time of community programs that use the same outdoor facility. Community programs would need to delay the start time of programming to meet the needs of students who have a later dismissal time and/or Westport's intramural programs would need to shorten their practices.
- **Shifts in daycare needs:** This will vary with individual families and will continue to be explored and considered.
- **Staff concerns:** Employee start and end times will be affected. This concern will vary with individuals and will continue to be explored and considered.

Other District Later Start Time Information:

- The average high school start time in the United States is 7:59 a.m. – 29 minutes later than the current start time of 7:30 a.m. at Staples High School.
- Several public schools in Fairfield County have implemented later start times for high school students, including:
 - Wilton High School (8:20 a.m.)
 - Greenwich High School (8:30 a.m.)
 - Newtown High School (8:00 a.m.)
- Several school districts in Westchester County have later start times for high school students as well, including:
 - In Scarsdale, Scarsdale Senior High School (8:00 a.m.) and Edgemont High School (8:30 a.m.)
 - Rye High School (8:00 a.m.)
 - Bronxville High School (8:30 a.m.)
 - In Chappaqua, Horace Greeley High School (6-day rotating schedule with 7:45 a.m. on 4 days and 8:45 a.m. on 2 days)

In addition, Danbury, New Canaan, Norwalk, and Ridgefield School Districts are actively discussing later secondary school start times. Scheduling challenges related to athletic and other after-school activities may decrease as more school districts implement this change.

Recommendation

After the depth of work done by the committee to explore and research sleep needs and school start times, as well as the logistical challenges that need to be considered, **the committee recommends that all Westport K-12 Public Schools start no earlier than 8:00 a.m.** More detailed considerations will be explored as information and decisions are released regarding the status of Coleytown Middle School.

References and Resources

All references and resources are included in Appendix C.

Appendix A

School Start Time Committee Members:

Colleen Palmer, Ph.D.	Superintendent; Committee Co-Chair (2018-19)
Chris Wanner	Coordinator, Health and PE; Committee Co-Chair (2017-2019)
Mike Rizzo	Former Pupil Services Director; Committee Co-Chair (2017-18)
James D'Amico:	SHS Principal
Jackie Mellin	BMS Assistant Principal
Lauren Pitocco	CMS Assistant Principal
Chris Breyan	GFS Assistant Principal
Candace Savin	BOE
Vik Muktavaram	BOE
Christine Meiers Schatz	RTM; Parent; President, Sleep for Success
Ritu Johorey	Parent
Netta Levy	Parent
Eugenie Ten Cate	Parent
Anne Spencer	Parent
Carolyn Caney	Parent
Jackson Delgado	High School Student (2017-18)
Amanda Samuels	High School Student (2018-19)
Suzanne Levasseur	Supervisor, Health Services
Marty Lisevick	Athletic Director
Elio Longo	Chief Financial Officer
Sandy Evangelista	Transportation Director
Melissa Kane	Westport Third Selectwoman; Parent

Appendix C

POSITION STATEMENT:

Start Middle and High Schools at 8:30 a.m. or Later to Promote Student Health and Learning

(NOVEMBER 2017) Tracy Trevorow, PhD, Chaminade University, Honolulu, HI; Eric S. Zhou, PhD, Harvard University, Boston, MA; Jessica R. Dietch, MS, University of North Texas, Denton, TX; and Brian D. Gonzalez, PhD, Moffitt Cancer Center, Tampa, FL

The Society of Behavioral Medicine recommends school officials start middle and high school classes at 8:30 a.m. or later. Such a schedule promotes students' sleep, resulting in improvements in physical health, psychological well-being, attention and concentration, academic performance, and driving safety.

As a consequence of puberty, teenagers are biologically driven to have later sleep and wake-up times than younger children.¹ Most middle and high schools in the United States start well before 8:30 a.m., which is too early to accommodate for this shift in sleep patterns and contributes to a nation of chronically sleep-deprived students.² Inadequate sleep results in compromised physical health, emotional and behavioral problems, and reduced ability to perform and learn.³⁻⁶ Starting schools early may be intended to accommodate adult considerations such as bus schedules, parents' work schedules, and the use of athletic facilities; these issues have not been problematic for schools with later start times.⁷

The American Academy of Sleep Medicine, the American Academy of Pediatrics, and the American Medical Association recommend middle and high schools start no earlier than 8:30 a.m.⁸⁻¹⁰ However, only about 15% of U.S. public high schools start at 8:30 a.m. or later.¹¹ For decades, starting school after 8:30 a.m. has been the standard in many countries, such as Finland, Japan, New Zealand, Australia, and England, all of which outperform the United States on international student achievement tests.^{12,13} Out of 50 countries, U.S. children ranked worst in sleep deprivation.¹⁴

There are no demonstrable health or learning benefits to support early start times for middle and high schools. However, schools with delayed start times have shown improvements in:

- daytime alertness and concentration;^{3,15-17}
- mood;^{6,17}
- behavioral control;^{3,4,6,17}
- academic achievement, including standardized test scores;^{4,5,18-20}
- tardiness;^{4,16,17,21}



- school attendance;^{4,17,21}
- coffee and stimulant drink use;¹⁶ and
- rates of motor vehicle accidents for teen drivers.^{4,22}

BARRIERS TO CHANGING START TIMES

Changing school start times is often met with resistance in school districts across the United States.^{2,4} Barriers include:

- conflicts with after-school programs, sports activities, and after-school student jobs;
- teacher concerns regarding scheduling and total work hours;
- transportation costs for busing children to school;
- difficulties in changing family patterns of daily life; and
- lack of awareness among school community stakeholders (i.e., school administrators, faculty, students, families) regarding the importance of sleep.

However, schools that have delayed start times do not report significant problems with this change.^{3,15-17} As such, a national trend to delay high school start times may not only be possible but also welcomed as school administrators and school communities appreciate the related benefits to students' health and learning.

In consideration of a later school start time, it is important to note:

- Teachers' arrivals and departures from school do not need to change. Teachers may use the period before instruction each morning for preparation, grading, meetings, and professional development.

- Bus schedules may be staggered to allow younger students to be transported to school before middle and high school students.⁷
- Schools that start between 8:30 and 9 a.m. would typically finish between 3 and 3:30 p.m., allowing daylight time for sports and after-school activities. Coaches often need late afternoon practices and game times due to their day jobs.
- Families' morning routines may be less chaotic when teen students are rested.
- Students are less likely to have unsupervised time when school finishes later in the day.

RECOMMENDATIONS FOR CHANGING SCHOOL START TIMES

The Society of Behavioral Medicine (SBM) advocates for a four-tiered approach to promote later start times for middle and high schools.

- 1. School board members must enact an 8:30 a.m. or later school start time policy in their school districts.** It is fundamentally at the school district level that administrators can prioritize school start times that promote students' health, well-being, and learning.
- 2. State departments of education and state legislators, particularly those on education committees, should advocate for later school start times for middle and high schools.** This advocacy can be achieved by including student healthy-sleep promotion on committee agendas and by lobbying school board members to enact an 8:30 a.m. or later school start policy.
- 3. SBM encourages lobbying of the U.S. Department of Education through congressional representatives,** particularly those on the House Committee on Education and the Workforce, and the Senate Committee on Health, Education, Labor and Pensions, so they understand the value of later school start times and can enact pertinent legislation.
- 4. To increase awareness, SBM suggests school-level promotion of education about the importance of sleep** through in-services, workshops, curriculum changes, and family and community events. On a community level, media should be engaged to promote the public's understanding of the benefits of later school start times for middle and high school students. Healthy student sleep campaigns may be provided through media programming.

It is no longer a question of whether policies promoting later school start times *should be adopted, but rather how they should be implemented.*

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the expert review and support provided by SBM's Health Policy Committee, Health Policy Council, and Child and Family Health Special Interest Group.

ENDORSEMENTS



REFERENCES

- 1 Crowley SJ, Acebo C, Carskadon MA. Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep Medicine*. 2007; 602-612.
- 2 Kirby M, Maggi S, D'Angiulli A. School start times and the sleep-wake cycle of adolescents: A review and critical evaluation of available evidence. *Educational Researcher*. 2011;56-61.
- 3 Lufi D, Tzischinsky O, Hadar S. Delaying school start time by one hour: Some effects on attention levels in adolescents. *J Clinical Sleep Medicine*. 2011;7, 137-143.
- 4 Wahlstrom KL, Dretzke BJ, Gordon MF, Peterson K, Edwards K, Gdula J. 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. Final Report*. 2014;1-71.
- 5 Edwards F. Early to rise? The effect of daily start times on academic performance. *Economics of Education Review*. 2012;970-983.
- 6 Dahl RE. The consequences of insufficient sleep for adolescents. Links between sleep and emotional regulation. *Phi Delta Kappan*. 1999;80, 354-359.
- 7 Wolfson AR, Carskadon MA. A survey of factors influencing high school start times. *NASSP Bulletin*. 2005;89, 47-65.
- 8 AASM position: Delaying middle and high school start times is beneficial to students. *J Clinical Sleep Medicine*. 2017; April 15.
- 9 School start times for Adolescents. Adolescent sleep working group and committee on adolescence and council on school health. *Pediatrics*. 2014 DOI: 10.1542/peds-1697.
- 10 Council on Science and Public Health Report 6 – Delaying School Start Time to Alleviate Adolescent Sleep Deprivation. MD Bishop (Chair). American Medical Association House of Delegates (A-16). 2016. <https://teensneedsleep.files.wordpress.com/2011/04/ama-school-start-time-policy-statement.pdf>
- 11 Frieden TR, Jaffe HW, Cono J, Richards CL, Iademarco MF. School start times for middle school and high school students – United States, 2011-12 school year. *MMWR Morb Mortal Wkly Rep*. 2015;64:809-813.
- 12 School days around the world. <http://pocketcultures.com/2010/09/15/school-days-around-the-world>
- 13 PISA 2015. Results in Focus. <http://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf>.
- 14 TIMSS/PIRLS, Lynch School of Education, Boston College. www.bbc.com/news/business-22209818
- 15 Vedaa O, Saxvig IW, Wilhelmsen-Langeland, A. School start time, sleepiness and functioning in Norwegian adolescents. *Scandinavian J Educational Research*. 2012;56, 55-67.
- 16 Boeger J, Gable CJ, Owens JA. Later school start time is associated with improved sleep and daytime functioning in adolescents. *J Developmental Behavioral Pediatrics*. 2014;33, 11-17.
- 17 Owens JA, Belon K, Moss P. Impact of delaying school start times on adolescent sleep, mood, and behavior. *Archives Pediatric Adolescent Medicine*. 2010;164, 608-614.
- 18 Pagel JF, Forister N, Kwiatkowski C. Adolescent sleep disturbance and school performance: The confounding variable of socioeconomic status. *J Clinical Sleep Medicine*. 2007;3, 19-23.
- 19 Keller PS, Smith OA, Gilbert LR, Bi S, Haak EA, Buckhalt JA. Earlier school start times as a risk factor for poor school performance: An examination of public elementary schools in the commonwealth of

Kentucky. *J Educational Psychology*. 2015;107, 236-245.

- 20 Ming X, Koransky R, Kang V, Buchman S, Sarris C, Wagner GC. Sleep insufficiency, sleep health problems and performance in high school students. *Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine*, 2011;71-79. DOI: 10.4137/CCRPM.S7955
- 21 Wolfson AR, Spaulding NL, Dandrow C, Baroni EM. Middle school start times: The importance of a good night's sleep for young adolescents. *Behavioral Sleep Medicine*. 2007;5, 194-209.
- 22 Vorona RD, Szklo-Coxe M, Lamichhane R, Ware JC, McNallen A, Leszczyszyn, D. Adolescent crash rates and school start times in two central Virginia counties, 2009-2011: a follow-up study to a southeastern Virginia study, 2007-2008. *Journal of Clinical Sleep Medicine*. 2015;10, 1169-1177.

SPECIAL ARTICLES

Delaying Middle School and High School Start Times Promotes Student Health and Performance: An American Academy of Sleep Medicine Position Statement

Nathaniel F. Watson, MD, MS¹; Jennifer L. Martin, PhD²; Merrill S. Wise, MD³; Kelly A. Carden, MD⁴; Douglas B. Kirsch, MD⁵; David A. Kristo, MD⁶; Raman K. Malhotra, MD^{7,8}; Eric J. Olson, MD⁹; Kannan Ramar, MD⁹; Ilene M. Rosen, MD, MS¹⁰; James A. Rowley, MD¹¹; Terri E. Weaver, PhD, RN¹²; Ronald D. Chervin, MD, MS¹³; for the American Academy of Sleep Medicine Board of Directors

¹University of Washington Medicine Sleep Disorders Center and Department of Neurology, University of Washington, Seattle, Washington; ²Veteran Affairs Greater Los Angeles Health System, North Hills, California and David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, California; ³Methodist Healthcare Sleep Disorders Center, Memphis, Tennessee; ⁴Saint Thomas Medical Partners - Sleep Specialists, Nashville, Tennessee; ⁵Carolinas Healthcare Medical Group Sleep Services, Charlotte, North Carolina; ⁶University of Pittsburgh, Pittsburgh, Pennsylvania; ⁷SLUCare Sleep Disorders Center; ⁸Department of Neurology, Saint Louis University, St. Louis, Missouri; ⁹Division of Pulmonary/Sleep/Critical Care, Mayo Clinic, Rochester, Minnesota; ¹⁰Division of Sleep Medicine, Department of Medicine, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania; ¹¹Wayne State University, Detroit, Michigan; ¹²College of Nursing, University of Illinois at Chicago, Chicago, Illinois; ¹³University of Michigan Sleep Disorders Center, University of Michigan, Ann Arbor, Michigan

During adolescence, internal circadian rhythms and biological sleep drive change to result in later sleep and wake times. As a result of these changes, early middle school and high school start times curtail sleep, hamper a student's preparedness to learn, negatively impact physical and mental health, and impair driving safety. Furthermore, a growing body of evidence shows that delaying school start times positively impacts student achievement, health, and safety. Public awareness of the hazards of early school start times and the benefits of later start times are largely unappreciated. As a result, the American Academy of Sleep Medicine is calling on communities, school boards, and educational institutions to implement start times of 8:30 AM or later for middle schools and high schools to ensure that every student arrives at school healthy, awake, alert, and ready to learn.

Keywords: health, high school, middle school, performance, student

Citation: Watson NF, Martin JL, Wise MS, Carden KA, Kirsch DB, Kristo DA, Malhotra RK, Olson EJ, Ramar K, Rosen IM, Rowley JA, Weaver TE, Chervin RD. Delaying middle school and high school start times promotes student health and performance: an American Academy of Sleep Medicine position statement. *J Clin Sleep Med.* 2017;13(4):623–625.

The American Academy of Sleep Medicine (AASM) is the leading professional society dedicated to the promotion of sleep health. As the leading voice in the sleep field, the AASM improves sleep health and promotes high-quality, patient-centered care through advocacy, education, strategic research, and practice standards. The AASM has a combined membership of more than 10,000 accredited member sleep centers and individual members, including physicians, scientists, and other health care professionals, many of whom are involved in higher education. The AASM is dedicated to advancing sleep health policy to improve the health and well-being of the general public.

POSITION

The AASM asserts that middle school and high school start times should be 8:30 AM or later to support:

- An adequate opportunity for adolescents to obtain sufficient sleep on school nights
- Optimal alertness in the classroom environment to facilitate peak academic performance
- Reduced tardiness and school absences to foster improved opportunities for learning

- Adolescent mental health and psychological well-being
- Adolescent driving safety

DISCUSSION

As children progress into their teenage years, they experience delayed patterns of melatonin secretion and a slower build-up of homeostatic sleep pressure during wakefulness.¹ These changes reflect a delayed circadian rhythm that contributes to later sleep onset and later morning awakening, with teenagers typically struggling to fall asleep before 11:00 PM.² The AASM recommends that teenagers 13 to 18 years of age should sleep 8 to 10 hours per 24 hours on a regular basis to promote optimal health, and this recommendation has been endorsed by the American Academy of Pediatrics, Sleep Research Society, and American Association of Sleep Technologists.^{3–6} Because sleep onset is not instantaneous, and it is normal to spend some time awake in bed during the sleep period, a teenager who goes to bed at 11:00 PM would need to sleep until 7:30 AM or later in order to obtain sufficient sleep. Early middle school and high school start times work contrary to this change in adolescent circadian physiology and truncate students' sleep

opportunity, resulting in chronic sleep loss.⁷ Presently, 68.4% of United States high school students sleep 7 hours or less on school nights, while only 23.2% sleep 8 hours, 6.0% sleep 9 hours, and 2.4% sleep 10 hours or more.⁸

Short sleep in adolescents is associated with poor school performance, obesity, metabolic dysfunction and cardiovascular morbidity, increased depressive symptoms, suicidal ideation, risk-taking behaviors, athletic injuries, and increased motor vehicle accident risk.^{9–17} Increased motor vehicle accident risk is particularly concerning because young, novice drivers have a higher crash risk when sleep deprived, and motor vehicle crashes account for 35% of all deaths and 73% of deaths from unintentional injury in teenagers.^{18–20}

Importantly, a delay in school start time has beneficial impacts on teenage students. Studies show that implementation of later school start times for adolescents is associated with longer total sleep time, reduced daytime sleepiness, increased engagement in classroom activities, and reduced first-hour tardiness and absences.^{7,21–23} Delayed school start times also are associated with reduced depressive symptoms and irritability.^{21,22} Reaction time improves, and crash rates decline by 16.5%, following a school start time delay of 60 minutes.^{12,13} Extension of sleep time also facilitates behavioral weight loss interventions in adolescents.²⁴

While an operational change in school start times does not automatically assure longer sleep durations, this change, coupled with inclusion of relevant and targeted educational materials regarding the importance of sleep into middle school and high school curricula, will help motivate students, teachers, and parents to prioritize sleep and implement healthy sleep practices. This includes a cool, dark, quiet sleep environment; adequate time for 8 to 10 hours of sleep per night; consistent bedtimes and wake times on weekdays and weekends; a regular bedtime routine to cue the body that sleep is imminent; and morning light exposure. Furthermore, the use of sleep-disrupting electronic devices near bedtime or during the night should be avoided, because light emitted from electronic devices, particularly blue wavelengths, can suppress the production of melatonin and contribute to difficulty falling asleep.²⁵ These practices will benefit the student regardless of school start time.

The compelling rationale for delayed school start times must be conveyed to all stakeholders including students, families, teachers, school administrators, school boards, athletic directors, coaches, and transportation workers. These efforts should focus on the importance of sleep for health, safety, performance, and student well-being in order to maximize the desired effect of helping adolescents get the sleep they need. Middle school and high school administrators also need to understand the importance of preventing extracurricular activities, including team practices and workouts, from being scheduled before 8:30 AM.

Although adequate sleep duration is necessary, it alone is insufficient to ensure optimal student performance. Good sleep quality, appropriate timing and regularity of sleep, and the effective treatment of sleep disorders also are essential. Parents of students who are experiencing extreme difficulty awakening to arrive at school on time, or who experience significant

daytime sleepiness, should consider scheduling a consultation with the adolescent's primary care provider or a sleep medicine specialist to evaluate for a sleep disorder, regardless of the student's school start time.

CONCLUSIONS

Every middle school and high school student deserves the opportunity to start school awake, alert, and ready to learn. The benefits of later school start times have gained attention in recent years in the eyes of the public, school boards, educators, researchers, and physician organizations.²⁶ However, there are substantial gaps between published scientific knowledge and public awareness of the untoward consequences of early start times and, conversely, the important benefits of later start times. Based on the available evidence, the AASM calls on primary academic institutions, school boards, parents, and policy makers to raise public awareness and improve education in order to promote a national standard of middle school and high school start times of 8:30 AM or later. The AASM also encourages a collaborative and participatory approach among all stakeholders to support school boards as they overcome a variety of real and perceived barriers to the implementation of delayed school start times.

REFERENCES

- Jenni OG, Achermann P, Carskadon MA. Homeostatic sleep regulation in adolescents. *Sleep*. 2005;28(11):1446–1454.
- Crowley SJ, Acebo C, Carskadon MA. Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep Med*. 2007;8(6):602–612.
- Paruthi S, Brooks LJ, D'Ambrosio C, et al. Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine. *J Clin Sleep Med*. 2016;12(6):785–786.
- Frey S, Balu S, Greusing S, Rothen N, Cajochen C. Consequences of the timing of menarche on female adolescent sleep phase preference. *PLoS One*. 2009;4(4):e5217.
- Carskadon MA, Acebo C, Seifer R. Extended nights, sleep loss, and recovery sleep in adolescents. *Arch Ital Biol*. 2001;139(3):301–312.
- Roenneberg T, Kuehnle T, Pramstaller PP, et al. A marker for the end of adolescence. *Curr Biol*. 2004;14(24):R1038–R1039.
- Morgenthaler TI, Hashmi S, Croft JB, Dort L, Heald JL, Mullington J. High school start times and the impact on high school students: what we know, and what we hope to learn. *J Clin Sleep Med*. 2016;12(12):1681–1689.
- Wheaton AG, Olsen EO, Miller GF, Croft JB. Sleep duration and injury-related risk behaviors among high school students--United States, 2007-2013. *MMWR Morb Mortal Wkly Rep*. 2016;65(13):337–341.
- Wahlstrom K, Dretzke B, Gordon M, Peterson K, Edwards K, Gdula J. Examining the impact of later school start times on the health and academic performance of high school students: a multi-site study. University of Minnesota Libraries Digital Conservancy website. <http://conservancy.umn.edu/handle/11299/162769>. Published February 2014. Accessed February 13, 2017.
- Winsler A, Deutsch A, Vorona RD, Payne PA, Szklo-Coxe M. Sleepless in Fairfax: the difference one more hour of sleep can make for teen hopelessness, suicidal ideation, and substance use. *J Youth Adolesc*. 2015;44(2):362–378.
- Milewski MD, Skaggs DL, Bishop GA, et al. Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. *J Pediatr Orthop*. 2014;34(2):129–133.

12. Danner F, Phillips B. Adolescent sleep, school start times, and teen motor vehicle crashes. *J Clin Sleep Med*. 2008;4(6):533–535.
13. Vorona RD, Szklo-Coxe M, Lamichhane R, Ware JC, McNallen A, Leszczyszyn D. Adolescent crash rates and school start times in two central Virginia counties, 2009-2011: a follow-up study to a southeastern Virginia study, 2007-2008. *J Clin Sleep Med*. 2014;10(11):1169–1177.
14. Mitchell JA, Rodriguez D, Schmitz KH, Audrain-McGovern J. Sleep duration and adolescent obesity. *Pediatrics*. 2013;131(5):e1428–e1434.
15. Au CT, Ho CK, Wing YK, Lam HS, Li AM. Acute and chronic effects of sleep duration on blood pressure. *Pediatrics*. 2014;133(1):e64–e72.
16. Azadbakht L, Kelishadi R, Khodarahmi M, et al. The association of sleep duration and cardiometabolic risk factors in a national sample of children and adolescents: the CASPIAN III study. *Nutrition*. 2013;29(9):1133–1141.
17. Meininger JC, Gallagher MR, Eissa MA, Nguyen TQ, Chan W. Sleep duration and its association with ambulatory blood pressure in a school-based, diverse sample of adolescents. *Am J Hypertens*. 2014;27(7):948–955.
18. Martiniuk AL, Senserrick T, Lo S, et al. Sleep-deprived young drivers and the risk for crash: the DRIVE prospective cohort study. *JAMA Pediatr*. 2013;167(7):647–655.
19. Hutchens L, Senserrick TM, Jamieson PE, Romer D, Winston FK. Teen driver crash risk and associations with smoking and drowsy driving. *Accid Anal Prev*. 2008;40(3):869–876.
20. Miniño A. Mortality among teenagers aged 12-19 years: United States, 1999-2006. *NCHS Data Brief*. 2010;(37):1–8.
21. Owens JA, Belon K, Moss P. Impact of delaying school start time on adolescent sleep, mood, and behavior. *Arch Pediatr Adolesc Med*. 2010;164(7):608–614.
22. Boergers J, Gable CJ, Owens JA. Later school start time is associated with improved sleep and daytime functioning in adolescents. *J Dev Behav Pediatr*. 2014;35(1):11–17.
23. Vedaa Ø, Saxvig IW, Wilhelmsen-Langeland A, Bjorvatn B, Pallesen S. School start time, sleepiness and functioning in Norwegian adolescents. *Scandinavian Journal of Educational Research*. 2012;56(1):55–67.
24. Valrie CR, Bond K, Lutes LD, Carraway M, Collier DN. Relationship of sleep quality, baseline weight status, and weight-loss responsiveness in obese adolescents in an immersion treatment program. *Sleep Med*. 2015;16(3):432–434.
25. Chang AM, Aeschbach D, Duffy JF, Czeisler CA. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proc Natl Acad Sci U S A*. 2015;112(4):1232–1237.
26. Adolescent Sleep Working Group, Committee on Adolescence, Council on School Health. School start times for adolescents. *Pediatrics*. 2014;134(3):642–649.

SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication February 1, 2017

Submitted in final revised form February 1, 2017

Accepted for publication February 2, 2017

Address correspondence to: Nathaniel F. Watson, MD, MS, University of Washington Medicine Sleep Center, Box 359803, 325 Ninth Avenue, Seattle, WA 98104-2499; Tel: (206) 744-4337; Fax (206) 744-5657; Email: nwatson@uw.edu

DISCLOSURE STATEMENT

The authors comprise the 2016–2017 board of directors of the American Academy of Sleep Medicine, with the exception of Dr. Wise, who completed his term on the board in June 2016.



POLICY STATEMENT

School Start Times for Adolescents

abstract

FREE

The American Academy of Pediatrics recognizes insufficient sleep in adolescents as an important public health issue that significantly affects the health and safety, as well as the academic success, of our nation's middle and high school students. Although a number of factors, including biological changes in sleep associated with puberty, lifestyle choices, and academic demands, negatively affect middle and high school students' ability to obtain sufficient sleep, the evidence strongly implicates earlier school start times (ie, before 8:30 AM) as a key modifiable contributor to insufficient sleep, as well as circadian rhythm disruption, in this population. Furthermore, a substantial body of research has now demonstrated that delaying school start times is an effective countermeasure to chronic sleep loss and has a wide range of potential benefits to students with regard to physical and mental health, safety, and academic achievement. The American Academy of Pediatrics strongly supports the efforts of school districts to optimize sleep in students and urges high schools and middle schools to aim for start times that allow students the opportunity to achieve optimal levels of sleep (8.5–9.5 hours) and to improve physical (eg, reduced obesity risk) and mental (eg, lower rates of depression) health, safety (eg, drowsy driving crashes), academic performance, and quality of life. *Pediatrics* 2014;134:642–649

FACTORS INFLUENCING INSUFFICIENT SLEEP IN ADOLESCENTS

Insufficient sleep represents one of the most common, important, and potentially remediable health risks in children,^{1,2} particularly in the adolescent population, for whom chronic sleep loss has increasingly become the norm.³ The reasons behind the current epidemic of insufficient sleep are complex and interrelated. From a biological perspective, at about the time of pubertal onset, most adolescents begin to experience a sleep–wake “phase delay” (later sleep onset and wake times), manifested as a shift of up to 2 hours relative to sleep–wake cycles in middle childhood.⁴ Two principal biological changes in sleep regulation are thought to be responsible for this phenomenon.^{5,6} One factor is delayed timing of nocturnal melatonin secretion across adolescence^{5,7,8} that parallels a shift in circadian phase preference from more “morning” type to more “evening” type, which consequently results in difficulty falling asleep at an earlier bedtime.⁴ The second biological factor is an altered “sleep drive” across adolescence, in which the pressure to fall asleep accumulates more slowly, as demonstrated by the adolescent brain's response to sleep loss⁹

ADOLESCENT SLEEP WORKING GROUP, COMMITTEE ON
ADOLESCENCE, AND COUNCIL ON SCHOOL HEALTH**KEY WORDS**

adolescents, insufficient sleep, school start times

This document is copyrighted and is property of the American Academy of Pediatrics and its Board of Directors. All authors have filed conflict of interest statements with the American Academy of Pediatrics. Any conflicts have been resolved through a process approved by the Board of Directors. The American Academy of Pediatrics has neither solicited nor accepted any commercial involvement in the development of the content of this publication.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

www.pediatrics.org/cgi/doi/10.1542/peds.2014-1697

doi:10.1542/peds.2014-1697

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2014 by the American Academy of Pediatrics

and by a longer time to fall asleep after being awake for 14.5 to 18.5 hours in postpubertal versus prepubertal teenagers.¹⁰ Thus, these 2 factors typically make it easier for adolescents to stay awake later. At the same time, several studies from different perspectives indicate that adolescent sleep needs do not decline from preadolescent levels, and optimal sleep for most teenagers is in the range of 8.5 to 9.5 hours per night.^{5,11,12} On a practical level, this research indicates that the average teenager in today's society has difficulty falling asleep before 11:00 PM and is best suited to wake at 8:00 AM or later.^{4,12,13}

The sleep-wake changes that flow from this biological maturation may enable teenagers' interactions with such environmental factors and lifestyle/social demands as homework, extra-curricular activities, after-school jobs, and use of technology.¹⁴⁻¹⁶ As a result, most teenagers stay up late on school nights, getting too little sleep, and then sleep in on weekends to "catch up" on sleep. Although this weekend oversleeping can help offset the weekly sleep deficit, it can worsen circadian disruption and morning sleepiness at school.^{9,17,18}

The Extent and Effects of Adolescent Sleep Loss

Given both biological demands and today's sociocultural influences, it is not surprising that many studies have documented that the average adolescent in the United States is chronically sleep deprived and pathologically sleepy (ie, regularly experiencing levels of sleepiness commensurate with those of patients with sleep disorders such as narcolepsy).¹⁹ For example, a recent National Sleep Foundation poll²⁰ found that 59% of sixth- through eighth-graders and 87% of high school students in the United States were getting less than the recommended 8.5 to 9.5 hours of sleep on school

nights; indeed, the average amount of school night sleep obtained by high school seniors was less than 7 hours. In this same survey, however, 71% of parents believed that their adolescent was obtaining sufficient sleep. This mismatch indicates a significant lack of awareness among adults regarding the extent of adolescent sleep loss. As a result, many middle and high school students are at risk for adverse consequences of insufficient sleep, including impairments in mood, affect regulation, attention, memory, behavior control, executive function, and quality of life (Table 1).²¹⁻²⁶

Insufficient sleep also takes a toll on academic performance. In the National Sleep Foundation poll cited previously,²⁰ 28% of students reported falling asleep in school at least once a week, and more than 1 in 5 fell asleep doing homework with similar frequency. Many studies show an association between decreased sleep duration and lower academic achievement at the middle school, high school, and college levels, as well as higher rates of absenteeism and tardiness and decreased readiness to learn (Table 1).^{17,27-30}

An increased prevalence of anxiety and mood disorders has also been linked to poor quality and insufficient sleep in adolescents.³¹⁻³³ Other specific health-related effects of sleep loss include increased use of stimulants (eg, caffeine, prescription medications) to counter the effects of chronic sleepiness on academic performance.^{34,35} Adolescents are also at greater risk of drowsy driving-related crashes as a result of insufficient sleep.^{36,37} Chronic sleep restriction increases subsequent risk of both cardiovascular disease and metabolic dysfunction, such as type 2 diabetes mellitus.^{38,39} An association between short sleep duration and obesity in children and adolescents has been demonstrated in several cross-sectional and prospective

studies, underscoring how chronic sleep restriction can undermine health (Table 1).^{40,41}

IDENTIFYING SOLUTIONS: THE ROLE OF DELAYING SCHOOL START TIMES

This "epidemic" of delayed, insufficient, and erratic sleep patterns among adolescents and the accompanying negative effects on adolescent health and well-being highlight the importance of identifying potentially modifiable factors. The quest to reduce the high cost of sleep loss in adolescents is not only an important public health issue but one of paramount importance to educators, pediatric health care providers, and

TABLE 1 Impact of Chronic Sleep Loss in Adolescents

Physical health and safety
Increased obesity risk
Metabolic dysfunction (hypercholesterolemia, type 2 diabetes mellitus)
Increased cardiovascular morbidity (hypertension, increased risk of stroke)
Increased rates of motor vehicle crashes ("drowsy driving")
Higher rates of caffeine consumption; increased risk of toxicity/overdose
Nonmedical use of stimulant medications; diversion
Lower levels of physical activity
Mental health and behavior
Increased risk for anxiety, depression, suicidal ideation
Poor impulse control and self-regulation; increased risk-taking behaviors
Emotional dysregulation; decreased positive affect
Impaired interpretation of social/emotional cues in self and others
Decreased motivation
Increased vulnerability to stress
Academics and school performance
Cognitive deficits, especially with more complex tasks
Impairments in executive function (working memory, organization, time management, sustained effort)
Impairments in attention and memory
Deficits in abstract thinking, verbal creativity
Decreased performance efficiency and output
Lower academic achievement
Poor school attendance
Increased dropout rates

advocates for adolescent health. Although many changes over the course of adolescence can affect the quality and quantity of sleep, one of the most salient and, arguably, most malleable is that of school start times. Numerous studies have demonstrated that early start times impede middle and high school students' ability to get sufficient sleep. Studies comparing high schools with start times as little as 30 minutes earlier versus those with later start times demonstrate such adverse consequences as shorter sleep duration, increased sleepiness, difficulty concentrating, behavior problems, and absenteeism.^{29,30,42–46} For example, in one key school transition study, Carskadon et al¹⁹ evaluated the effects of a 65-minute advance (ie, move earlier) in school start time from grade 9 to grade 10 in 40 students. They found a delay in the biological markers of circadian timing but also objectively measured daytime sleepiness levels typical of patients with sleep disorders. Because circadian-based phase delays emerge at around the time of pubertal onset, they also affect younger adolescents, who increasingly are subject to many of the same environmental and lifestyle competing priorities for sleep as older teenagers. Recent research shows that delaying school start times for middle school students is accompanied by positive outcomes similar to those found in high schools, including later rise times, more school night total sleep, less daytime sleepiness, decreased tardiness rates, improved academic performance, and better performance on computerized attention tasks.^{30,47,48}

According to the US Department of Education statistics for 2011–2012,⁴⁹ approximately 43% of the over 18 000 public high schools in the United States currently have a start time before 8:00 AM. Over the last 15 years, however, a small but growing number of

school districts have responded to research reports regarding insufficient sleep among middle and high school students with what may be viewed as a “systematic countermeasure” to reduce the prevalence of sleepiness and its consequences: delaying school start times. Early studies addressed a core question: “Does delaying start time result in students obtaining more sleep, or do students just stay up later and thus negate the effects of the delayed start time?” Wahlstrom et al^{50,51} assessed more than 18 000 high school students in Minneapolis before and after the district's school start time changed from 7:15 AM to 8:40 AM beginning with the 1997–1998 school year. Bedtimes after the change were similar (ie, did not shift to a later time) to those of students in schools that did not change start times, and, as a result, students obtained nearly 1 additional hour of sleep on school nights during the 1999–2000 school year. Other studies have also failed to show a delay in bedtime in response to delayed start times. In a study involving grades 6 through 12 in a school district that delayed high school start times by 1 hour (7:30 to 8:30 AM), students averaged 12 to 30 minutes more nightly sleep, and the percentage of students who reported ≥ 8 hours of sleep increased from 37% to 50%.⁵² Owens et al,⁵³ in a study of adolescents attending an independent school that instituted a start time delay of 30 minutes (from 8:00 to 8:30 AM), reported that average bedtimes actually shifted *earlier* by an average of 18 minutes, and mean self-reported school night sleep duration increased by 45 minutes. In addition, the percentage of students getting less than 7 hours of sleep decreased by 79%, and those reporting at least 8 hours of sleep increased from 16% to 55%. Finally, in a 3-year study of >9000 students from 8 public high schools in 3 states (Colorado, Wyoming, and Minnesota),

the percentage of students sleeping ≥ 8 hours per night was dramatically higher in those schools that had a later start time (eg, 33% at 7:30 AM vs 66% at 8:55 AM).⁵⁴

Moreover, a number of studies have now clearly demonstrated that delaying school start times not only results in a substantive increase in average sleep duration but also has a significant positive effect on a variety of key outcomes; these effects range from decreased levels of self-reported sleepiness and fatigue to improvements in academic measures. In the Minneapolis study,^{50,51} attendance rates for students in grades 9 through 11 improved, and the percentage of high school students continuously enrolled increased. Likewise, Dexter et al⁴² found that public high school sophomores and juniors at a later- versus earlier-starting high school reported more sleep and less daytime sleepiness. Htwe et al⁵⁵ reported that high school students slept an additional 35 minutes, on average, and experienced less daytime sleepiness after their school start time was delayed from 7:35 to 8:15 AM.

Improvements in academic achievement associated with delayed start times have been somewhat less consistently demonstrated; in the Minneapolis study, grades showed a slight but not statistically significant improvement,⁵⁰ and standardized test scores were not increased overall compared with those before the start time change.^{46,56} However, several recent studies have documented improvements in academic performance associated with later start times. A study of students in Chicago public high schools demonstrated that absences were much more common and student grades and test score performance were notably lower for first-period classes compared with afternoon classes and that performance on end-of-year

subject-specific standardized tests (ie, math, English) correlated with whether the student was scheduled for that subject during first period.⁵⁶ Similarly, first-year Air Force Academy students assigned to start classes after 8:00 AM (compared with before 8:00 AM) performed better in their first-period course and, in addition, had a 0.15 SD increase in performance across all of their courses.⁴⁴ In a study focusing on middle school students,⁴⁵ a 1-hour later shift in school start times was associated with an increase in reading test scores by 0.03 to 0.10 SD and in math test scores by 0.06 to 0.09 SD. The author concluded that an increase in start times by 1 hour would result in a 3 percentile point gain in both math and reading test scores for the average student. Furthermore, students performing in the lower end of the test score distribution seemed to benefit most, with gains roughly twice those in above-average students, and the effects persisted into high school. In a more recent middle school study by the same research group, the results suggested that moving school start later by 1 hour can have an impact on standardized test scores comparable to decreasing the class size by one-third. Finally, in a recent 3-state study, 5 of the 6 high schools in which grade point average was assessed showed a significant pre-post increase in grade point average in core subjects of math, English, science, and social studies.⁵⁴

Finally, there may be additional health-related and other benefits associated with delays in start time. For example, students in the independent school study cited previously⁵³ reported significantly more satisfaction with their sleep. In addition, class attendance improved, as did health-related variables, including fewer visits to the campus health center for fatigue-related complaints.⁵³ Although not specifically

assessed as an outcome in previous research, later start times might increase the likelihood that students will eat breakfast before school and thus further enhance their readiness to learn.⁵⁷ Finally, improvements in teacher satisfaction linked to increased sleep offers yet another potential mechanism for classroom enrichment.

Several other outcome measures examined in these studies also deserve emphasis. In the study by Owens et al,⁵³ there were significantly fewer students self-reporting symptoms of depressed mood as well as improved motivation after the start time delay. In a more recent study, also conducted in an independent school setting, a 25-minute delay in start time was associated not only with increased sleep duration and decreased daytime sleepiness but also with less self-reported depressed mood.⁵⁸ Although more research is needed, given the mounting evidence supporting a bidirectional link between sleep patterns and problems and mood disorders in this population⁵⁹ (including an increased risk of suicidal ideation⁵⁷), countermeasures that could potentially mitigate these effects have important public health implications.

Furthermore, adolescents are at particularly high risk of driving while impaired by sleepiness, and young drivers aged 25 years or younger are involved in more than one-half of the estimated 100 000 police-reported, fatigue-related traffic crashes each year.⁶⁰ Danner and Phillips⁵² examined the relationship between automobile crash records for students 17 to 18 years of age and high school start times. Car crash rates for the county that delayed school start times decreased by 16.5% over the 2 years before and after the school-start change, whereas those for the state as a whole increased by 7.8% across the same time period. In another recent study conducted in

2 adjacent, demographically similar cities, there were significantly increased teen (16- to 18-year-olds) crash rates over a 2-year period in the city with earlier high school start times (2007: 71.2 per 1000 vs 55.6 per 1000; 2008: 65.8 per 1000 vs 46.6 per 1000 [$P < .001$]), and teen drivers' morning crash peaks occurred 1 hour earlier.⁶¹ Finally, the recent study by Wahlstrom et al⁵⁴ found a crash rate reduction in 16- to 18-year-olds of 65% and 70%, respectively, in 2 of the 4 high schools studied; notably, the high school with the latest start time (Jackson Hole, WY) had the largest decline in car crashes.

Although considerable empiric support exists for the concepts that early school start times are detrimental to adolescents' health and well-being and that delaying school start times results in substantive and sustained benefits to students, the ongoing debate among school districts in the United States regarding the widespread institution of later start times for middle and high schools continues to spark controversy. Moreover, the logistical considerations in implementing delayed school start times in middle and high schools are far from trivial. Wolfson and Carskadon⁶² surveyed 345 public high school personnel regarding their perspective on high school start times, factors influencing school start times, and decision-making around school schedules. Most respondents at that time had not changed or contemplated changing their school start times. Perceived barriers to changing school schedules commonly endorsed included curtailed time for athletic practices and interference with scheduling of games, reduced after-school employment hours for students, challenges in providing child care for younger siblings, adjustments in parent and family schedules, potential safety issues, effects on sleep duration in younger children if

elementary school schedules are “flipped” with those of middle/high school students, and the need to make alternative transportation arrangements. However, to date, to our knowledge, there have been no published studies that have systematically examined the impact of school start time delay on these parameters, although anecdotal evidence suggests that many of these concerns are unfounded (www.sleepfoundation.org). Moreover, communities across the country have adopted a variety of creative solutions to address these problems, including shifting to public transportation for older students, enlisting community volunteers to provide supervision at bus stops, adjusting class schedules to minimize late dismissal times, scheduling free periods/study halls at the end of the school day to allow participation in after-school extracurricular activities, exempting student athletes from physical education requirements, and installing lights for athletic fields.

In addition, as outlined in a recent Brookings Institute Report (“Organizing Schools to Improve Student Achievement: Start Times, Grade Configurations, and Teacher Assignments”),⁶³ economists have suggested that delaying school start times would have a substantial benefit-to-cost ratio (9:1). This finding is based on a conservative estimate of both costs per student (\$0–\$1950, largely related to transportation) and the increase in projected future earnings per student in present value because of test score gains related to moving start times 1 hour later (approximately \$17 500). Finally, because the appropriation of federal dollars for schools is partially dependent on student attendance data, reducing tardiness and absenteeism levels could result in increased funding and further offset costs related to moving start times later.

CONCLUSIONS

Taken together, these studies support the presence of significant improvements in benchmarks of health and academic success in a variety of settings in association with later school start times, including in urban school districts with a large percentage of low-income and minority students, suburban public schools, and college-preparatory independent schools. It is clear that additional research is needed to further document the effects of changes in school start times over time, to examine specific factors that increase or decrease the likelihood of positive outcomes, and to assess the effect on families, the community, other stakeholders, and the educational system in general. However, it may be strongly argued that both the urgency and the magnitude of the problem of sleep loss in adolescents and the availability of an intervention that has the potential to have broad and immediate effects are highly compelling. It should also be emphasized that delaying school start times alone is less likely to have a significant effect without concomitant attention to other contributing and potentially remediable factors, such as excessive demands on students’ time because of homework, extracurricular activities, after-school employment, social networking, and electronic media use. One of the biggest challenges school districts face is the need to inform community stakeholders (eg, parents, teachers and administrators, coaches, students, bus drivers, businesses that employ students, law enforcement officials) about the scientific rationale underpinning the merits of delaying school start times; the threats to health, safety, and academic success posed by insufficient sleep; and the potential benefits for adolescents of school start time delay. Thus, education and community engagement are equally

key components in increasing the likelihood of success.

The American Academy of Pediatrics recognizes insufficient sleep in adolescents as a public health issue, endorses the scientific rationale for later school start times, and acknowledges the potential benefits to students with regard to physical and mental health, safety, and academic achievement. The American Academy of Pediatrics lends its strong support to school districts contemplating delaying school start times as a means of optimizing sleep and alertness in the learning environment and encourages all school administrators and other stakeholders in communities around the country to review the scientific evidence regarding school start times, to initiate discussions on this issue, and to systematically evaluate the community-wide impact of these changes (eg, on academic performance, school budget, traffic patterns, teacher retention).

RECOMMENDATIONS

1. Pediatricians should educate adolescents and parents regarding the optimal sleep amount teenagers need to match physiologic sleep needs (8.5–9.5 hours). Although napping, extending sleep on weekends, and caffeine consumption can temporarily counteract sleepiness, these measures do not restore optimal alertness and are not a substitute for regular sufficient sleep.
2. Health care professionals, especially those working in school-based clinics or acting in an advisory capacity to schools, should be aware of adolescent sleep needs. They should educate parents, teenagers, educators, athletic coaches, and other stakeholders about the biological and environmental factors, including early school start times, that contribute to widespread chronic sleep deprivation in America’s youth.

3. Educational interventions for parents and adolescents as well as the general public should be developed and disseminated by the American Academy of Pediatrics and other child and sleep health advocacy groups. Content should include the potential risks of chronic sleep loss in adolescents, including depressed mood, deficits in learning, attention and memory problems, poor impulse control, academic performance deficits, an increased risk of fall-asleep motor vehicle crashes, and an elevated risk of obesity, hypertension, and long-term cardiovascular morbidity. Information should also be included about the potential utility of systemic countermeasures, including delaying school start times, in mitigating these effects. Finally, educational efforts should also emphasize the importance of behavior change on the individual level and the personal responsibility that families and students themselves have in modifying their sleep habits.
4. Pediatricians and other pediatric health care providers (eg, school physicians, school nurses) should provide scientific information, evidence-based rationales, guidance, and support to educate school administrators, parent-teacher associations, and school boards about the benefits of instituting a delay in start times as a potentially highly cost-effective countermeasure to adolescent sleep deprivation and sleepiness. In most districts, middle and high schools should aim for a starting time of no earlier than 8:30 AM. However, individual school districts also need to take average commuting times and other exigencies into

account in setting a start time that allows for adequate sleep opportunity for students. Additional information regarding opportunities, challenges, and potential solutions involved in changing school start times may be found at: <http://www.sleepfoundation.org/article/sleep-topics/school-start-time-and-sleep>; <http://schoolstarttime.org>.

5. Pediatricians should routinely provide education and support to adolescents and families regarding the significance of sleep and healthy sleep habits as an important component of anticipatory guidance and well-child care. In particular, pediatricians should endorse parental involvement in setting bedtimes and in supervising sleep practices, such as social networking and electronic media use in the bedroom; for example, pediatricians could recommend to parents that they establish a “home media use plan” and enforce a “media curfew.” Adolescents should be regularly queried regarding sleep patterns and duration and counseled about the risks of excessive caffeine consumption, misuse of stimulant medications as a countermeasure to sleepiness, and the dangers of drowsy driving.

LEAD AUTHOR

Judith A. Owens, MD, MPH, FAAP

CONTRIBUTING AUTHORS (ADOLESCENT SLEEP WORKING GROUP)

Rhoda Au, PhD
Mary Carskadon, PhD
Richard Millman, MD
Amy Wolfson, PhD

COMMITTEE ON ADOLESCENCE, 2012–2013

Paula K. Braverman, MD, FAAP, Chairperson
William P. Adelman, MD, FAAP
Cora C. Breuner, MD, MPH, FAAP
David A. Levine, MD, FAAP
Arik V. Marcell, MD, MPH, FAAP
Pamela J. Murray, MD, MPH, FAAP
Rebecca F. O'Brien, MD, FAAP

LIAISONS

Loretta E. Gavin, PhD, MPH – *Centers for Disease Control and Prevention*
Rachel J. Miller, MD – *American College of Obstetricians and Gynecologists*
Margo Lane, MD – *Canadian Pediatric Society*
Benjamin Shain, MD, PhD – *American Academy of Child and Adolescent Psychiatry*

STAFF

Karen Smith
James Baumberger

COUNCIL ON SCHOOL HEALTH EXECUTIVE COMMITTEE, 2012–2013

Cynthia D. Devore, MD, FAAP, Chairperson
Mandy Allison, MD, MSPH, FAAP
Richard Ancona, MD, FAAP
Stephen E. Barnett, MD, FAAP
Robert Gunther, MD, FAAP
Breena Holmes, MD, FAAP
Marc Lerner, MD, FAAP
Mark Minier, MD, FAAP
Jeffrey K. Okamoto, MD, FAAP
Thomas Young, MD, FAAP

FORMER COUNCIL EXECUTIVE COMMITTEE MEMBERS

Jeffrey H. Lamont, MD, FAAP
Robert D. Murray, MD, FAAP, Chairperson
Lani S. M. Wheeler, MD, FAAP

LIAISONS

Mary Vernon-Smile, MD, MPH – *Centers for Disease Control and Prevention*
Carolyn Duff, RN, MS, NCSN – *National Association of School Nurses*
Linda Grant, MD, MPH – *American School Health Association*
Veda Johnson, MD – *National Assembly on School-Based Health Care*

STAFF

Madra Guinn-Jones, MPH

REFERENCES

1. US Department of Health and Human Services. Healthy People 2020 sleep health

objectives. Available at: www.healthypeople.gov/2020/topicsobjectives2020/

[objectiveslist.aspx?topicid=38](http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=38). Accessed June 26, 2013

2. Chen MY, Wang EK, Jeng YJ. Adequate sleep among adolescents is positively associated with health status and health-related behaviors. *BMC Public Health*. 2006;6:59
3. Eaton DK, McKnight-Eily LR, Lowry R, Perry GS, Presley-Cantrell L, Croft JB. Prevalence of insufficient, borderline, and optimal hours of sleep among high school students—United States, 2007. *J Adolesc Health*. 2010;46(4):399–401
4. Frey S, Balu S, Greusing S, Rothen N, Cajochen C. Consequences of the timing of menarche on female adolescent sleep phase preference. *PLoS ONE*. 2009;4(4):e5217
5. Carskadon MA, Acebo C, Jenni OG. Regulation of adolescent sleep: implications for behavior. *Ann N Y Acad Sci*. 2004;1021:276–291
6. Carskadon MA. Sleep in adolescents: the perfect storm. *Pediatr Clin North Am*. 2011;58(3):637–647
7. Crowley SJ, Acebo C, Fallone G, Carskadon MA. Estimating dim light melatonin onset (DLMO) phase in adolescents using summer or school-year sleep/wake schedules. *Sleep*. 2006;29(12):1632–1641
8. Carskadon MA, Acebo C, Richardson GS, Tate BA, Seifer R. An approach to studying circadian rhythms of adolescent humans. *J Biol Rhythms*. 1997;12(3):278–289
9. Jenni OG, Achermann P, Carskadon MA. Homeostatic sleep regulation in adolescents. *Sleep*. 2005;28(11):1446–1454
10. Taylor DJ, Jenni OG, Acebo C, Carskadon MA. Sleep tendency during extended wakefulness: insights into adolescent sleep regulation and behavior. *J Sleep Res*. 2005;14(3):239–244
11. Carskadon MA. The second decade. In: Guilleminault C, ed. *Sleeping and Waking Disorders: Indications and Techniques*. Menlo Park, CA: Addison Wesley; 1982:99–125
12. Carskadon MA, Acebo C, Seifer R. Extended nights, sleep loss, and recovery sleep in adolescents. *Arch Ital Biol*. 2001;139(3):301–312
13. Roenneberg T, Kuehnele T, Pramstaller PP, et al. A marker for the end of adolescence. *Curr Biol*. 2004;14(24):R1038–R1039
14. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: a review. *Sleep Med*. 2010;11(8):735–742
15. Knutson KL, Lauderdale DS. Sociodemographic and behavioral predictors of bed time and wake time among US adolescents aged 15 to 17 years. *J Pediatr*. 2009;154(3):426–430, 430.e1
16. Wolfson AR. Bridging the gap between research and practice: what will adolescents' sleep-wake patterns look like in the 21st century? In: Carskadon MA, ed. *Adolescent Sleep Patterns: Biological, Social, and Psychological Influences*. New York, NY: Cambridge University Press; 2002:198–219
17. Fredriksen K, Rhodes J, Reddy R, Way N. Sleepless in Chicago: tracking the effects of adolescent sleep loss during the middle school years. *Child Dev*. 2004;75(1):84–95
18. Dahl RE, Carskadon MA. Sleep and its disorders in adolescence. In: Ferber R, Krieger MH, eds. *Principles and Practices of Sleep Medicine in the Child*. Philadelphia, PA: WB Saunders Co; 1995:19–27
19. Carskadon MA, Wolfson AR, Acebo C, Tzischinsky O, Seifer R. Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. *Sleep*. 1998;21(8):871–881
20. National Sleep Foundation. 2006 Teens and sleep. Available at: www.sleepfoundation.org/article/sleep-america-polls/2006-teens-and-sleep. Accessed June 26, 2013
21. O'Brien EM, Mindell JA. Sleep and risk-taking behavior in adolescents. *Behav Sleep Med*. 2005;3(3):113–133
22. Giedd JN. Linking adolescent sleep, brain maturation, and behavior. *J Adolesc Health*. 2009;45(4):319–320
23. Holm SM, Forbes EE, Ryan ND, Phillips ML, Tarr JA, Dahl RE. Reward-related brain function and sleep in pre/early pubertal and mid/late pubertal adolescents. *J Adolesc Health*. 2009;45(4):326–334
24. Moore M, Kirchner HL, Drotar D, et al. Relationships among sleepiness, sleep time, and psychological functioning in adolescents. *J Pediatr Psychol*. 2009;34(10):1175–1183
25. Pasch KE, Laska MN, Lytle LA, Moe SG. Adolescent sleep, risk behaviors, and depressive symptoms: are they linked? *Am J Health Behav*. 2010;34(2):237–248
26. Soffer-Dudek N, Shahar G. Daily stress interacts with trait dissociation to predict sleep-related experiences in young adults. *J Abnorm Psychol*. 2011;120(3):719–729
27. Curcio G, Ferrara M, De Gennaro L. Sleep loss, learning capacity and academic performance. *Sleep Med Rev*. 2006;10(5):323–337
28. Pagel JF, Forister N, Kwiatkowsky C. Adolescent sleep disturbance and school performance: the confounding variable of socioeconomic status. *J Clin Sleep Med*. 2007;3(1):19–23
29. Wolfson AR, Carskadon MA. Understanding adolescents' sleep patterns and school performance: a critical appraisal. *Sleep Med Rev*. 2003;7(6):491–506
30. Wolfson AR, Spaulding NL, Dandrow C, Baroni EM. Middle school start times: the importance of a good night's sleep for young adolescents. *Behav Sleep Med*. 2007;5(3):194–209
31. Alfano CA, Zakem AH, Costa NM, Taylor LK, Weems CF. Sleep problems and their relation to cognitive factors, anxiety, and depressive symptoms in children and adolescents. *Depress Anxiety*. 2009;26(6):503–512
32. Lofthouse N, Gilchrist R, Splaingard M. Mood-related sleep problems in children and adolescents. *Child Adolesc Psychiatr Clin N Am*. 2009;18(4):893–916
33. Regestein Q, Natarajan V, Pavlova M, Kawasaki S, Gleason R, Koff E. Sleep debt and depression in female college students. *Psychiatry Res*. 2010;176(1):34–39
34. Gromov I, Gromov D. Sleep and substance use and abuse in adolescents. *Child Adolesc Psychiatr Clin N Am*. 2009;18(4):929–946
35. Bryant Ludden A, Wolfson AR. Understanding adolescent caffeine use: connecting use patterns with expectancies, reasons, and sleep. *Health Educ Behav*. 2010;37(3):330–342
36. Dahl RE. Biological, developmental, and neurobehavioral factors relevant to adolescent driving risks. *Am J Prev Med*. 2008;35(suppl 3):S278–S284
37. Hutchens L, Senserrick TM, Jamieson PE, Romer D, Winston FK. Teen driver crash risk and associations with smoking and drowsy driving. *Accid Anal Prev*. 2008;40(3):869–876
38. Verhulst SL, Schrauwen N, Haentjens D, et al. Sleep duration and metabolic dysregulation in overweight children and adolescents. *Arch Dis Child*. 2008;93(1):89–90
39. Gangwisch JE, Malaspina D, Babiss LA, et al. Short sleep duration as a risk factor for hypercholesterolemia: analyses of the National Longitudinal Study of Adolescent Health. *Sleep*. 2010;33(7):956–961
40. Hasler G, Buysse DJ, Klaghofer R, et al. The association between short sleep duration and obesity in young adults: a 13-year prospective study. *Sleep*. 2004;27(4):661–666
41. Cappuccio FP, Taggart FM, Kandala NB, et al. Meta-analysis of short sleep duration and obesity in children and adults. *Sleep*. 2008;31(5):619–626
42. Dexter D, Bijwadia J, Schilling D, Applebaugh G. Sleep, sleepiness and school start times: a preliminary study. *WMJ*. 2003;102(1):44–46
43. Hansen M, Janssen I, Schiff A, Zee PC, Dubocovich ML. The impact of school daily schedule on adolescent sleep. *Pediatrics*. 2005;115(6):1555–1561

44. Carrell SE, Maghakian T, West JE. As from Zzzz's? The causal effect of school start time on the academic achievement of adolescents. *Am Econ J Economic Policy*. 2011;3(3):62–81
45. Edwards F. Early to rise: the effect of daily start times on academic performance. Working Paper, University of Illinois at Urbana-Champaign; 2010. Available at: <http://ssrn.com/abstract=1628693>. Accessed June 26, 2013
46. Hinrichs P. When the bell tolls: the effects of school starting times on academic achievement. *Educ Finance Policy*. 2011;6(4):1–22
47. Epstein R, Chillag N, Lavie P. Starting times of school: effects on daytime functioning of fifth-grade children in Israel. *Sleep*. 1998;21(3):250–256
48. Lufi D, Tzischinsky O, Hadar S. Delaying school starting time by one hour: some effects on attention levels in adolescents. *J Clin Sleep Med*. 2011;7(2):137–143
49. US Department of Education, National Center for Education Statistics, Schools and Staffing Survey. Public School Data File, 2011–12. Available at: http://nces.ed.gov/surveys/sass/tables/sass1112_201381_s1n.asp. Accessed July 14, 2014
50. Wahlstrom K. Changing times: findings from the first longitudinal study of later high school start times. *NASSP Bull*. 2002;286(633):3–21
51. Wahlstrom K. Accommodating the sleep patterns of adolescents within current educational structures: an uncharted path. In: Carskadon M, ed. *Adolescent Sleep Patterns: Biological, Social, and Psychological Influences*. New York, NY, and Cambridge, England: Cambridge University Press; 2002:72–197
52. Danner F, Phillips B. Adolescent sleep, school start times, and teen motor vehicle crashes. *J Clin Sleep Med*. 2008;4(6):533–535
53. Owens JA, Belon K, Moss P. Impact of delaying school start time on adolescent sleep, mood, and behavior. *Arch Pediatr Adolesc Med*. 2010;164(7):608–614
54. Wahlstrom K, Dretzke B, Gordon M, Peterson K, Edwards K, Gdula J. *Examining the Impact of Later School Start Times on the Health and Academic Performance of High School Students: A Multi-Site Study*. Center for Applied Research and Educational Improvement. St Paul, MN: University of Minnesota; 2014
55. Htwe ZW, Cuzzone D, O'Malley MB, O'Malley EB. Sleep patterns of high school students before and after delayed school start time. *J Sleep Disord Res*. 2008;31(suppl):A74–A75
56. Cortes KE, Bricker J, Rohlf C. The role of specific subjects in education production functions: Evidence from morning classes in Chicago public high schools. *The BE Journal of Economic Analysis & Policy*. 2010;12(1)
57. Hoyland A, Dye L, Lawton CL. A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. *Nutr Res Rev*. 2009;22(2):220–243
58. Boergers J, Gable CJ, Owens JA. Later school start time is associated with improved sleep and daytime functioning in adolescents. *J Dev Behav Pediatr*. 2014;35(1):11–17
59. Fitzgerald CT, Messias E, Buysse DJ. Teen sleep and suicidality: results from the youth risk behavior surveys of 2007 and 2009. *J Clin Sleep Med*. 2011;7(4):351–356
60. Knippling R, Wang J. *Crashes and Fatalities Related to Driver Drowsiness/Fatigue*. Washington, DC: National Highway Traffic Safety Administration; 1994. Available at: http://ntl.bts.gov/lib/jpodocs/repts_te/1004.pdf. Accessed June 26, 2013
61. Vorona RD, Szklo-Coxe M, Wu A, Dubik M, Zhao Y, Ware JC. Dissimilar teen crash rates in two neighboring southeastern Virginia cities with different high school start times. *J Clin Sleep Med*. 2011;7(2):145–151
62. Wolfson AR, Carskadon MA. A survey of factors influencing high school start times. *NASSP Bull*. 2005;89(642):47–66
63. Jacob BA, Rockoff JE. *Organizing Schools to Improve Student Achievement: Start Times, Grade Configurations, and Teacher Assignments. The Hamilton Project*. Brookings Institute Discussion Paper. Washington, DC: Brookings Institute; 2011. Available at www.brookings.edu/research/papers/2011/09/organization-jacob-rockoff. Accessed June 26, 2013



Later School Start Times Promote Adolescent Well-Being

Moving high school start times can improve student performance and general well-being.

Delaying Start Times

Though comprehensive national statistics on school start times are not available, it is common for American public high schools to begin their instructional day between 7:00-8:00AM. Research has shown that these early bell times are responsible for the discrepancy between how much sleep teens need and how much sleep they get.⁹ When school systems have moved to later start times, they have found that their students get more sleep.^{4,19-20} Numerous studies have been done with schools that have shifted to later start times; while individual differences in communities and research methodology have led to different outcomes, results are almost always positive. Benefits observed from later high school start times include:^{4, 6,9-14, 16, 19-21}

- Increased attendance rates
- Decrease in disciplinary action
- Decrease in student-involved car accidents
- Increase in student GPA
- Increase in state assessment scores
- Increase in college admissions test scores
- Increase in student attention
- Decrease in student sleeping during instruction
- Increase in quality of student-family interaction

These benefits are from studies of delayed start times in schools and districts across the country in Colorado, Connecticut, Kentucky, Minnesota, Missouri, Rhode Island, Virginia, & Wyoming. They have been done with schools in a broad range of developed environments—urban, suburban, and rural.



Sleeping in Adolescence

The optimal amount of sleep for adolescents is approximately 9 ¼ hours nightly.² Surveys show that, while younger children generally get enough sleep, by early adolescence, most do not; this trend continues to worsen throughout the teenage years (See Figure 1). More than half of teens age 15-17 sleep for 7 or fewer hours per school night.

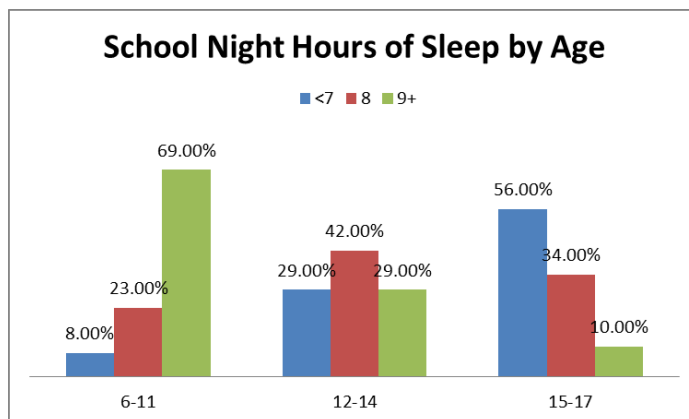


Figure 1: School Night Hours of Sleep by Age Group. While 69% of kids age 6-11 get approximately enough sleep, just 1 in 10 15-17 year olds are. Source: National Sleep Foundation, 2014..

Teens are notorious night owls – generally, they go to bed late in the evening and, when given the opportunity, wake up late in the morning. This tendency has biological and physiological roots. The sleep-wake cycle is governed by both the homeostatic drive for sleep (Process S) and the circadian rhythm (Process C).^{5,8}

- Process S builds during wakefulness and makes you feel tired. This process weakens during adolescence.^{1,3}
- Process C helps the body determine when the right time for sleep is. It naturally shifts later during adolescence. This is called Delayed Phase Preference.¹⁸

Process S and Process C heavily influence mood and learning abilities.¹⁷ While they are interconnected, fixing an issue with one does not mean that an issue with the other will be resolved. That is, simply going to bed earlier does not necessarily make someone less tired in the early morning hours.⁹

Benefits of Sleep

Scientists are still discovering new benefits of sleep. Research has suggested that sleep is vital to almost all areas of human functioning. Some benefits of sleep are listed below.^{6,7,9,16,21}

Sleep leads to increases in/benefits to:

- Memory & learning
- Attention
- Emotional regulation
- Mental health & well-being
- Weight control/Body Mass Index (BMI)

Loss of sleep leads to decreases in/problems with:

- Information retention & cognition
- Student behavior and classroom conflict
- Attendance issues
- Mood regulation

Concerns

Concerns about delayed start times have generally focused less on academic/social/cognitive outcomes and more on logistical complications. Some considerations include:⁹

- Increased cost, congestion, & delays associated with having busses on the road later in the morning
- Inability of parents to rely on older children for afternoon childcare, as the lower schools would have effectively switched schedules with the upper schools.
- Scheduling conflicts for intervarsity/interscholastic events with neighboring jurisdictions that have earlier dismissal.

These issues are surmountable, and, with adequate planning, can be minimized or completely eliminated.

Conclusion

While implementation may be complex, particularly when a change would bring a school's schedule out of sync with neighboring systems, delaying school start times so that adolescents begin their instructional day later provides numerous benefits to the students and their broader community alike.

References

1. Carskadon, M. A. (2011). Sleep in adolescents: The perfect storm. *Pediatrics Clinics of North America*, *58*, 637-647.
2. Carskadon, M. A. (2013). Optimal sleep habits in adolescents. In H. P. A. Van Dongen & G. A. Kerkhof (Eds.), *Encyclopedia of Sleep*, *190*, 86-87.
3. Carskadon, M. A., Acebo, C., & Jenni, O. G. (2004). Regulation of adolescent sleep: Implications for behavior. *Annals of the New York Academy of Sciences*, *1021*, 276-291.
4. *Center for Applied Research and Educational Improvement*. (1998). School start time study. Technical report: Vol. II. Analysis of student survey data.
5. Crowley, S. J., Acebo, C., & Carskadon, M. A. (2007). Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep Medicine*, *8*, 602-612
6. Davison, C. M., Newton, L., Brown, R. S., Freeman, J., Ufholz, L. A., & Smith, J. D. (2012). Systematic Review Protocol: Later School Start Times for Supporting the Education, Health and Well-being of High School Students. *The Campbell Collaboration*.
7. El-Sheikh, M., Bagley, E. J., Keiley, M. K., & Erath, S. A. (2014). Growth in Body Mass Index From Childhood Into Adolescence: The Role of Sleep Duration and Quality. *The Journal of Early Adolescence*.
8. Hagenauer, M. H., Perryman, J. I., Lee, T. M., & Carskadon, M. A. (2009). Adolescent changes in the homeostatic and circadian regulation of sleep. *Developmental Neuroscience*, *31*, 276-284.
9. Kirby, M., Maggi, S., & D'Angiulli, A. (2011). School start times and the sleep-wake cycle of adolescents: A review and critical evaluation of available evidence. *Educational Researcher*. *40*(2), 56-61
10. *National Sleep Foundation*. (2005a). Changing school start times: Arlington, Virginia
11. *National Sleep Foundation*. (2005b). Changing school start times: Denver, Colorado
12. *National Sleep Foundation*. (2005c). Changing school start times: Fayette County, Kentucky
13. *National Sleep Foundation*. (2005d). Changing school start times: Jessamine County, Kentucky
14. *National Sleep Foundation*. (2005e). Changing school start times: Wilton, Connecticut
15. *National Sleep Foundation*. (2014). 2014 Sleep In America® poll - Sleep in the modern family: Summary of findings.
16. Owens JA, Belon K, Moss P. (2010). Impact of delaying school start time on adolescent sleep, mood, and behavior. *Archives of Pediatrics & Adolescent Medicine*, *164*(7), 608-14
17. Schmidt, C., Collette, F., Cajochen, C., & Peigneux, P. (2007). A time to think: Circadian rhythms in human cognition. *Cognitive Neuropsychology*, *24*, 755-789.
18. Tarokh, L., & Carskadon, M. A. (2009). Sleep in adolescents. In Squire, L.R. (Ed.). *Encyclopedia of Neuroscience*, *8*, Oxford Academic Press, 1015-1022
19. Vedaa, Ø., Saxvig, I. W., & Wilhelmsen-Langeland, A. (2012). School start time, sleepiness and functioning in Norwegian adolescents. *Scandinavian Journal of Educational Research*, *56*, 55-67
20. Wahlstrom, K. (2002). Changing times: Findings from the first longitudinal study of later high school start times. *NASSP Bulletin*, *86*(633), 3-21.
21. Wahlstrom, K., Dretzke, B., Gordon, M., Peterson, K., Edwards, K., & Gdula, J. (2014). 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*.

The American Psychological Association is the largest scientific and professional organization representing psychology in the United States. APA is the world's largest association of psychologists, with nearly 130,000 researchers, educators, clinicians, consultants and students as its members.

Our mission is to advance the creation, communication and application of psychological knowledge to benefit society and improve people's lives.

Copyright © 2014, The American Psychological Association. This material may be reproduced in whole or in part without fees or permission provided that acknowledgement is given to the American Psychological Association. This material may not be reprinted, translated, or distributed electronically without prior permission in writing from the publisher. For permission contact APA, Rights and Permissions, 750 First St NE, Washington, DC 20002-4242.

APA materials synthesize current psychological knowledge in a given area. They do not constitute APA policy or commit APA to the activities that may be described therein. This particular fact sheet originated in the APA Children, Youth, & Families Office.

Later Education Start Times in Adolescence: Time for Change

By Paul Kelley and Clark Lee

School start times for adolescents in the United States are typically too early to be healthy for this age group. There is significant evidence from the research literature that early starts have serious negative impacts on students. In particular, early education start times in adolescence cause chronic sleep deprivation, which damages both adolescents' education and health. Fortunately, chronic sleep deprivation is one of the more preventable public health issues facing the nation. This briefing paper summarizes the latest research on the subject, explores policy options to address this education and public health issue, and sets forth the recommendation that education start times be adjusted appropriately for U.S. adolescents.

Research

Adolescence starts with the onset of puberty and ends in the early 20s. During this period, adolescents are driven to later wake/sleep times by their biological clock (see The Adolescent Biological Clock sidebar). Because education start times do not adjust for this change, early school start times effectively limit sleep in adolescents. Researchers have found that students lose as much as an average of 2.7 hours of sleep on school days.¹ This is why sleep loss in adolescence is greater than at any period in our lives.

Sleep loss associated with early school start times can damage adolescents' learning and health. Later starting times, by contrast, are associated with longer sleep, better learning and reduced health risks. Research from the past 20 years has consistently supported these findings.

The Adolescent Biological Clock

Our biological timing systems are determined by genes throughout the body. These timing systems are largely outside our control. A small group of cells, the suprachiasmatic nucleus (SCN), is the master clock in the human brain.

The SCN is our circadian (daily) pacemaker, controlling the timing of most 24-hour behavioral and physiological rhythms. These daily rhythms include the sleep-wake cycle, alertness and performance rhythms, hormone production, core body temperature regulation and metabolism. These natural rhythms cannot be trained to suit modern society. Despite all our technologies and timetables, our bodies continue to run on sun time, not clock time.

This biological clock changes our sleep patterns from the onset of puberty, slowly moving to later sleep/wake times until 20 or 21 years of age. During our late teens and early 20s, this biologically driven delay in our natural sleep/wake patterns reaches almost three hours. At that point, students in our schools and colleges can be losing two to three hours of sleep every night. This is why education start times requiring waking at 7 a.m. or earlier – which is like adults waking at 4 a.m. every day – cause chronic sleep loss. Losing sleep through the week on this scale leads to poorer academic achievement and increased health risks.

Research from a variety of fields on different stages of adolescence consistently shows the positive effects of later starts. Recently, economists looking at existing school data where start times were changed for administrative reasons found similar positive improvements. Research found clear test gains in middle school students (grades 6 to 8) when they had later start times, and the positive effect in 8th grade scores remained two years later in 10th grade.² Additional research examined data from the United States Air Force Academy and found that the earlier students had to start classes, the worse they did in those classes.³ Moreover, the earlier students had their first class, the lower their achievement in all classes taken on the same day. Taken together, these two studies alone involved more than 10,000 students, and findings in both studies were consistent over a number of years.

Later school times also are associated with other positive social outcomes. In the Minneapolis School District high schools study of later start times, parents were very positive about the later start time, with 92 percent liking the change. Parents also reported that their children were “easier to live with” and that families had “more conversation time.”⁴

From our personal experience, we understand that several hours of sleep deprivation over several nights would impact anyone’s alertness and performance. These perceptions are clearly supported by scientific research. Even relatively moderate sleep restriction can seriously impair learning in healthy adolescents. For example, a 2013 study found that subjects restricted to six hours or less sleep per night produced cognitive performance deficits equivalent to up to two nights of total sleep deprivation.⁵ Adequate sleep is particularly important in adolescent development. It is also important when adolescents are trying to form long-term memories because key memory processes occur during sleep. These are some of the reasons good sleep improves in-class attention, academic performance and test results in adolescents.

Sleep deprivation not only impacts learning but also increases risks of accidents and injuries and affects hormones and metabolism. Changing to later school start times has been shown to reduce car accidents involving adolescent drivers. There is also clinical evidence that sleep deprivation is a contributing factor to obesity, depressive illness and sleep disorders.

Sleep deprivation not only impacts learning but also increases risks of accidents and injuries and affects hormones and metabolism. Changing to later school start times has been shown to reduce car accidents involving adolescent drivers. There is also clinical evidence that sleep deprivation is a contributing factor to obesity, depressive illness and sleep disorders. Sleep-deprived adolescents (and adults) are more likely to resort to potentially risky behaviors to control sleep that include using sleep medications and depressants (including alcohol) at night and stimulants during the day (including coffee, high caffeine drinks and smoking).

There is clear evidence that sleep deprivation poses health risks for millions of young adults and adolescents. In a study of 1.3 million cases starting from 16 years of age, research found short sleep duration per night was significantly associated with increased health risks.⁶ The study concluded that modifications of working environments to allow sufficient sleep were highly desirable.

Given that many adolescents routinely lose more than two hours of sleep a night through early start times, it can be argued that adolescents are a particularly high-risk population for the numerous negative health outcomes associated with chronic sleep deprivation. For example, recent analysis based on July 2006 Census data estimated that more than 3 million adolescents and adults younger than 24 years of age are Delayed Sleep Phase types (as defined by the International Classification of Sleep Disorders).

There is virtually unanimous agreement in the research community that later start times in adolescent education would produce a positive change in adolescent learning, health and safety. Leading researchers in sleep medicine and sleep neuroscience have frequently called for this change in education start times to improve learning and reduce health risks. Few, if any, educational interventions are so strongly supported by research evidence from so many different disciplines and experts in the field.

Considering Options for Change

Despite the substantial body of evidence from scientific, medical and education research supporting later school starts, almost all adolescent education in the United States currently has early start times. This leaves states, school districts and other responsible bodies in the untenable position of defending a current practice that has been demonstrated to be detrimental to student learning, health and safety. It seems prudent for these parties to demonstrate a greater awareness of the issues, engage with other stakeholders and consider some of the options for reasonable and appropriate changes.

There are undoubtedly pragmatic reasons to avoid change. Changing community habits based on conventional wisdom can be difficult and needs to be handled confidently. Current early start times have determined timing of other activities (bus transportation and student athletics, for example), and organizers of these activities may resist change. Although most students (and increasingly parents) would support change, there will remain some who are opposed to it. These are not reasons, however, for stakeholders to avoid considering options for reasonable and appropriate changes to school start times.

There is a major shift in public knowledge and attitudes toward later start times. School districts are increasingly finding themselves compared to districts with later start times, and this has fuelled calls to take action in many communities.

There is a major shift in public knowledge and attitudes toward later start times. School districts are increasingly finding themselves compared to districts with later start times, and this has fuelled calls to take action in many communities. Enhancing public knowledge and securing the acknowledgement of key stakeholders on the demonstrated benefits of later school start times may be a prudent approach to keeping the issue in the forefront of the public's conscience. Normal risk management of change, including planning and implementation preparation, needs to be in place in due course.

Another possible strategy is to simply act decisively to improve public schools by moving to later starts. Altering education times can be legitimately presented as a strategy to both improve learning and reduce health risks. This message, especially the potential reduction of risk for children, can be powerful for families. Indeed, evidence of consultations with families has shown positive responses from families and students once a change to later start times is implemented.

Finally, in an increasingly accountable education environment, a powerful means to increase test scores, reduce health risk and improve faster than other states or districts must have at least some appeal.

Emerging Legal Risks⁷

There appears to be no argument for keeping early start times that is supported by scientific or medical studies, and this may make it difficult to defend current practice. The mere existence of more than 3 million adolescents and young adults younger than 24 with delayed sleep phase

disorders indicates the scale of potential problems arising from negligence suits (given that states already spend millions of dollars on settlements and judgements from injuries to students).

Education start times are the responsibility of education bodies and institutions, and thus it could be argued they have full responsibility for any foreseeable negative impact of early start times. Education bodies and institutions have an affirmative duty to provide a reasonable standard of care to their students, in part because of the compulsory nature of education. This duty of care may include warning of known risks or dangers and providing a safe environment (this may be taken to include the temporal environment). These considerations, taken as a whole, suggest that consideration of legal risks involved in keeping early start times may be advisable.

Education Policy on Starting Times

While start times are typically set at the local level, leaders can help raise awareness of the overwhelming evidence that later starts are beneficial.

State support could take the form of briefing papers such as this one, or through sharing examples of successful approaches to the management of change. There are other preliminary steps that can be taken, for example giving advice on improving the quality of sleep to students. Although biological drivers determine the extent of the shift to later wake/sleep times in adolescence, the impact on sleep can be made worse by use of screen technologies in the last hour before sleep (such as televisions, computers and phones). Sleep can be enhanced when bedroom temperatures are lower, and there are other ways to contribute to better quality sleep.

The current context is one in which there is a growing pressure to change to later start times for adolescent students (see Political and Legislative Context in sidebar). Of particular note is the House Concurrent Resolution calling for secondary schools to begin the school day no earlier than 9 a.m. Already, schools in the United Kingdom and New Zealand start at 10 a.m. or later for older adolescents, with strong positive impacts on achievement and behaviors. Many colleges already start at these times both in the United States and internationally.

The cost of implementing policies related to later start times is negligible. Later school start times can improve learning and reduce health risks. It is a change that is in the best interests of our students, families, communities and nation.

Political and Legislative Context

Public interest is growing in later school starts with organizations including the National Sleep Foundation and campaigns such as Start School Later taking a consistent line that change is necessary.

Legislative and policy proposals are increasing. Virginia and Massachusetts have considered new laws, and Maryland passed legislation related to later school start times recently. Action on a national level includes the House Concurrent Resolution 176 (2009): Expressing the sense of the Congress that secondary schools should begin the school day no earlier than 9 a.m.

The U.S. Secretary of State for Education in 2013 tweeted “let teens sleep, start school later.” He was no doubt aware the statement already had wider research and political support.

About the Authors

Paul Kelley, Ph.D., is an honorary research associate in the University of Oxford's Sleep and Circadian Neuroscience Institute and part of a team researching start times in adolescent education. Email: paul.kelley@ndcn.ox.ac.uk or mobile: Mobile: +44(0) 7590453812; Web: <http://scni.ndcn.ox.ac.uk>.

Clark J. Lee, JD, CPH, is senior law and policy analyst at the Center for Health and Homeland Security and an associate member at the Center for Health Outcomes Research at University of Maryland, Baltimore. E-mail: clee@law.umaryland.edu

Endnotes

-
- ¹ Hansen et al. 2005 <http://pediatrics.aappublications.org/content/115/6/1555.long>; Jenni et al. 2005 <http://www.journalsleep.org/Articles/281116.pdf>; Foster et al. 2013 <http://www.ncbi.nlm.nih.gov/pubmed/23899602>
- ² Edwards, F. 2012. <http://eric.ed.gov/?id=EJ989056>
- ³ Carrell et al. 2011 <http://old.econ.ucdavis.edu/faculty/scarrell/sleep.pdf>
- ⁴ Center for Applied Research and Educational Improvement (CAREI). 2002. School start time study: Final Report Summary. (University of Minnesota).
- ⁵ Möller-Levet et al., 2013 <http://www.pnas.org/content/110/12/E1132>
- ⁶ Cappuccio et al. 2010. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2864873/>.
- ⁷ None of the contents in this briefing or discussion of risk should be construed as formal legal advice to any person or organization and should be used strictly for informational purposes only. Please consult with appropriate legal counsel for formal legal advice.

Appendix C

Dear Members of the Westport Board of Education:

As health professionals working in Connecticut who are concerned about the adverse effects of chronic sleep deficits in teenagers, we strongly endorse the policy statements of the American Academy of Pediatrics (“AAP”), American Medical Association (“AMA”), and the Centers for Disease Control and Prevention (“CDC”), which provide that middle and high schools should start at 8:30 a.m. or later. These policy statements are grounded in a broad medical and scientific consensus about the importance of sleep to adolescents and the biological changes that occur to adolescent sleep cycles when children enter puberty. At this time, adolescents’ biological clocks shift later so that it is difficult to fall asleep before 11:00 p.m., even with the best sleep hygiene.

The AAP describes a school start time of no earlier than 8:30 a.m. for adolescents as “an effective countermeasure to chronic sleep loss” that “has a wide range of potential benefits to students with regard to physical and mental health, safety, and academic achievement.” Data shows that starting school at 8:30 a.m. or later leads to better academic performance, better sports performance, better mental and physical health, fewer motor vehicle accidents, and fewer sports injuries. The academy notes in an accompanying technical report a nearly threefold increase in the risk of suicide attempts among adolescents who sleep less than eight hours per night, even when controlling for confounding factors. This data underscores the potential seriousness of this issue. The policy statement concludes that “both the urgency and the magnitude of the problem of sleep loss in adolescents and the availability of an intervention that has the potential to have broad and immediate effects are highly compelling.”

We would also point out that the CDC policy statement in support of later start times explains that, “among the possible public health interventions for increasing sufficient sleep among adolescents, delaying school start times has the potential for the greatest population impact (emphasis added) by changing the environmental context for students in entire school districts.”

We agree with these conclusions and endorse the AAP, AMA, and CDC’s recommendations. We view moving secondary school start times to 8:30 a.m. or later to be a practical and necessary public health measure.

Very truly yours:

Signatures as of July 20, 2017

Robin Abramowicz, M.D., *Village Pediatrics*

Lauren Allison, M.D., F.A.A.P., *Willows Pediatrics*

Steven T. Benaderet, M.D., *Westport Family Medicine*

Peter Czuczka, M.S., F.A.A.P., *Willows Pediatrics*

Carol Nicole Gorman, M.D., *Village Pediatrics*

Jennifer Gruen, M.D., *Village Pediatrics*

Laura Marks, M.D., F.A.A.P., *Willows Pediatrics*

[Continued Next Page]

Jeffrey Owens, M.D., F.A.A.P., *Willows Pediatrics*

Fern Perlman, M.D., *Bay Street Pediatrics*

Lynelle Schneeberg, PsyD, *Director of the Behavioral Sleep Medicine Program at Connecticut Children's Sleep Center, Licensed Clinical Sleep Psychologist*

Rachel Sheiman, M.D., F.A.A.P., *Willows Pediatrics*

Sarah Siegel, M.D., *Village Pediatrics*

Lori Storch Smith, M.D., *Bay Street Pediatrics*

Jonathan Sollinger, M.D., F.A.A.P., *Willows Pediatrics*

Janet Woodward, M.D., F.A.A.P., *Willows Pediatrics*

**Medical Health Insurance
FY 18-19 Projections - As of 01/31/2019**

	<u>FY 19 Projection</u>
Cash receipts	
General Fund Budget from line 210	15,203,452
Other Fund Contributions	100,000
Employee Contributions (Active)	3,045,340
Flex Spending Accounts	-
Cobra Participants	-
Retirees - Under 65	375,000
State Teachers Retirement (TRB)	115,000
Life Insurance Premiums	25,000
Retirees Medicare Surround	598,619
Other Contributions (FMLA, Retiree Life, etc.)	64,500
Prescription Guarantee Adjustment	-
Pharmacy Rebate	-
Total cash receipts	19,526,911
Cash disbursements	
State Partnership Plan 2.0 (10 months)	13,222,576
Medical & Prescription (2 Months Self insured)	2,800,000
IBNR	1,300,000
Dental	1,147,718
Flex Spending Accounts	-
Contribution to HSA	-
Medical Administrative	66,322
Network Access Fee	25,546
Individual Stop-Loss	171,662
Dental Administrative	55,931
FSA Administrative	2,000
Consulting Fee	52,500
PCORI Fee	4,525
Retirees Medicare Surround	913,706
Total cash disbursements	19,762,486
Change in cash balance	(235,575)
Beginning cash balance	1,695,998
FY 19 Pre funded by Town	(1,500,000)
Change in Cash	(235,575)
Net Position(Deficit) end of year-projection	(39,576)

	<u>Medical/Rx (HDHP)</u>	<u>Medical/Rx (SPP)</u>	<u>IBNR</u>	<u>Dental</u>	<u>Flex/Other</u>
HDHP					
Jul 2018	\$ 1,514,635	\$ -	\$ -	\$ 99,980	\$ 775
Aug 2018	\$ 1,611,274	\$ -	\$ -	\$ 90,743	\$ 190
Sep 2018	\$ -	\$ 1,318,542	\$ 979,962	\$ 90,285	\$ 7,367
Oct 2018	\$ -	\$ 1,338,285	\$ 200,148	\$ 111,642	\$ 8,790
Nov 2018	\$ -	\$ 1,349,207	\$ 116,084	\$ 72,889	\$ 7,760
Dec 2018	\$ -	\$ 1,334,166	\$ 48,325	\$ 75,711	\$ 13,023
Jan 2019	\$ -	\$ 1,341,191	\$ 48,772	\$ 65,984	\$ 13,825
Actual	\$ 3,125,910	\$ 6,681,391	\$ 1,393,291	\$ 607,234	\$ 51,730
Budget	\$ 2,800,000	\$ 13,222,576	\$ 1,300,000	\$ 1,147,718	
Actual vs. Budget	\$ (325,910)	\$ -	\$ -	\$ -	
Actual YTD Spend Rate	111.6%	50.5%	107.2%	52.9%	
Theoretical YTD Spend Rate	100.0%	50.0%	100.0%	58.3%	
YTD variance %	11.6%	0.5%	7.2%	-5.4%	
YTD variance \$	\$ (325,910)	\$ (70,103)	\$ (93,291)	\$ 62,268	
Projected Trend full year	\$ (325,910)	\$ (140,206)		\$ 106,745	