November 17, 2014 Staples High School

WESTPORT BOARD OF EDUCATION

*AGENDA

(Agenda Subject to Modification in Accordance with Law)

PUBLIC CALL TO ORDER:
5:00 p.m., Staples High School, Room 1025C, Principal's Conference Room

ANTICIPATED EXECUTIVE SESSION: Performance Evaluation of the Board of Education and the Superintendent of Schools and School Security

RESUME PUBLIC SESSION

PLEDGE OF ALLEGIANCE: Staples High School, Cafeteria B (Room 301), 7:30 p.m.

DISCUSSION/ACTION:

Election of Officers of the Board of Education — Dr. Landon

ANNOUNCEMENTS FROM BOARD AND ADMINISTRATION

MINUTES: November 10, 2014

PUBLIC QUESTIONS/COMMENTS ON NON-AGENDA ITEMS (15 MINUTES)

REPORT:

1. Parent Education and Information for K-5 Standards-Based Progress Reports	(Encl.)	Ms. Droller
2. Collaborative Efforts with Town of Westport: July 1, 2014-October 31, 2014	(Encl.)	Mr. Longo

DISCUSSION:

1. K-12 Start Times: Analysis of Research	(Encl.)	Dr. Landon

DISCUSSION/ACTION:

1. Approval: New Course Proposals for Staples High School	(Encl.)	Mr. D'Amico
2. Approval: Health and Medical Insurance Monthly Report	(Encl.)	Mr. Longo
3. Approval: RFP for School Security Communications Systems	(Encl.)	Mr. Longo

ADJOURNMENT

*A 2/3 vote is required to go to executive session, to add a topic to the agenda of a regular meeting, or to start a new topic after 10:30 p.m.
The meeting can also be viewed on cable TV on channel 78; AT&T channel 99 and by video stream @www.westport.k12.ct.us

PUBLIC PARTICIPATION WELCOME USING THE FOLLOWING GUIDELINES:

- Comment on non-agenda topics will occur during the first 15 minutes *except* when staff or guest presentations are scheduled.
- Board will not engage in dialogue on non-agenda items.
- Public may speak as agenda topics come up for discussion or information.
- Speakers on non-agenda items are limited to 2 minutes each, except by prior arrangement with chair.
- Speakers on agenda items are limited to 3 minutes each, except by prior arrangement with chair.
- Speakers must give name and use microphone.
- Responses to questions may be deferred if answers not immediately available.
- Public comment is normally not invited for topics listed for action after having been publicly discussed at one or more meetings.

Julie Droller
Director, Elementary Education
Telephone: 203-341-1213
Email: jdroller@westport.k12.ct.us

TO: Elliott Landon
FROM: Julie Droller
SUBJECT: Report on Parent Education for K-5 Standards Based Progress Reports
DATE: November 17, 2014

The revised K-5 Progress Reports have been a major focus of the elementary teachers and administrators this fall. Training sessions, which began during the first teacher work day and continued during multiple faculty and grade level meetings, have occurred in each of the elementary schools. This time was spent productively discussing our practice and calibrating our understanding of how we share student progress in Westport.

Under the leadership of Dr. Susie Da Silva, Principal of Kings Highway Elementary School; along with Kimberly Ambrosio, Assistant Principal of Coleytown Elementary School; Rebecca Laus, K-5 Math and Literacy Resource Teacher; and Carolyn Santella, 4th grade teacher at Saugatuck Elementary School, Parent Information Sessions were held. The first of these sessions occurred on October 1st, at 10:00 am and 7:00 pm, to provide an overview of the process, philosophy, and timeline of the revisions, and to illuminate some key changes in the Progress Reports.

As a follow-up, PTA Coffees were held in each elementary school to provide more specific details, including sharing grade level Progress Reports and scoring rubrics, and reviewing the online Parent Handbook. These sessions provided an opportunity for parents to ask clarifying questions and learn how to navigate the available resources.

Teachers are currently finalizing first trimester Progress Reports, which are due to Principals tomorrow, to be reviewed prior to administration. Parents will be able to access their child's Progress Report in eSchool on Monday, December 1st, with Parent-Teacher Conferences scheduled for Wednesday, December 3rd through Friday, December 5th.

I would like to thank Dr. Da Silva, Ms. Ambrosio, Ms. Laus, Ms. Santella, the entire Progress Report Committee, elementary leadership team, department chairs, and all of the K-5 teachers, for their considerable effort in unpacking the Progress Reports and conscientiously analyzing student progress in a robust and comprehensive manner.

Dr. Da Silva will be in attendance to discuss our efforts to communicate with and inform the parent community about the K-5 Progress Reports.

INTEROFFICE MEMORANDUM

TO: Elliott Landon, Superintendent

FROM: Elio Longo, Jr.
Director of School Business Operations

SUBJECT: Collaborative Efforts with Town of Westport
July 1, 2014 – October 31, 2014

DATE: November 13, 2014

The following collaborative efforts of the Board of Education and Town of Westport were undertaken and achieved during the period of July 1 – October 31, 2014:

VoIP – Voice over Internet Protocol
Health Insurance Consultant (Lockton)
Multi-digital equipment lease
Liability/Automotive/Property Insurance
Workers Compensation claims review
Energy Performance Contracting
Electricity supplier contract
SpyGlass (phone line audit)
Internal audit of select BOE accounts

I will elaborate on the success of each effort at the November 17, 2014 Board of Education meeting.

WESTPORT PUBLIC SCHOOLS

ELLIOTT LANDON
Superintendent of Schools

110 MYRTLE AVENUE
WESTPORT, CONNECTICUT 06880
TELEPHONE: (203) 341-1010
FAX: (203) 341-1029

To: Members of the Board of Education

From: Elliott Landon

Subject: K-12 Start Times – Analysis of Research

Date: November 17, 2014

The Board of Education has included within its approved document entitled, "Westport Public School District GOALS FYE 2015," the following Performance Objective:

> **Evaluate and amend (if necessary) start times with regard to sleep research.**

In response to that request, I have reviewed past research and the most recent publications on this subject. The overall consensus is that high school students need more sleep. The other, and equally significant finding, is that there is no research that unequivocally addresses the question as to what the appropriate start time for high school students might be.

This matter was reviewed and discussed fully by the Board of Education in 2004. Participating in those discussions were teachers, parents, students, medical doctors, researchers and psychologists. At that time, the Board discussions centered upon the recommendations of the official School Start Time Committee report that was issued in March 2004. The recommendations of the Committee were as follows:

1. Staples High School should be the focus of future start time discussions. Start time decisions should not adversely impact the elementary or middle school start times.

2. There should be parity/equity regarding the start and end times for schools at each level. Elementary schools should be at the same start and end times; middle schools should be at the same start and end times.

3. As the scientific research does not point to one ideal start time for high schools, the Board of Education should make its best decision taking into account the history, culture, and dynamics of the Westport community.

4. The Board of Education should hold forums for feedback from Westport students, teachers, parents, and the general community regarding any proposed change in start times. The committee also feels the community should hear from medical doctors who have extensive knowledge in this area.

5. The Board of Education, as a committee [of the whole], should assume the role of facilitator for future discussions and final decision-making on this challenging issue.

Subsequent to the issuance of the Committee's report, the Board of Education acted as requested by the Committee and rejected any attempt to alter the start times at Staples High School.

Also within the current Board of Education's approved document entitled, "Westport Public School District GOALS FYE 2015," and aforementioned Performance Objective, is the following statement:

> **Benchmark [school start and ending times] with other schools in our DRG.**

The following information is being provided in response to that Performance Objective:

DRG A SCHOOL HOURS

DISTRICT:	SCHOOL NAME	SCHOOL DAY
DARIEN	Darien High School	7:40 - 2:20
	Middlesex Middle	7:55 - 2:22
	Hindley Elementary	8:25 - 2:55
	Royle Elementary	8:25 - 2:55
	Tokeneke Elementary	8:25 - 2:55
	Holmes Elementary	9:00 - 3:30
	Ox Ridge Elementary	9:00 - 3:30
NEW CANAAN	New Canaan High School	7:30 - 2:05
	Saxe M.S. Gr 7 & 8	7:30 - 2:05
	Gr. 5 & 6	8:20 - 2:55
	South End	8:15 - 2:45
	East & West Elem.	9:05 - 3:35

WILTON	Wilton High	8:20 - 2:50
	Middlebrook Middle	8:20 - 2:50
	Cider Mill (Gr. 3-5)	7:40 - 2:15
	Miller Driscoll (Gr k,1,2)	9:05 - 3:35
WESTON	Weston High School	7:45 - 2:30
	Weston Middle School	7:45 - 2:30
	Weston Intermediate	8:30 - 3:15
	Weston Elementary	8:30 - 3:15
RIDGEFIELD	Ridgefield High School	7:25 - 2:15
	East Ridge Middle	8:00 - 2:50
	Scotts Ridge Middle	8:00 - 2:50
	Branchville Elem.	8:35 - 3:25
	Ridgfield Elem	8:35 - 3:25
	Scotland Elem	8:35 - 3:25
	Barlow Mtn Elem	9:10 - 4:00
	Farmington Elem	9:10 - 4:00
	Veterans Park Elem	9:10 - 4:00
ER 9	Joel Barlow High School	7:30 - 2:07
	John Read Middle School	8:50 - 3:35
	Helen Keller Middle	8:10 - 2:40

	Samuel Staples Elem.	9:00 - 3:30
	Redding Elementary School	8:00 - 2:45

You will also find appended to this memorandum many materials pertinent to this matter. The first of those materials is the Final Report of the School Start Time Committee, March 2004. The second, "Literature and Evidence Review: The Effects of School Starting Times on Educational Outcomes," as prepared for the Westport Public Schools by Clive R. Belfield of Teachers College, Columbia University. The third is a press room release of the American Academy of Pediatrics dated August 25, 2014. The remaining documents relate to this subject from a variety of organizations and perspectives.

This item has been placed on the Agenda of the Board of Education meeting that is scheduled for November 17 for the purpose of "Discussion."

SCHOOL START-TIME COMMITTEE
FINAL REPORT
MARCH, 2004

Committee Co-chairs:

Dan Sullivan, Principal, Green's Farms School (GFS) and
Angela Wormser, Principal, Bedford Middle School (BMS)

Committee Members:

Bob Buckley, Principal, SES
Rita Hennessey, Library-Media, BMS
Joanne Klouda, Science Teacher, SHS
Marty Lisevick, Athletics Director, SHS
Connie Miller, PE Teacher, GFS
Karyn Morgan, PPS Coordinator, SHS
Nadine Schwab, Nursing Supervisor
Julie Warren, Science Teacher, CMS
James Welsch, Principal, CMS

Committee's Charge from the Board of Education: To examine, develop and make recommendations for school start time for all Westport Schools.

The committee is directed to be responsive to:

- **The health, safety and general well-being of students at each level- Pre-K, K - 5, 6-8, and 9 – 12.**
- **The academic achievement of students at each level.**
- **The impact upon school and student functioning at each level, including transportation and pre—and post-school activities.**
- **(Cost or cost constraints were not part of the charge to the committee.)**

Meetings: Committee has met weekly from September 30th through December 9 and on January 14, January 27, and February 23rd - a total of thirteen meetings. All of these were open to the public and, generally, there were approximately 5 to 30 members of the public attending. Members of the press attended every meeting.

REPORT FRAMEWORK:

I. Overview

II. Conclusions

III. Recommendations

IV. Start-Time Recommendations

V. Committee Activities/Research Strands

I. Overview

This document represents the final report of the School Start Time Committee, as requested by the Board of Education at its February 23, 2004, meeting. It is the hope of this committee that the reflections, conclusions, and recommendations contained within this report will serve as a framework for the Board of Education's continuing deliberations on this challenging issue.

At the committee's most recent meeting (Tuesday, February 24, 2004), the School Start Time Committee members engaged in discussions regarding their reflections on the research we had read and discussed and the views shared by invited guests or consultants at various points in the committee's history. Out of these February 23rd discussions, we have provided the Board of Education with a list of shared conclusions, recommendations, and suggested school start-times to consider in order to assist the Board of Education in focusing its discussions as it moves forward.

Clearly, in all of our discussions (including our most recent), the School Start Time Committee has been consistently brought back to the complexities presented by this issue, particularly as we looked at determining optimum start (and ending) times, which realistically correspond to the somewhat divergent needs of elementary, middle, and high school students and staff. The times we have suggested the Board of Education examine more closely are indicative of this dilemma. Each has its benefits to one or, perhaps, two levels of the school system; none clearly satisfies the needs of all three levels. We offer these times for your consideration as they appear to us to offer the best foundations upon which to craft a realistic change in school start times.

In addition to the information contained in this brief report, the School Start Time Committee has asked Dr. Landon to create for each member of the Board of Education a companion packet of materials containing meeting minutes and research articles we reviewed.

II. Conclusions

As noted, based on our deliberations, the School Start Time Committee has come to the following points of consensus regarding the issues related to our charge. (These are presented in no hierarchical order):

- High school adolescents could benefit from more sleep. This is supported by much of the research we have read.

- The greater school community needs to be involved in this discussion. For example, if the Board of Education moves the high school to a later start time, the

full community needs to understand the implications to the start (and ending) times for the elementary and middle schools, if their times are altered.

- Research does not support one best school start time for any level.

- The research does not define how to get more sleep for adolescents. There are many factors which play into this, including family dynamics, extra-curricular obligations, homework loads, social expectations, work schedules, etc.

- There appears to be no research dealing with the issue of elementary school start times. The committee was unable to find any such research.

- Similarly, there is little research which focuses on the particular needs of middle school adolescents and start-times.

- Since the research focuses on the needs of high school adolescents, any start-time decisions should not adversely impact on the elementary or middle schools.

- While not a key factor of our discussions, increased transportation costs will likely have an impact on the overall budget. Again, we were asked to determine the best solution(s) and not worry about cost.

- There is no clear research which indicates that a change in high school start-times will necessarily impact or improve student academic achievement.

- The research on sleep is generally not school-based; rather, it stems from clinical studies on sleep, and, by extension, is then tied to high school adolescents' school experiences.

- On the CES and CMS surveys dealing with their 2003 – 2004 shift in school start times, parents and teachers had divergent views on the impact of the shift. Generally, parents (CES, 54%; CMS, 52%), preferred to return to their original start times; teachers felt the 2003 – 2004 start times should remain.

- No elementary school should start before 8:00 A.M. or end after 3:15.

III. Recommendations

Flowing out of the discussion points noted in the prior section, the School Start Time Committee developed the following core recommendations for the Board of Education. Again, we hope that these will help to ground and guide the Board's further discussions. (These, too, are in no hierarchical order):

- The high school should be the focus of future start-time discussions. Start-time decisions should not adversely impact the elementary or middle school start-times.

- There should be parity/equity regarding the start and end times for schools at each level. Elementary Schools should be at the same start and end times; middle schools should be at the same start and end times.

- As the scientific research does not point to one ideal start-time for high schools, the Board of Education should make its best decision, taking into account the history, culture, and dynamics of the Westport community.

- The Board of Education should hold forums for feedback from Westport students, teachers, parents, and the general community regarding any proposed change in start-times. The committee also feels the community should hear from medical doctors who have extensive knowledge in this area.

- The School Start Time Committee's work is now ended, and the committee should cease to exist. We feel the Board of Education, as a committee, should assume the role of facilitator for future discussions and final decision-making on this challenging issue (as noted above).

IV. Start-Time Recommendations

As noted in the Overview, none of the start (and ending) times listed below offer – in the view of the School Start Time Committee – a clear solution to the dilemma posed by our conclusions and the recommendations noted in the prior section. Most offer, however, - in our view – the best possibilities for crafting a solution.

In presenting these to the Board, we have deliberately not annotated them with their plusses and minuses. At our February 23rd meeting, we had considerable discussion about each but did not feel that we had the time for an in-depth assessment of each; we feel that discussion is best left to the Board. We do feel that four of these (#'s 2 – 5) do adhere to many of the conclusions and recommendations we have presented in this report to the Board.

We have listed five possible scenarios for recreating school start times. Of these, the first is a simple variation on our anticipated school start times in the 2004 – 2005 school year. It is presented here solely as a solution to the issue of parity; that is, enabling all schools at a level (elementary and middle) to be on the same start and ending times, an issue which was important to many members of our committee.

Of the remaining four times, numbers two and three are variations of one another, as are numbers three and four.

Briefly . . .

- Numbers two and three are responsive to the issues of having later school start times for high school adolescents, maintaining parity of start times for the elementary and middle school levels, and not significantly impacting the elementary and middle school start and ending times.

- Numbers four and five are similarly responsive to the issues of having later school start times for high school adolescents and maintaining parity of start times for the elementary and middle school levels. It does alter the start and end times for elementary schools by pushing their days from the current 8:30 – 3:15 norm, as experienced at King's Highway, Greens' Farms School, and Long Lots. This two-tiered approach contains an increase in the current time (30 minutes) between tiers to 45 minutes and is in keeping with a recommendation of the August, 2003 *Review of Transportation Structure.*

These scenarios do not factor in transportation costs. While our discussions often did touch upon issues related to transportation costs, this was not part of our charge, and, thus, was not a primary factor in looking at these suggested times.

The Start and Ending Times we suggest the Board study more carefully are the following:

1.	7:30 – 2:15	Staples High School
	8:00 – 2:45	Bedford Middle School Coleytown Middle School
	8:30 – 3:15	All Elementary Schools
2.	8:00 – 2:45	Bedford Middle School Coleytown Middle School
	8:30 – 3:15	All Elementary Schools
	9:00 – 3:45	Staples High School

3.	8:00 – 2:45	All Elementary Schools
	8:30 – 3:15	Bedford Middle School Coleytown Middle School
	9:00 – 3:45	Staples High School
4.	8:00 – 2:45	All Elementary Schools
	8:45 – 3:30	Bedford Middle School Coleytown Middle School Staples High School
5.	8:00 – 2:45	Bedford Middle School Coleytown Middle School Staples High School
	8:45 – 3:30	All Elementary Schools

V. Committee Activities/Research Strands

The following is a partial listing of articles and research discussed as well as guests and consultants with whom the School Start Time Committee met during its fall and winter meetings. (This information is identical to the information presented in the School Start Time Committee's December interim report to the Board of Education.)

- Read, studied and discussed articles and research dealing with adolescent sleep time as well as high school start times. In total, the committee viewed more than 60 different pieces of literature. Each committee member read and shared a selected number of articles with the remaining members of the committee. The committee read a variety of articles; many were provided by community members as well as by committee members and others, including the Superintendent of Schools.

- Reviewed start times of all schools, at all levels, within Westport's Educational Reference Group.

- Met with Dr. Clive Belfield who shared with the committee his review of all existing research related to adolescent sleep as well as sleep deprivation related to this age group. Dr. Belfield is a member of the teaching staff at Columbia University and his area

of expertise is research *methodology* regardless of content. Therefore, although he has no specific expertise with sleep disorder, he is well qualified to perform the *analysis* of research. He reported that one clear conclusion from the research was that adolescents are not getting enough sleep. However, Dr. Belfield stated strongly that the literature showed no causal relationship between school start time and student success in school or between school start time and the amount of sleep students get.

- The University of Minnesota School Start Time Study was carefully reviewed because of its overall scope. Seventeen school districts in the Minneapolis/St. Paul area moved the starting time for their high schools later in the day by more than one hour. Elementary and middle school times were also adjusted. In some cases, they were made earlier and in other communities they were made later. Reports of the initial results from the high schools appear positive. The study reports that tardiness is down, as are school dropouts. Additionally, there appears to be a slight, not statistically relevant, improvement in student grades. This report occurred after only the first year that the time changes were implemented and a further look at the more long-range results needs to occur. We believe further examination is necessary, particularly in the light of the opinion of Dr. Belfield and Dr. Schonfeld (see below) that there are major flaws in the validity of this study. Additionally, the extra curricular situation was eased because the districts all competed against each other so that the later school starting times were felt equally by all the communities.

- Met with the principal of Wilton High School, Ms. Debbie Lowe. She described Wilton's two-year process to examine school start-time. The Wilton League of Women Voters had conducted an initial study in the first year and the school district participated during the second year. During this time, Wilton conducted community forums to educate parents. Parents were then asked to vote for a particular start-time plan. The community endorsed the revised school start time plan for all of Wilton schools. Middle and high school students ride on the same buses in Wilton and their start time was pushed back 40 minutes to 8:20 A. M. The grade 3-5 school now starts at 7:40 A. M. and the K – 2 school starts at 9 AM. The district had initially operated on the premise that transportation costs would not increase, but the district did add an additional bus, at an additional cost, after school started this year. Mrs. Lowe indicated that it was early in the process and that more time was needed to assess its outcome. She did feel the high school was doing very well and that students, parents and staff were positive about the change. She said, however that tardiness was

still a problem at the high school. Mrs. Lowe also stated that there were concerns about the starting time of the grade 3-5 school, with students required to be at their bus stops as early as 6:50 A. M.

- The committee listened to three doctors: Dr. Edward O'Malley and Dr. Jonathan Fine are affiliated with the Sleep Disorder Clinic at Norwalk Hospital; Dr. David Schonfeld, an expert in developmental-behavioral pediatrics, is an associate professor of pediatrics at Yale University School of Medicine who has a strong research background on issues related to school health. Through Dr. Schonfeld, the committee also received information from Dr. Kim Freudigan, a developmental psychologist with a strong background in sleep research, who is an associate research scientist at Yale University. (Dr. Freudigan was unable to address the committee in person, as scheduled, because of a personal emergency.)

  Drs. O' Malley and Fine, who addressed the committee in November, had played an active role in the Wilton process and concurred with Dr. Belfield's opinion that adolescents, especially high school students, were not getting enough sleep. Dr. O'Malley and Dr. Fine believe this was a result of adolescents' "biological rhythms," i.e., that they are unable to fall asleep until after 10 pm, 11pm or even midnight. These speakers supported a later start time for high school students. They based this recommendation not on school performance but on other factors such as safety, most importantly- late night/early morning driving. They agreed that there was *not* an academic link with sleep but they felt in time that such a link might be demonstrated. They felt that different communities should develop their own school start times. When pressed for a specific recommendation, they supported an 8 AM start time for elementary schools, 8:30 AM start time for middle schools and 9 AM start time for the high school.

- Dr. Schonfeld met with the committee in early December. While he agreed that adolescents are not getting enough sleep, he described the problem as very complicated and not amenable to a simplistic, one-dimensional solution such as simply changing the school start time. He stated that the scientific literature does not provide evidence to support altering school start time for high school students at the present time. He shared with the committee some of Dr. Freudigman's conclusions. She reported that the problems with current sleep research include small sample sizes, biased or self-selected samples, limited ways of collecting valid sleep data and poor or weak research designs, (i.e., no randomized controls.) Dr. Freudigman's points included the fact that while adolescents go to bed later than younger children, there is no conclusive evidence that this is a *biological* phenomenon. This of

course is in direct contradiction to the opinions of Drs. Fine and O'Malley.

Dr. Schonfeld also stated that sleep schedules *can* be changed, which also differs from the opinions of Drs. Fine & O'Malley. As evidence, Dr. Schonfeld cited the hour change to and from daylight savings time that occurs twice each year, noting that everyone makes this transition within a day or two with no noticeable problems. He stated that starting the school day later, by itself, won't solve the problem. He attributed the phenomenon of adolescent sleep loss to other more overriding factors which include social, athletic and extracurricular activities as well as a heavy school work load. He believes that the number of activities that high school children are involved with needs to be examined and reduced. He even discussed reducing homework or spreading it into weekends and considering shortening school hours but increasing the length of the school year. His goal was to reduce demands on high school students and therefore minimize the stress and anxiety that they currently face.

- The committee met with Nancy Harris, Westport assistant superintendent for business, and Peter Isabelle, Westport director of transportation, and reviewed the transportation plan for the district and the costs associated with buses. The committee had developed 12 possible options for school start times in Westport and Ms. Harris and Mr. Isabelle developed and reviewed the costs associated with each of these options.

- The committee worked with James Welsch, principal of Coleytown Middle School, and Kaye May, principal of Coleytown Elementary School, to develop parent surveys to review the present start time at each of these two schools. These surveys were implemented in January, 2004.

- The committee, working at the request of the Board of Education conducted a system-wide survey of parents and faculty on the single issue of shifting all school start times by fifteen minutes. This survey was implemented in January, 2004; results were reported back to the Board of Education in February, 2004.

Literature and Evidence Review:

The Effects of School Starting Times on Educational Outcomes

Clive R. Belfield
Teachers College
Columbia University

CONTENTS

Literature and Evidence Review:
The Effects of School Starting Times on Educational Outcomes

Report prepared for:

Dr. Elliot Landon
Superintendent of Schools
Westport Public Schools
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Report prepared by:

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August 2003

SUMMARY

This investigation reviews and evaluates research on the effects of earlier or later school starting times on students' education (see Chapter 1).

The literature search yielded relevant research which includes direct empirical tests and discussions as to possible relationships between school starting times, sleep, and educational outcomes (see Chapter 2).

Key findings from the research evidence are:

- Adolescents do not get sufficient sleep, a conclusion which is robust and reliable. Evidence on sleep deficiency for younger school-aged children is limited and less conclusive.
- The link between a lack of sleep and impaired general cognitive capacities is strong and compelling.
- More sleep is associated with higher educational performance, but the evidence is correlational and inferential; a causal link has not been established.
- Information on the link between school starting times, sleep, and educational performance is modest. Based on the few studies available, earlier school starting times are likely to be associated with less sleep and less sleep may be correlated with lower educational performance.

Case study evidence is available on changes in school starting times in Minnesota during the 1990s (see Chapter 3). Evaluation of this evidence indicates that the methods used may introduce some positive bias.

Key findings on the impact of a later school starting time were:

- Positive reactions from students and parents
- More sleep time for students and less 'struggling to stay awake while studying'; and more alert students, according to teachers' perceptions
- Weakly positive effects on educational performance as measured by letter grades and enrollment trends
- Mixed responses – both positive and negative – reported from teachers
- Issues of implementation were important: education staff, students, and parents all had to adjust to the new school schedule

STATEMENT OF AIMS

The aims of this investigation are to review and evaluate evidence and research literature on the following two questions:

1. Is there valid and reliable research that concludes that earlier or later school starting times between the hours of 7am and 9am have an effect, either positive or negative, upon the health, safety, and general well-being of students enrolled at each of the levels Pre-K, K-5, 6-8, and 9-12?
2. Is there valid and reliable research that concludes that earlier or later school starting times between the hours of 7am and 9am have an effect, either positive or negative, upon the academic achievement of students enrolled at each of the levels K-5, 6-8, and 9-12?

The review draws on published academic literature as primary evidence. This literature has been collected from bibliographic searches of journals and databases in Education and the Health Sciences and from internet searches. Relevant secondary literature is also included in the review. A full statement of the literature search protocol is given in Appendix 1.

The evaluation protocol is based on the approach set out in Clarke and Oxman (2003) and Shadish et al. (2002) to take account of the method used in each piece of research. The evaluation protocol assumes that research findings will be most reliable where: experimental methods are applied under laboratory conditions with a treatment and control group; and repeated testing yields consistent conclusions (Mosteller and Boruch, 2001). For survey evidence, the research evidence is persuasive where: an appropriate sampling frame is used; account is taken for confounding effects from other factors; and issues of bias are directly addressed (see McEwan and McEwan, 2003).

RESEARCH EVIDENCE

The literature search yielded research with direct empirical tests on school starting times, sleep, and educational performance. This research evidence – mainly from publications in the Health Sciences – is summarized and evaluated in this Chapter. There is also case study fieldwork research, based on reforms in Minnesota in the 1990s. This case study is the primary source for many of the general reports as to the relationship between school starting times and students' well-being. This evidence is discussed in detail in Chapter 3. (The total yield of 49 citations is catalogued in Appendix 3).

The argument for delaying the starting time for school is simple. As children develop into adolescence, their sleep needs change toward later bed times and later waking times. Because sufficient sleep is important for students' development, the starting time for school should accommodate this change in sleep needs, and for many schools this would make it necessary to delay the start of school.

A thorough evaluation of the literature allows for each component of this argument to be tested. In this Chapter, empirical research evidence is discussed on:

- Sleep needs in adolescence and childhood
- The effects of sleep deficiency on cognitive capacities
- The effects of sleep amounts on educational performance
- School starting times, sleep, and educational performance

1. The research evidence from the Health Sciences shows that adolescents do not get sufficient sleep; this conclusion is robust and reliable. The evidence on sleep deficiency for younger school-aged children is limited and less conclusive.

Research on the sleep needs of adolescents applies laboratory tests, activity monitors, and longitudinal and cross-sectional surveys; it also uses inferential evidence on the behaviors of adolescents. The international evidence has also been reviewed, to establish a consensus.[14,30,47]

Adolescents appear to need more sleep than prepubertal youth, and certainly need no less sleep.[5,9,29] High school students aged 14-18 sleep a median of 7.5 hours, well below the duration typically thought to be sufficient:[6,8]

- In a survey of 449 Dutch school children aged 9-14, 43% of children had difficulty getting up in the morning, 15% reported sleep problems, and 25% did not feel rested.[31] Other survey evidence indicates that around 15% of 10-14 year olds claim they need more sleep.[41]

Adolescents' sleep less because they go to bed at a later time, yet they do not rise correspondingly as late.[43] Sleep duration – particularly on school days – falls by approximately one hour as children become teenagers:

- In a longitudinal survey of 1,146 Canadian school children the average time in bed on a school day at age 10 is 630 minutes; by age 13, it falls to 567 minutes.[29] Data from 140 activity monitors shows that children aged 11-13 had delayed sleep onset times, shorter sleep periods, shorter true sleep periods, and more drowsiness than those aged 7-11; sleep onset time is delayed by approximately one hour between the ages 7 to 13.[40] Very similar conclusions are reached when evidence from sleep logs and surveys is used.[10,41,48]

The difference between weekend and weekday sleep times also increases during adolescence:

- Based on surveys and time logs, adolescents spend considerably longer time in bed at the weekends and during vacation periods.[41,42]

There is much less evidence on sleep patterns for younger children.[2,22] As changes in sleep patterns during adolescence derive from biological changes, and they serve primarily to delay the onset of sleep, it may be inferred that the sleep durations and sleep quality of younger children are adequate.[5] But, the evidence on these relationships is sparse.

2. The research evidence from Health Sciences on the link between a lack of sleep and impaired general cognitive capacities is strong and compelling.

This research evidence uses a range of methods, tests, and datasets; it also measures the effects of sleep across many different domains of cognition:

- From computer-aided and self-administered questionnaires to 3,136 U.S. students aged 11-17 there is evidence that insomnia impacts adversely on perceived health, limitations due to health problems, impact of illness on family activities, social support, relations with parents, relations with peers and relations at school, self-esteem, perceived mental health, life satisfaction, and depression.[34,39]
- In laboratory test of 82 adolescents, those who obtained one night of 4 hours sleep showed significantly less attentiveness than those who obtained 10 hours.[21]
- In applying a questionnaire to 448 Dutch school children aged 9-13, a clear association is found between mental health and restorative sleep.[32] Similar effects are found for a survey of 3,120 U.S. high school students aged 13-19.[48]
- In an experiment on 16 children aged 10-14, those who received a single night of 5 hours of sleep reported less verbal creativity and lower ability to learn new abstract concepts compared to those students who obtained optimal sleep of 11 hours. Tests identified no differences in rote activities and simple cognitive functions, however.[38]
- The results of sleep deprivation may be severe. A meta-analysis of 19 studies of adults concluded that sleep deprivation is very deleterious: the effect size deterioration in motor skills was 0.87, in cognitive performance was 1.55, and in mood was 3.16.[37] Also, the effects of sleep deprivation appear especially strong when creative or flexible thinking is needed.[26]

3. Research on sleep and educational performance shows that more sleep is associated with higher performance, but the evidence is correlational and inferential; a causal link has not been established.

Given the clinical evidence on the cognitive consequences of sleep deprivation, it is possible to infer that educational performance would be impaired. But, causation has not been established.[34]

The link between sleep and educational performance is primarily based on correlational analysis from surveys. In some cases, these instruments may have weak validity. Response biases are possible and important. Causal relationships cannot be identified (students may sleep less because they are not doing well in school, for example). Confounding factors may explain any observed correlation: parental behaviors may influence sleep and educational performance, for example. (These are particularly important when, as in much of the research surveyed here, simple two-way correlations are presented). Finally, using self-reported data both on sleep and on educational performance may introduce high measurement error.

The correlational analysis does indicate that lack of sleep is associated with lower educational performance:

- From a hierarchical linear model on data from 448 Dutch school children aged 9-13, no relationship is evident between time in bed and levels of concentration, getting bored at school, self-image as a pupil, achievement motivation, and control of aggression. However, when quality of sleep is considered, statistically significant and substantively significant effects on these outcomes are found.[31]
- Cross-sectional survey of 1,747 Italian adolescents aged 14-18 finds that students who reported less sleep were more more likely to report: poor school performance; attention problems in school, and a tendency to fall asleep in school. Sleep-deprived students also reported more emotional problems, but equivalent levels of substance abuse.[25]
- From a cross-sectional self-report survey of 3,120 high school students, there is evidence that, as sleep duration falls by 50 minutes between the ages of 13 and 19, lower grades are correlated with less sleep.[48] However, the correlations indicate that only the lowest performing students with D-F grades report less sleep; students with A-B grades report equivalent levels of sleep.
- From a cross-sectional survey of 450 US students aged 11-15, those who self-report less daytime sleepiness also report higher grades (but no

difference in extracurricular activity). But, these correlations do not adjust for covariates that may influence both sleepiness and grades.[18]

- Cross-sectional survey of 855 middle school students in Taiwan identifies a correlation between less sleep time and academic pressures, as reported by the student.[23]
- A small-scale survey reports on a 'School Sleep Habits Survey' given to 247 students in Fairfield County, Connecticut. Lower grades and less sleep time appear correlated. The correlations are unadjusted for other covariates and the sample was small and purposive (i.e., not selected from a well-defined population).[13]

4. Survey evidence on the link between school starting times, sleep, and educational performance is modest. Available studies suggest that earlier school starting times are likely to be associated with less sleep and that less sleep may be correlated with lower educational performance.

The survey evidence on the three-way relationship between school starting times, sleep, and educational performance is limited to two studies. (Other research indicates that academic performance varies with the time of day, and that academic performance is higher during the afternoon;[9] but this research is limited and inconclusive).[17]

There are many social determinants of children's sleep and sleepiness (as well as physical problems and sleep disorders[4]). These include: absence of parental controls on sleep times; peer pressure to stay up late; and household circumstances, such as sharing a bedroom. (The evidence on these is largely anecdotal or inferential). Other factors include students' academic workload and employment opportunities, as well as their lifestyle choices to stay up late.[16,24,33]

One factor determining waking times is the start of the school day. There is some evidence that students would obtain extra sleep during the school week if school starting times were delayed:[1,7]

- Based on a survey to 119 12th grade students who start school at 9:30am and 97 11-12th grade students who start school at 7:20am, the earlier group obtained less sleep. The school starting time was later by 130 minutes, and the later group obtained 30 minutes more sleep.[27] No difference in sleep behavior during the weekends was observed, however.[20]

- Based on telephone interviews, 1,125 adolescents aged 15-18 reported waking later and sleeping longer than young adults aged 19-24 when it was possible to choose their hours of sleep.[36]

Students do sleep longer when school starting times are later, but this additional sleep needs to be sufficient duration to translate into noticeably higher educational performance. The direct evidence that links starting times, sleep, and educational outcomes is suggestive, rather than conclusive, and shows mixed results. Again, this evidence is only relevant to students in the higher grades:

- From a cross-sectional survey comparison of 811 students aged 10-12, those students whose school starts at 7:10am reported 8.7 hours of sleep, compared to 9.1 hours for those students whose school starts at 8:00am (a statistically significant difference). Whereas 58% of the earlier group complained that it was hard to concentrate, 42% of the later group did so. Also, 20% of the earlier group complained of sleepiness, compared to 11% of the later group.[19]
- Evidence is also available from activity monitors, sleep diaries, and laboratory evaluations of 26 volunteer students aged 14-16 in comparisons of their sleep patterns when moving from a 9th grade school starting time of 8:25 to a 10th grade school starting time of 7:20. The findings indicate that students woke earlier for 10th grade, but did not go to sleep earlier, resulting in less sleep time and worse sleep quality. No effect on academic outcomes was evident in this study, however.[7,19]

CASE STUDY EVIDENCE

Case study evidence on school starting times, sleep patterns, and educational outcomes is based on evaluation of policy changes implemented in Minnesota in the 1990s.

In 1996, Edina Public Schools, Minnesota, changed the starting (finishing) time of its senior high school from 7:25am (2:05pm) to 8:30am (3:10pm). For the school year 1997-98, the Minneapolis Public Schools district changed the starting times for seven comprehensive schools from 7:15am (finish at 1:45pm) to 8:40am (finish at 3:20pm); it switched starting times at middle schools from 7:40am to 9:40 am; and it staggered starting times at elementary schools to begin between 7:40am and 9:40am.

Several research studies – undertaken by the Center for Applied Research and Educational Improvement at the University of Minnesota – have evaluated the impact of both of these changes. Components of these evaluations have been published in journals; and other findings are available from reports published on the internet.[10-12,28,44-46]

Other school districts have debated changing the school starting time. In these cases, satisfaction surveys and focus groups were typically used to gauge the overall impact. A survey of 91 staff at two schools in Connecticut found two-thirds were in favor of a later starting time.[13] In focus groups of teachers, local administrators, and state officials in North Carolina, both positive and negative impacts of delaying the school starting time were noted; no clear preference for delaying the school starting time emerged.[35]

However, evidence such as small-scale surveys without an adequate sampling frame may have low validity and significant response bias, whereby those in favor of change are more likely to respond to the survey or participate in discussions.

The focus of this Chapter is therefore on the evaluations of the changes in Edina School District in 1996 and Minneapolis Public Schools in 1997.

Edina Public Schools: Retrospective Evaluation

In 1997, an evaluation of the starting time changes applied in Edina Public Schools was conducted using focus groups and a satisfaction survey. The focus groups were composed of teachers, students, counsellors and administrators. The survey was administered to parents in the affected high school.

The reports from the focus groups were consistently positive about the delay in the school starting time:

- From the teacher focus groups, the main reasons cited were that it gave teachers more time to work in the morning and that students' attention levels seem to have improved. Teachers also believed that parents preferred the later starting time.
- The students in the focus groups declared the main benefit of the later starting time was the extra time for sleep.
- The focus groups of counsellors and administrators also reported that students appeared more attentive.

Survey responses were available for 245 parents of students at the high school:

- By a large majority, the parents reported being 'pleased with the later starting time for high school students'. (No information is available on the sampling frame or response rate for this survey, however).

Overall, the change in the starting time for the high school in Edina was well-received, although it is difficult to assess the response bias or selection bias within the focus groups as well as the accuracy of perceptions.

Minneapolis Public Schools: Initial Evaluation

The initial evaluation of the change in school starting times in Minnesota Public Schools was conducted in 1998.[10,11] The evaluation involved a range of data instruments, applied to multiple stakeholders. The conclusions from this evaluaton are summarized below, along with a methodological assessment.

Students' Sleep Patterns

The evidence on sleep patterns is based on a School Sleep Habits Survey administered to a sample of approximately 400 high school and middle school students in grades 9-12. The survey was conducted in December 1997, by which time all these students were attending a school which (newly) started at 8:40am. The survey was also given to a sample of students in two similar urban high schools which started at 7:30am and 7:15am. (The sampling frames and sample sizes for these surveys are not declared).

Student sleep patterns differed across the schools. Students who attended the 8:30am-start school reported one hour more of sleep per school night. They also reported lower frequencies of 'struggling to stay awake while studying' and 'falling asleep in class'.

Students' Educational Achievement

The evidence on educational achievement is based on two datasets: one is the same sample of 400 students who took the School Sleep Habits Survey; the second is a sample of 7,168 students across 17 school districts in Minnesota.

Using self-reported data in the smaller sample, the students in the 8:30am-start school declared higher grades than students in the other (later-starting districts). They also reported more hours of homework, both during the week and at the weekend. Evidence from the larger sample is reported to find a correlation between academic grades and later starting times (but no tabulations of this correlation are available).[10] This evidence is suggestive of improved educational achievement; but, given the many factors that determine school grades, the low variability of letter grades (A and B grades are the majority of all grades), and measurement error in using grades, it should not be considered as compelling.

Teachers' Opinions of Educational Impacts

Teachers' opinions were assessed using a survey to 335 Minneapolis high school teachers, with a response rate of 67%.

In the survey, teachers were asked about the impacts on their students. A majority of teachers reported that 'students were more alert during the first two periods of the day' and that 'students were less likely to be asleep at their desks. The teachers also reported mixed views as to whether student behavior had improved in general.

From the survey and focus groups, teachers reported that the change in starting time allowed them more time for team planning within the school. There is also some anecdotal evidence that other education professionals (principals, school counsellors, and nurses) appreciated the change in school starting time. However, it is difficult to assess if these findings are a result of response bias in giving 'plausible' answers to questions about whether later starting times improve educational impacts.

Teacher Satisfaction

The survey evidence also showed that teachers' satisfaction varied according to location. Teachers in suburban areas generally appreciated the new starting time, because of the impact on the students and the extra time in the morning. In contrast, teachers in the urban areas reported very mixed views about the later starting time: as many teachers disliked the change as liked it. The main disadvantage was that the school day ended later, affecting other work and family commitments.

Implementation Issues

The field research also identified challenges to the implementation of delayed school starting times. These included: additional transportation costs; conflicts in the daily schedules for athletics and other extracurricular activities; and use of school facilities for alternative community activities.[46] These challenges were noted both by students and teachers.

Students and their families also had to make adjustments to a new school schedule.[49] If school dismissal is later, students may be unable to work in the evenings or make personal appointments. After-school safety must also be considered, if the school day finishes after dark. Family schedules may also be affected by changes to the timing of the school day, perhaps with unintended consequences for the children such as more television-watching or less supervised care in the mornings.

Minneapolis Public Schools: Three-Year Follow-up Evaluation

A follow-up evaluation of the change in starting times was undertaken in 2001, to identify the long run impacts for the high school students.[44] Using a range of data sources and research methods, this impact study considered several key outcomes.

Sleep Patterns

The evidence on sleep patterns is based on a School Sleep Habits Survey administered to a sample of 467 students in grades 9-12 in 2001 (as a follow-up to a survey in 1997). All students were attending a school which started at 8:40am. The survey was also given to a sample of 169 students in a similar urban high school which started at 7:30am. (The sampling frames for these surveys are not declared).

Students in the earlier starting schools reported 46-58 minutes less sleep than students in the later starting schools. They also reported higher frequencies of: daytime sleepiness; struggling to stay awake in schools; arriving late to class; and sleepiness in class.

Student Preferences

Focus groups were run in 2001 for students in 9-12th grades in the Minneapolis schools which began at 8:40am. It is difficult both to summarize the reports from the focus groups and to assess their validity for other student populations.

Broadly, the students appreciated the additional time in the morning before the start of school, but recognized that this constrained their schedules later in the day (e.g. for athletics or work).

Student Achievement

Student achievement was measured using examination letter grades for 50,962 9-12th grade students across the period 1995 to 2000, i.e. three years prior to and three years after the change.

The analysis found no statistically significant difference in grades in the years before and after the change in school starting time. The researchers attribute this lack of evidence to: difficulties in generating clean data for analysis; students not taking a full load of classes in 12th grade; and to the fact that lower-achieving students are no longer in school by 12th grade.

Student Attendance and Enrollment Rates

Student attendance and continuous enrollment rates were measured for the district high school students over the period 1995 to 2000.

The trend data indicate that attendance rates rose over the period. In 9th grade, the average attendance rate rose from 83% to 87%. Also, the rate of continuous enrollment (in the same district or school) rose from 55% to 67%. But, these trends need to be compared to respective trends at other schools, particularly as outcomes such as school attendance rates will be strongly influenced by many other contemporaneous factors (such as the buoyancy of the youth labor market, demographic changes, or expenditures on education by the state). Without a counterfactual, it is difficult to assess whether these educational impacts are caused by the change in school starting times or whether they correspond to a general educational trend.

Finally, it should be noted that there is no evidence on the relationship between school starting times and outcomes such as juvenile crime or antisocial behaviors.

Chapter 4

CONCLUSIONS

The above evidence establishes that adequate sleep is important to students' general educational and cognitive development and that many students – as they become adolescents – do not obtain sufficient sleep.

Based on this evidence, policy documents identify numerous possible recommendations for schools and districts, including:[3,13]

- School staff should be made aware of sleep deficiency amongst students, both its symptoms and effects[15]
- Students should be made aware of the adverse consequences from insufficient sleep[28]
- Districts should base their scheduling plans on sound research on adolescent sleep and adolescent behaviors
- The school day should not begin 'too early' and serious consideration should be given to delaying the starting time for school

Given the pertinent evidence, for adolescents this last suggestion is plausible – students' development, education, and general well-being is likely to improve – but the evidence is neither compelling nor comprehensively resolved. As well, the evidence is absent on the sleep needs – and starting times – that are most beneficial for students in the lower grades. Ultimately, for students at all grades the efficacy of a change to the school starting time will depend on whether the earlier time is now used more effectively (e.g., in sleep), without significant disruption to afternoon activities.

This raises two issues:

- What is the optimal school starting time?
- And what length of delay to the school starting time is worth making, given the costs of reorganization?

The scholarly research does not give specific answers to these questions. (In a survey for the implementation of the changes in Minnesota, 578 high school teachers were asked to identify the optimal school starting time: 60% voted for a starting time between 8:00am and 8:30am). Instead, the policy conclusions indicate the effectiveness of changing the school starting time will vary from district to district. Local circumstances will play an important role in determining the optimal school starting time: the educational benefits of changing the school day will vary across districts, taking account of the numbers of students involved, the length of the time change, and the extent of re-organization required.

Appendix 1

SEARCH PROTOCOL

The search protocol follows the approach set out in Hart (1998) and White (1994). The initial search strategy involved consultation, using documents remitted by Westport Public Schools.

A systematic search was undertaken of the Educational Resources Information Clearinghouse (ERIC), EDUCAT, Web of Science, Dissertation Abstracts, and National Center for Educational Statistics databases.

The search was restricted to the period 1970-2003. Search terms used were: 'school start[ing] time'; 'school/student and sleep[ing]'; 'education and sleep[ing]'. Only research on students in Kindergarten to 12th grade education was considered. International research was included.

Handsearch of two journals was undertaken: *Journal of Sleep Research* (from 1998–2003); and *Sleep* (from 1988–2003).

Based on the yield from the database search and handsearch, citation searches and footnote searches were undertaken.

Internet searches were undertaken using the key search terms and the names of authors of the relevant publications. The websites of Edina Public Schools and Minnesota Public Schools were reviewed.

Websites produced by the following organizations were also browsed for further information:

- American Academy of Sleep Medicine (www.aasmnet.org)
- Center for Applied Research and Educational Improvement, University of Minnesota (www.education.umn.edu/CAREI)
- National Center on Sleep Disorders Research (www.nhlbi.nih.gov/about/ncsdr)
- National Sleep Foundation (www.sleepfoundation.org/)
- Sleep Research Laboratory, Brown University (www.sleepforscience.org)
- Sleep Research Society (www.sleepresearchsociety.org)
- Stanford University Center of Excellence for the Diagnosis and Treatment of Sleep Disorders (www.med.stanford.edu/school/psychiatry/coe/)

RESEARCH CITATIONS

[1] Allen, R and J Mirabile. 1989. Self-reported sleep-wake patterns for students during the school year from two different senior high schools. *Sleep Research*, **18**, 132.

[2] Beltramini, AU and ME Hertzig. 1983. Sleep and bedtime behavior in preschool-aged children. *Pediatrics*, **136**, 1257-1262.

[3] Black, S. 2000. A wake-up call on high-school starting times. *The Education Digest*, **66**, 33-38.

[4] Blader, JC, Koplewicz, HS, Abikoff, H and C Foley. 1997. Sleep problems of elementary school children. *Archives of Pediatric Adolescent Medicine*, **151**, 473-480.

[5] Carskadon MA, and C Acebo. 2002. Regulation of sleepiness in adolescents: update, insights, and speculation. *Sleep*, **25**, 606-16.

[6] Carskadon MA, Harvey K, Duke P, Anders TF, Litt IF, and WC Dement. 1980. Pubertal changes in daytime sleepiness. *Sleep*, **2**, 453-460.

[7] Carskadon, MA, Wolfson, AR, Acebo, C, Tzischinsky, O and R Seifer. 1998. Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. *Sleep*, **21**, 871-881.

[8] Carskadon, MA, Wolfson, AR, Tzischinsky, O and C Acebo. 1995. Early school schedules modify adolescent sleepiness. *Sleep Research*, **24**, 92.

[9] Carskadon, MA. 1999. When worlds collide: Adolescent need for sleep versus societal demands. *Phi Delta Kappan*, **80**, 5, 348-353.

[10] Center for Applied Research and Educational Improvement (CAREI). 1998. School Start Time Study. Final Report Summary. Research paper, University of Minnesota.

[11] Center for Applied Research and Educational Improvement (CAREI). 1998. School Start Time Study. Technical Report, Volume II: Analysis of Student Survey Data. Research paper, University of Minnesota.

[12] Center for Applied Research and Educational Improvement (CAREI). 2001. School Start Time Study. Executive Summary. Research paper, University of Minnesota.

[13] Connecticut Thoracic Society (CTS). 2002. Sleep deprivation among adolescents and high school start time. Resource Guide. CTS and American Lung Association.

[14] Dahl, RE and DS Lewin. 2002. Pathways to adolescent health sleep regulation and behavior. *Journal of Adolescent Health*, **31**, 175-184.

[15] Dahl, RE. 1996. The impact of inadequate sleep on children's daytime cognitive function. *Seminars in Pediatric Neurology*, **3**, 44-50.
[16] Dahl, RE. 1999. The consequences of insufficient sleep for adolescents: links between sleep and emotional regulation. *Phi Delta Kappan*, **80**, 5, 354-359.
[17] Davis, ZT. 1988. The effect of time of day of instruction on eighth grade students' English and mathematics achievement. *High School Journal*, **71**, 78-80.
[18] Drake C, Nickel C, Burduvali E, Roth T, Jefferson C, and P Badia. 2003. The pediatric daytime sleepiness scale (PDSS): Sleep habits and school outcomes in middle-school children. *Sleep*, **26**, 455-58.
[19] Epstein, R, Chillag, N and P Lavie. 1998. Starting times of school: effects on daytime functioning of fifth-grade children in Israel. *Sleep*, **21**, 250-256.
[20] Fallone GF, Seifer R, Acebo C, and MA Carskadon. 2002. How well do school-aged children comply with imposed sleep schedules at home? *Sleep*, **25**, 739-45.
[21] Fallone, G, Acebo, C, Arnedt, JT, Seifer, R and MA Carskadon. 2001. Effects of acute sleep restriction on behavior, sustained attention, and response inhibition in children. *Perceptual and Motor Skills*, **93**, 213-229.
[22] Fallone, G, Owens, JA and J Deane. 2002. Sleepiness in children and adolescents: clinical implications. *Sleep Medicine Reviews*, **6**, 287-306.
[23] Gau SF and WT Soong. 1995. Sleep problems of junior high school students in Taipei. *Sleep*, **18**, 667-73.
[24] Gau SF, and WT Soong. 2003. The transition of sleep-wake patterns in early adolescence. *Sleep*, **26**, 449-54.
[25] Giannotti, F, Cortesi, F, Sebastiani, T, and S Ottaviano. 2002. Circadian preference, sleep and daytime behaviour in adolescence. *Journal of Sleep Research*, **11**, 191-199.
[26] Horne, JA. 1993. Human sleep, sleep loss, and behaviour implications for the prefrontal cortex and psychiatric disorder. *Journal of Psychiatry*, **162**, 413-419.
[27] Kowalski, NA and RP Allen. 1995. School sleep lag is less but persists with a very late starting high school. *Sleep Research*, **24**, 124.
[28] Kubow, PK, Wahlstrom, KL, and AE Bemis. 1999. Starting time and school life: Reflections from educators and students. *Phi Delta Kappan*, **80**, 5, 366-371.
[29] Laberge, A, Petit, D, Simard, C, Vitaro, F, Tremblay, RE, and J Montplaisir. 2001. Development of sleep patterns in early adolescence. *Journal of Sleep Research*, **10**, 59-67.
[30] Manni, R, Ratti, MT, Marchioni, E, Castelnovo, G, Murelli, R, Sartori, I, Galimberti, CA and A Tartara. 1997. Poor sleep in adolescents, a study of 869 17-year old Italian secondary school students. *Journal of Sleep Research*, **20**, 381-387.
[31] Meijer, AM, Habekothe, HT and GLH van den Wittenboer. 2000. Time in bed, quality of sleep and school functioning of children. *Journal of Sleep Research*, **9**, 145-153.
[32] Meijer, AM, Habekothe, HT and GLH van den Wittenboer. 2001. Mental health, parental rules and sleep in pre-adolescents. *Journal of Sleep Research*, **10**, 297-302.
[33] Mitru, G, Millrood, DL and JH Mateika. 2002. The impact of sleep on learning and behavior in adolescents. *Teachers College Record*, **104**, 704-726.

[34] National Sleep Foundation [NSF]. 2000. Adolescent Sleep Needs and Patterns. Research Report and Resource Guide. www.sleepfoundation.org.
[35] North Carolina Public Schools [NCPS]. 1999. Report on delaying the start of the school day. Division of Accountability Services, www.ncpublicschools.org/accountability/evaluation/DSchDay.pdf
[36] Ohayon, MM, Roberts, RE, Zulley, J, Smirne, S and RG Priest. 2000. Prevalence and patterns of problematic sleep among older adolescents. *American Academy of Child and Adolescent Psychiatry*, **39**, 1549-1556.
[37] Pilcher JJ, and AI Huffcutt. 1996. Effects of sleep deprivation on performance: a meta-analysis. *Sleep*, **19**, 318-26.
[38] Randazzo, AC, Muehlbach, MJ, Schweitzer, PK and JK Walsh. 1998. Cognitive function following acute sleep restriction in children ages 10-14. *Sleep*, **21**, 861-867.
[39] Roberts, RE, Roberts, CR and IG Chen. 2002. Impact of insomnia on future functioning of adolescents. *Journal of Psychosomatic Research*, **53**, 561-569.
[40] Sadeh, A, Raviv, A, and R Gruber. 2000. Sleep patterns and sleep disruptions in school-age children. *Development Psychology*, **36**, 291-301.
[41] Strauch, I and B Meier. 1988. Sleep need in adolescents: a longitudinal approach. *Sleep*, **11**, 378-86
[42] Szymczak JT, Jasinska M, Pawlak E, and M Zwierzykowska. 1993. Annual and weekly changes in the sleep-wake rhythm of school children. *Sleep*, **16**, 433-5
[43] Thorleifsdottir, B, Bjornsson, JK, Benediktsdottir, B, Gislason, Th. and H Kristbjarnson. 2002. Sleep and sleep habits from childhood to young adulthood over a 10-year period. *Journal of Psychosomatic Research*, **53**, 529-537.
[44] Wahlstrom, K, Wrobel, G and P Kubow. 1998. Minneapolis Public Schools Start Time Study. Executive Summary. Research paper, University of Minnesota.
[45] Wahlstrom, K. 2002. Changing times: Findings from the first longitudinal study of later high school start times. *National Association of Secondary School Principals Bulletin*, **86**, 3-21.
[46] Wahlstrom, KL. 1999. The prickly politics of school starting times. *Phi Delta Kappan*, **80**, 5, 344-347.
[47] Wolfson AR, Carskadon MA, Acebo C, Seifer R, Fallone G, Labyak SE, and JL Martin. 2002. Evidence for the validity of a sleep habits survey for adolescents. *Sleep*, **26**, 213-16.
[48] Wolfson, AR and MA Carskadon. 1998. Sleep schedules and daytime functioning in adolescents. *Child Development*, **69**, 875-877.
[49] Wrobel, GD. 1999. The impact of school starting time on family life. *Phi Delta Kappan*, **80**, 5, 360-365.

REFERENCES

Clarke M and AD Oxman (Eds.) 2003. *Cochrane Reviewers' Handbook 4.2.0* at www.cochrane.dk/cochrane/handbook/handbook.htm [Updated March 2003].

Hart, C. 1998. *Doing a Literature Review: Releasing the Social Science Imagination.* London: Russell Sage Foundation.

McEwan, EK and PJ McEwan. 2003. *Making Sense of Research.* Thousand Oaks, CA: Corwin Press.

Mosteller, F and R Boruch. 2001. *Evidence Matters.* Brookings: Washington, DC.

Shadish, WR, Cook, TD and DT Campbell. 2002. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference.* Boston, MA: Houghton Mifflin.

White, H. 1994. Scientific communication and literature retrieval. In H Cooper and LV Hedges (Eds.). *The Handbook of Research Synthesis.* New York: Russell Sage Foundation.

Let Them Sleep: AAP Recommends Delaying Start Times of Middle and High Schools to Combat Teen Sleep Deprivation

8/25/2014

For Release: August 25, 2014

Studies show that adolescents who don't get enough sleep often suffer physical and mental health problems, an increased risk of automobile accidents and a decline in academic performance. But getting enough sleep each night can be hard for teens whose natural sleep cycles make it difficult for them to fall asleep before 11 p.m. – and who face a first-period class at 7:30 a.m. or earlier the next day.

In a new policy statement published online Aug. 25, the American Academy of Pediatrics (AAP) recommends middle and high schools delay the start of class to 8:30 a.m. or later. Doing so will align school schedules to the biological sleep rhythms of adolescents, whose sleep-wake cycles begin to shift up to two hours later at the start of puberty.

"Chronic sleep loss in children and adolescents is one of the most common – and easily fixable – public health issues in the U.S. today," said pediatrician Judith Owens, MD, FAAP, lead author of the policy statement, "School Start Times for Adolescents," published in the September 2014 issue of Pediatrics.

"The research is clear that adolescents who get enough sleep have a reduced risk of being overweight or suffering depression, are less likely to be involved in automobile accidents, and have better grades, higher standardized test scores and an overall better quality of life," Dr. Owens said. "Studies have shown that delaying early school start times is one key factor that can help adolescents get the sleep they need to grow and learn."

Many studies have documented that the average adolescent in the U.S. is chronically sleep-deprived and pathologically sleepy. A National Sleep Foundation poll found 59 percent of 6th through 8th graders and 87 percent of high school students in the U.S. were getting less than the recommended 8.5 to 9.5 hours of sleep on school nights.

The policy statement is accompanied by a technical report, "Insufficient Sleep in Adolescents and Young Adults: An Update on Causes and Consequences," also published online Aug. 25. The technical report updates a prior report on excessive sleepiness among adolescents that was published in 2005.

The reasons for teens' lack of sleep are complex, and include homework, extracurricular activities, after-school jobs and use of technology that can keep them up late on week nights. The AAP recommends pediatricians counsel teens and parents about healthy sleep habits, including enforcing a media curfew. The AAP also advises health care professionals to educate parents, educators, athletic coaches and other stakeholders about the biological and environmental factors that contribute to insufficient sleep.

But the evidence strongly suggests that a too-early start to the school day is a critical contributor to chronic sleep deprivation among American adolescents. An estimated 40 percent of high schools in the U.S. currently have a start time before 8 a.m.; only 15 percent start at 8:30 a.m. or later. The median middle school start time is 8 a.m., and more than 20 percent of middle schools start at 7:45 a.m. or earlier.

Napping, extending sleep on weekends, and caffeine consumption can temporarily counteract sleepiness, but they do not restore optimal alertness and are not a substitute for regular, sufficient sleep, according to the AAP.

The AAP urges middle and high schools to aim for start times that allow students to receive 8.5 to 9.5 hours of sleep a night. In most cases, this will mean a school start time of 8:30 a.m. or later, though schools should also consider average commuting times and other local factors.

"The AAP is making a definitive and powerful statement about the importance of sleep to the health, safety, performance and well-being of our nation's youth," Dr. Owens said. "By advocating for later school start times for middle and high school students, the AAP is both promoting the compelling scientific evidence that supports school start time delay as an important public health measure, and providing support and encouragement to those school districts around the country contemplating that change."

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Insufficient Sleep in Adolescents and Young Adults: An Update on Causes and Consequences

Judith Owens, ADOLESCENT SLEEP WORKING GROUP and COMMITTEE ON ADOLESCENCE

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TECHNICAL REPORT

Insufficient Sleep in Adolescents and Young Adults: An Update on Causes and Consequences

Judith Owens, MD, MPH, FAAP, ADOLESCENT SLEEP WORKING GROUP, and COMMITTEE ON ADOLESCENCE

KEY WORDS
adolescents, caffeine, car crashes, media use, obesity, sleep loss, sleepiness

ABBREVIATIONS
REM—rapid eye movement

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abstract

Chronic sleep loss and associated sleepiness and daytime impairments in adolescence are a serious threat to the academic success, health, and safety of our nation's youth and an important public health issue. Understanding the extent and potential short- and long-term repercussions of sleep restriction, as well as the unhealthy sleep practices and environmental factors that contribute to sleep loss in adolescents, is key in setting public policies to mitigate these effects and in counseling patients and families in the clinical setting. This report reviews the current literature on sleep patterns in adolescents, factors contributing to chronic sleep loss (ie, electronic media use, caffeine consumption), and health-related consequences, such as depression, increased obesity risk, and higher rates of drowsy driving accidents. The report also discusses the potential role of later school start times as a means of reducing adolescent sleepiness. *Pediatrics* 2014;134:e921–e932

INTRODUCTION

Since the publication of the American Academy of Pediatrics technical report on excessive sleepiness in adolescents in 2005,[1] there have been a considerable number of articles published pertaining to sleep. These articles expand on many of the topics raised in the original report and add a number of new important health issues not previously or minimally discussed (ie, short sleep and its association with obesity, caffeine/stimulant use). The previous technical report provided an overview of the profound changes in sleep–wake regulation and circadian biology occurring during adolescence, outlined factors (ie, parental influence, school start times) contributing to insufficient sleep in adolescents, and summarized consequences such as negative impacts on mood, attention, and school performance. It also focused in particular on clinical sleep disorders such as insomnia, narcolepsy, and restless legs syndrome contributing to daytime sleepiness in adolescents. The new material in the present report adds to what is known about the extent of sleep restriction in the adolescent population and reinforces the importance of recognizing insufficient sleep both as a key public health issue and one that is immediately relevant to pediatric practice.

The focus of this updated technical report is on insufficient sleep, specifically as a consequence of voluntary sleep restriction. It should

be noted that such terms as insufficient sleep, inadequate sleep, short sleep duration, sleep loss, and sleep restriction are used interchangeably and as generic descriptive terms only and do not imply specific amounts but rather "less sleep than needed."

Insufficient sleep in adolescents was recognized as a serious health risk in 2010 in a jointly sponsored American Medical Association/American Academy of Sleep Medicine resolution acknowledging the problem.[2] Furthermore, objectives for Sleep Health, a new topic in Healthy People 2020,[3] specifically includes reducing adolescent sleep loss: "SH-3: Increase the proportion of students in grades 9 through 12 who get sufficient sleep" (defined as ≥8 hours).

A second focus of the present report is on unhealthy sleep behaviors (ie, poor "sleep hygiene") in teenagers, including irregular sleep–wake patterns, electronic media use in the bedroom, and excessive caffeine use. A third focus is on the myriad of potential consequences of inadequate sleep in adolescents, including depression/suicidal ideation, obesity, car crashes attributable to drowsiness, and poor academic performance.

EPIDEMIOLOGIC STUDIES OF SLEEPING ADOLESCENTS

Epidemiologic studies of sleep typically rely on self- or parent-reported questionnaire data to document adolescent sleep patterns and the factors affecting them. The key advantage of this method is the ease of assessment of large sample sizes. As a result, epidemiologic studies can determine sleep patterns across the full adolescent age range with less potential sampling bias than smaller case-control studies. Consistent with other methodologic approaches, the consensus finding across epidemiologic studies is that both younger[4–6] and older[4,7–11] adolescents are not getting enough sleep. It is important to note that studies comparing self-reported sleep duration with objectively measured sleep amounts (ie, with actigraphy) suggest that self-reports of sleep often overestimate actual sleep duration, signifying that the problem of chronic sleep loss in adolescents may be even greater than the data indicate.[12]

US-based[4,13] and international studies[5,6,14] revealed that as students get older, sleep durations decline. The National Sleep Foundation Sleep in America Poll[4] found that by the 12th grade, 75% of students self-reported sleep durations of less than 8 hours of sleep per night compared with 16% of sixth graders. Furthermore, although 30% to 41% of sixth through eighth graders were getting 9 or more hours of sleep, only 3% of 12th graders reported doing so. Adolescents often attempt to address the accumulated weekday sleep debt during the weekend, when oversleep (the difference between weekday and weekend sleep durations) of up to 2 or more hours is commonly reported.[4,7,8,15,16]

Comparisons with other countries show similar patterns of decreased sleep durations with increasing age among adolescents. For example, in Northern Taiwan,[5] Germany,[14] and India,[17] average sleep duration dropped to below 8 hours for high school–aged students. The most precipitous drop was reported in 2005 for more than 1400 South Korean adolescents, for whom the average duration of sleep was 4.9 hours.[6] In general, studies have demonstrated similar weekend sleep durations across countries, but weekday sleep durations tend to vary greatly.[5,9] In contrast, Australian adolescents seem to do comparatively well, with students 17 years and older reporting average sleep durations between 8.5 and 9.1 hours.[18] The difference between weeknight and weekend sleep durations also was not large, with weekend durations reported at 9.3 hours. Interestingly, although data on school start times in the Australian study were not presented, the average reported wake times on school days was 7:00 AM or later, suggesting that the schools these students attended did not start before 8:00 AM.

A number of studies have indicated that sleep health disparities exist and that adults,[19] children, and adolescents[20–22] from families with low income or of racial or ethnic minorities may be at even greater risk of poor-quality and insufficient sleep. For example, in a recent study of middle school students, appropriate timing and consistency of both weeknight and weekend sleep schedules were inversely correlated with low socioeconomic status and specific household/neighborhood variables (eg, overcrowding, noise levels, safety concerns).[23] This relationship may have important health implications. For example, a recent study suggested that less sleep was a predictor of obesity risk in African-American adolescents but not in white adolescents.[24] "Missed" sleep was also reported to be an important factor in asthma morbidity, especially in Latino children.[25] However, higher socioeconomic status is not necessarily protective because studies have also shown that youth from households with higher socioeconomic status have shorter sleep durations.[16,26]

For older adolescents, additional environmental factors, such as after-school employment,[16] striving for good grades,[5,6,12] socializing,[27,28] participation in sports and other extracurricular activities, and lack of parental monitoring or rules about bedtimes, can further interfere with sleep durations.[6,29,30] School start times are reviewed later in the present report.

In summary, short sleep durations, coupled with evidence of daytime sleepiness (eg, increased self-reported sleepiness ratings,[5,6,11,31] daytime napping,[5,14,26] weekend oversleeping,[6,10,14,32] need for assistance in waking[6]), as well as increased use of fatigue countermeasures

(eg, excessive caffeine consumption[4,5,15]), all indicate that adolescents are sleeping fewer hours than they need. The clear and consistent message is that middle and high school students are not getting enough sleep and that this issue is a chronic problem worldwide. In addition, the health and behavioral outcomes linked to restricted sleep, as further detailed in the following sections, are alarming. These outcomes include increased risk of car crashes,[4,33] delinquent behaviors,[27] depression,[8,10,34] and psychological stress.[35]

FACTORS CONTRIBUTING TO INSUFFICIENT SLEEP IN ADOLESCENTS

Influence of Biological Processes on Adolescent Sleep

The association of early adolescent development/pubertal onset and a more evening-type circadian phase preference (ie, preferred timing of sleep and wake as well as daytime activities) has been documented since the 1990s.[36] The behavioral result of this biological process is most clear in the timing of sleep, particularly for weekends. For example, Roenneberg et al[37] measured the midpoint of weekend sleep in European schoolchildren and revealed a marked linear delay of 2 (girls) to 3 (boys) hours across the second decade, roughly 12 to 18 minutes later with each year of age. The reversal of this delayed weekend sleep pattern may be a "biological marker for the end of adolescence."

Recent data have indicated that another process involved in regulating sleep timing seems to be altered to favor late nights across adolescent development. This process, called sleep–wake homeostasis, can be thought of as the system that accounts for greater pressure to sleep as one stays awake longer. Data collected with 2 different paradigms to estimate the rate of buildup of sleep pressure in prepubertal versus postpubertal adolescents indicate that more mature adolescents accumulate this sleep pressure at a slower rate.[38,39]

Maturational changes to these 2 bioregulatory processes begin in adolescents as young as middle school and present a major challenge for young people to fall asleep in the early evening and to wake refreshed/restored in the early morning to attend school. The most prominent factors in this regard are evening and nighttime screen use and social networking, both of which have increased markedly in the 21st century.[40] Going to bed later and waking later on weekends than on weekdays reflects the biology of circadian rhythm and is also a response to insufficient weekday sleep. Later sleep timing and catch-up sleep on the weekends further delay the signal for the biological night (ie, melatonin production) and dissipate residual sleep pressure.[41] In summary, the combination of biologically driven processes with modern lifestyles and social obligations minimize the opportunities for adolescents to obtain adequate sleep.

Electronic Media and Sleep

Today's adolescents and young adults have grown up in an electronic age. According to the National Sleep Foundation's 2006 Sleep in America Poll, almost all adolescents had at least 1 media electronic device in their bedroom.[4] Among the devices reported were televisions (57%), music players (90%), video game consoles (43%), computers (28%), and phones (64%). A more rigorous study of subjects recruited from a pediatric office in a Philadelphia suburb showed that of the 100 adolescents ranging in age from 12 to 18 years, two-thirds had a television in their bedroom, almost one-third had a computer, almost 80% had a digital music player, and 90% had a cellular phone in their bedroom.[42] The teenagers engaged simultaneously in an average of 4 electronic activities after 9:00 PM.

It is not surprising that several studies in adolescents have demonstrated that electronic exposure in the evening potentially disrupts sleep. The use of multiple electronic devices at the same time has been associated with less sleep at night and a greater degree of sleepiness during the daytime.[4,15,31,42,43] Having a television in the bedroom (or even out of the bedroom) has been associated with later bedtimes on weekdays, longer sleep latencies, shorter total sleep times, later wakeup times on the weekends, and more daytime sleepiness in adolescents.[44–46] In the Children in the Community Study in 1976,[47] adolescents who were watching 3 or more hours of television not only experienced difficulty falling asleep and frequent awakenings but also had a risk of having difficulties with their sleep later in adolescence and young adulthood. The use of computers before bedtime has also been shown to have the same effect, and this finding has been demonstrated in a wide range of countries and cultures.[45,46,48–51]

Engaging in a greater number and range of sleep-interfering activities before going to bed has also been associated with less nocturnal sleep and more daytime sleepiness in adolescents.[45] Several mechanisms have been postulated about how media disrupts sleep.[40] One is that the use of media directly displaces sleep; an adolescent or young adult may simply stay up later enjoying whatever media he or she is using. In addition, electronic media allow for greater interaction between friends. Early data suggested that peer-to-peer interaction did not have a major influence on school-night bedtime but rather had a more significant influence on a teenager's sleep on weekends.[52] These findings may no

longer hold now that there are enhanced ways for adolescents to communicate electronically. Calamaro et al[42] found that after 9:00 PM, 34% of adolescents in the study sample were text messaging, 44% were talking on the phone, 55% were online, and 24% were playing computer games. In another study of Belgian teenagers, 62% of the subjects used their phones after the lights were turned off, and phone use at this time was associated with increased daytime tiredness the next day.[53]

Another possible mechanism for the detrimental effect of electronics use on sleep is that the light produced by electronic devices may disrupt circadian rhythms by suppressing melatonin, resulting in the inability to fall asleep at a reasonable time.[40] Recent studies have demonstrated that exposure to relatively low-intensity light can alter circadian rhythms[54,55] and suppress nocturnal melatonin secretion.[56]

Finally, media use may cause increased sleep-disrupting mental, emotional, and physiologic arousal.[40] One study found that subjective sleepiness was lower, sleep latency was longer, and rapid eye movement (REM) sleep was shorter in subjects after playing video shooting games, independent of the brightness of the screen used.[56] Another study that compared playing an interactive computer game with watching a movie on television in the evening[51] found a decline in verbal memory performance, prolonged sleep latency, and an increase in light sleep in the computer game cohort.

School Start Times

As has been described elsewhere in the present report, a multitude of changes occur over the course of adolescence that can affect the quality and quantity of sleep in adolescents and young adults. One of the most salient and arguably most malleable is that of school start times, a systemic countermeasure. There are clearly a number of practical implications and/or challenges that schools might face when considering altering school start times, such as changes in athletic schedules, effects on after-school activities, and transportation issues.[57] Despite these hurdles, a small yet increasing number of school districts over the last 15 years have responded to research reports regarding the prevalence of inadequate sleep among middle and high school students by delaying school start times. Research on the effects of delaying the start times of middle and high schools for adolescents' sleep and daytime functioning is discussed in this section, and a more detailed discussion is available in the American Academy of Pediatrics policy statement on school start times.[58]

In one of the first studies to assess the effect of school start times on adolescents,[59] a 65-minute earlier school start time in the transition from grade 9 to grade 10 resulted in fewer than one-half of 10th graders obtaining an average of 7 hours or more of sleep on school nights and physiologic levels of daytime sleepiness ordinarily seen in patients with narcolepsy. A large prospective longitudinal study of delays in school start times in both an urban and a suburban school district found improvements in attendance rates and an increase in the percentage of high school students continuously enrolled in the district or the same school, although grades did not show a statistically significant improvement.[60] Similar to what has been reported in subsequent studies,[55] bedtimes did not change with the delay in start times, but morning wake times were significantly later, resulting in the students obtaining nearly 1 hour more of sleep on school nights. Other studies have also reported increases in sleep duration and decreased daytime sleepiness associated with delayed school start times,[61] as well as increased satisfaction with sleep and motivation and significant declines in self-reported depressed mood, health center visits for fatigue-related complaints, and first-period tardiness.[62]

Research on the effects of early versus delayed school start times for young adolescents has resulted in strikingly similar findings. Students at later-starting middle schools report later rise times, more total sleep on school nights, less daytime sleepiness, less tardiness, fewer attention/concentration difficulties, and better academic performance compared with middle school students at earlier-starting schools.[63,64] In addition, middle school students with a delayed start time of 1 hour for just 1 week performed better than the earlier-starting comparison group on tests requiring attention.[65] Undoubtedly, delaying the start of middle school allows early adolescents, similar to their older high school–aged peers, to obtain sufficient sleep and to perform better in school.

Danner and Phillips[33] demonstrated that delaying school start times in 1 community in Kentucky decreased the average crash rate for teenaged drivers by 16.5%, while the state as a whole increased by 7.8% in the same time period. In another recent study conducted in 2 adjacent, demographically similar cities, there were significantly increased teenaged (16- to 18-year-olds) crash rates over a 2-year period in the city with earlier high school start times.[66]

Taken together, it is clear that when middle and high schools (schools designed for adolescents) institute the countermeasure of delaying the start time of school, students obtain more sleep and there are associated improvements in behaviors pertinent to academic success (attendance and school performance) and safety.

Caffeine

Use of caffeine has been understudied in adolescents and children; however, current research has raised important questions regarding the complex interrelationship between caffeine use and sleep patterns during this developmental period.[67–70]

Similar to studies of adult caffeine use, higher caffeine intake as early as 12 years of age is associated with shorter sleep duration, increased sleep onset latency, increased wake time after sleep onset, and increased daytime sleepiness.[68,69,71] High school students who report a moderate to high intake of caffeine versus very low intake were nearly 2 times more likely to have difficulty sleeping and to report morning sleepiness.[71] High and regular caffeine users seem to develop a cycle in which disrupted sleep attributable to caffeine use leads to sleepiness, which then leads them to increase their caffeine consumption.[72] Moreover, caffeine reduces the percentage of time spent in slow-wave or "deep" sleep in a dose-related manner and alters the temporal organization of REM/non-REM sleep.[70,72,73] This outcome is particularly important because of the critical role that both slow-wave sleep and REM sleep play in learning and memory consolidation.

Researchers are beginning to examine adolescents' expectancies regarding caffeine use. Reported expectancies for caffeine users were for energy and mood enhancement and to counteract the effects of sleep disturbances. Other studies have found that adolescents report using energy drinks for the energy boost or "buzz" and that these beverages make them "feel more energetic."[74] In comparing different types of users, "mixed" caffeine product users (ie, soda, coffee, energy drinks) reported higher levels of withdrawal and/or dependence, energy and mood enhancement, appetite suppression, and performance enhancement expectancies than either the high-soda or low-caffeine use groups. A higher percentage of mixed users compared with high-soda users reported that the reasons for their caffeine use were related to getting through the day, experimentation, and recreation.[68]

Regardless of the reasons adolescents use caffeinated substances, there are clear consequences. Adolescents experience tolerance and withdrawal symptoms; however, in general, caffeine dependence in adolescents is poorly understood.[75,76] Female high school students were more likely to report withdrawal/dependence caffeine expectancies as well as appetite suppression expectancies compared with their male peers.[68] Although adolescents may consume excessive caffeine in an attempt to mitigate daytime sleepiness, this action not only further compromises the quality and quantity of sleep, but high caffeine users may also be at risk for other substance use and/or abuse as well as other risk-taking behaviors.[68,75,77–79] Consumption of caffeine is linked to nicotine use in adolescents,[80] which in turn may further disrupt sleep[81] and perpetuate the cycle of sleep fragmentation/daytime sleepiness coupled with stimulant use. Not surprisingly, increased caffeine use frequently coexists with other behaviors that negatively affect sleep, such as adolescents' late-night, multifaceted technology use. For example, a recent study[42] found that high school–aged adolescents who reported the highest levels of multitasking with media-related electronic products also consumed the most caffeine.

The correlation between caffeine consumption and daytime sleepiness is, in turn, inversely correlated with academic achievement. For example, 1 study of over 7000 adolescents reported that a significant proportion of the variance that occurs in academic achievement was found to be attributable to caffeine use.[82] The authors further postulated that daytime sleepiness might be an important mediator of the negative impact of not only caffeine but also alcohol use and cigarette smoking on academic success. Caffeine use may also serve as an affect modulator, particularly when it comes to adolescents with excessive daytime sleepiness or insufficient sleep. For example, studies have suggested that adolescents may use caffeine as a means of regulating mood and/or helping to alleviate depression.[75,83]

Undoubtedly, there is growing evidence that caffeine use is increasing among adolescents, with negative implications for sleep and other behaviors. Significant questions, however, remain regarding the direction of this complex relationship. Are adolescents turning to caffeine because of insufficient and inconsistent sleep patterns, or does increased caffeine use exacerbate sleep problems for developing adolescents? These findings document the need for more extensive health education about caffeine use during adolescence. Furthermore, with the dramatic and potentially dangerous rise in the consumption of energy drinks in combination with alcohol (particularly on college campuses), researchers and physicians need to carefully investigate the implications for adolescents across the developmental spectrum.[84]

Other Factors Affecting Sleep in Adolescents

A number of other factors have been related to reduced sleep durations across the adolescent age range, such as chronic medical illnesses, mental health issues (ie, anxiety/stress), and prescribed psychotropic medications.[10,15] Chronic respiratory illnesses, such as asthma, and pain conditions, such as migraines, may contribute to truncated and disrupted sleep. Although obesity

does not necessarily lead to poor sleep per se, it is an increasingly important risk factor for obstructive sleep apnea in adolescents, which in turn results in poor-quality sleep and daytime consequences. Moreover, although the evidence is still largely anecdotal, the use of stimulants (particularly those typically prescribed for the treatment of attention-deficit/hyperactivity disorder) as a "countermeasure" to sleepiness and/or as academic "performance enhancers" seems to be an increasingly common phenomenon across college campuses.[85,86] Future investigations need to assess the extent and context of "diversion" of legitimately prescribed stimulant medications as well as the use and abuse of increasingly diverse alternative sources of caffeine (eg, caffeinated alcoholic beverages, candy, foodstuffs). Finally, it should also be noted that both over-the-counter (ie, diphenhydramine) and prescription (ie, zolpidem) medications taken by adolescents to induce sleep may result in residual daytime sleepiness and that commonly used medications (eg, decongestants) and prescription drugs (eg, activating antidepressants [eg, fluoxetine], stimulant medication for attention-deficit/hyperactivity disorder) may also result in disrupted sleep and consequent daytime sleepiness in adolescents.

CONSEQUENCES OF INSUFFICIENT SLEEP

It is important to recognize that the causes and consequences of chronic sleep loss in adolescents are often closely intertwined in complex ways, further exacerbating the situation. For example, alcohol consumption can lead to insufficient and poor-quality sleep and subsequent daytime sleepiness.[10,32,87] In turn, chronic sleep loss has been linked to an increased risk of alcohol and drug use.[14,28,34] Similarly, compensatory oversleep behavior on weekends provides some temporary relief from sleepiness generated by insufficient sleep on weekdays, but it also leads to disrupted sleep–wake cycles, exacerbation of the normal adolescent circadian phase delay, and perpetuation of compromised weekday alertness. Moreover, consequences such as poor judgment, lack of motivation, and inattention and affective dysregulation resulting from sleep loss, as well as the effect of insufficient sleep on decision-making skills,[88] further compound the potential negative effects in adolescents. In particular, higher level cognitive "executive functions," for which adolescence is a critical period of evolution, are selectively affected by sleep loss.[89]

Sleep Loss and Depression, Mood Disturbances, and Suicidal Ideation

It has long been recognized that mood disorders (especially major depressive disorder) in clinical samples of adults exhibit a bidirectional relationship with sleep disturbances, and the presence of sleep problems has been shown to both increase the relative risk of developing depression[90] and to be a predictor of relapse.[91,92] Similar findings have emerged in the child and adolescent population, particularly with regard to an association between insomnia (difficulty initiating and/or maintaining sleep) and clinically diagnosed depression.[93] Recent studies have shown that addressing insomnia will greatly improve treatment of depression. Although studies examining sleep architecture in depressed adolescents[94] have not consistently replicated differences in polysomnographic findings in depressed adults (ie, increased REM sleep, decreased REM onset latency), there may be other sleep electroencephalographic markers, such as sleep spindle activity and cyclic alternating patterns,[95] that have more relevance for the adolescent population.

Sleep debt in college students has been shown to be associated with a higher risk of reporting depressive symptoms.[96] Similarly, in high school students, shorter school-night total sleep time has been associated with both daytime sleepiness and depressive symptoms,[97] whereas increased risk-taking behaviors were associated with irregular sleep patterns and self-reported sleep problems rather than sleep loss. These outcomes are similar to the findings of a large longitudinal adolescent health study in which symptoms of possible insomnia (ie, trouble sleeping, morning tiredness) predicted risk behaviors (eg, drinking and driving, smoking, delinquency) after controlling for depression symptoms.[97,98]

There is evidence that other sleep-related parameters may also have a significant effect on mood; for example, adolescent self-reported sleep variables (including trouble sleeping, tiredness, nightmares, and being a long sleeper) have been found to be significantly associated with psychological symptoms, including anxiety/depression, and withdrawal.[99] Circadian factors may also play a role in mood regulation; increased self-reported "eveningness," a marker of circadian phase delay, has also been associated with depression and lower behavior activation/positive affect.[100]

A number of recent studies have focused on the possible relationship between sleep and suicidal ideation.[101,102] Sleeping less than 8 hours at night seems to be associated with an almost threefold increased risk of suicide attempts after controlling for a number of confounding variables.[101] Not only do adolescents with insufficient sleep have an increased risk of suicidal ideation, but the risk may be similarly increased in adolescents whose parents also have insufficient sleep, raising some interesting questions about multigenerational environmental and/or genetic factors.[103] A

similar relationship has been found in middle and high school students; adolescents with parental-set bedtimes of midnight or later are significantly more likely to suffer from depression and to have suicidal ideation compared with adolescents with parental-set bedtimes of 10:00 PM or earlier. Earlier parental-set bedtimes, therefore, could potentially be protective against adolescent depression and suicidal ideation. Finally, both decreased (≤5 hours) or increased (≥10 hours) total sleep times may put adolescents at a significantly higher risk of suicidality compared with a total sleep time of 8 hours.[104] However, increased risk of the most severe forms of suicidality (attempt requiring treatment) seems to be associated with significantly shorter sleep duration (total sleep time ≤4 hours).

In summary, sleep has an important influence on mood and the development of depressive symptoms in adolescents. Although insufficient sleep and daytime sleepiness seem to have the most robust relationship with mood dysregulation, poor-quality sleep and irregular sleep patterns are also associated with depressed mood. Importantly, from a clinical standpoint, improvements in sleep may lead to improvements in mental health functioning (and vice versa). The association between sleep loss and increased suicidality in adolescents is particularly troubling and is clearly important for pediatricians to recognize.

Insufficient Sleep and Obesity Risk

A considerable body of evidence now links short sleep duration in both adults and children with an increased risk of obesity, an association that obviously has long-range health implications. With regard to mechanisms, experimental studies of sleep restriction in healthy adult volunteers have shown that there are alterations in metabolic profiles (eg, insulin, ghrelin, leptin, cortisol) associated with sleep loss, which result in insulin resistance, increased sympathetic nervous system activity, and increased hunger and decreased satiety.[105] As a result, sleep-restricted subjects consume more calories, exercise less, and consume a higher percentage of calories from fat.[106–109]

In 1 earlier study, it was estimated that for each hour sleep lost, the odds of being obese increased in adolescents by 80%.[110] Furthermore, there is evidence of a "dose–response" inverse relationship between sleep and weight,[111] with odds ratios of overweight increasing with decreasing sleep duration (<5 hours, 5–6 hours, 6–7 hours, and 7–8 hours compared with students sleeping >8 hours). The increased risk of obesity associated with insufficient sleep seems to be equivalent to or higher than the risk associated with other factors strongly correlated with weight, such as parental obesity and television viewing.[112]

Early sleep patterns may influence BMI in adolescents and young adults as well. Longitudinal data suggest that children who sleep less, have later bedtimes, or get up earlier subsequently have higher BMIs and are more likely to be overweight, even after controlling for baseline BMI.[113] This association may be established early in life; for example, an increased BMI and high prevalence of obesity in young adults was found in individuals whose mothers had reported sleeping problems ("irregular" or "troubled" sleeping) at ages 2 to 4 years (although sleep duration was not specified) compared with those who had not had sleeping problems.[114]

Although the underlying potential mechanisms for the relationship between sleep and weight in adolescents have yet to be elucidated, metabolic alterations associated with sleep loss similar to those observed in adults are likely to play an important role. In particular, perturbations in the levels of neurohormones known to be associated with hunger and satiety (eg, adiponectin, ghrelin) as well as increased insulin resistance (as measured by the homeostatic model assessment [HOMA]) have been demonstrated in adolescents sleeping <5 hours per day.[115] These "short sleepers" were also found to have a higher percentage of carbohydrate intake according to a dietary questionnaire.[116] Similarly, older adolescents sleeping less than 8 hours have been shown to consume a higher proportion of calories from fats, and shorter sleep duration is also associated with increased odds of consuming a higher percentage of daily caloric intake from snacks.[117] Importantly, these metabolic perturbations also increase the risk of development of type 2 diabetes in these obese adolescents.[118,119] Finally, it should be noted that the relationship between short sleep duration and obesity may be further complicated by the presence of obstructive sleep apnea. Not only is obesity emerging as an increasingly important risk factor for sleep-disordered breathing in children,[120] but obstructive sleep apnea may further exacerbate the inflammatory and metabolic consequences of both obesity and chronic sleep loss.[7,121–123] Some evidence also suggests there may be gender differences in the strength of the association between obesity and sleep duration, with adolescent boys seeming to be at higher risk compared with girls in both cross-sectional and longitudinal studies using large data sets.[124] However, not all studies have identified gender differences; in 1 study of junior high school students, short sleep duration was significantly associated with overweight in girls only.[125]

Finally, it should be noted that not all studies have found an inverse

relationship between sleep duration and obesity in adolescents.[126] It has been postulated that some of these discrepancies may be attributable to measurement issues; in a nationally representative sample of adolescents that included 2 different measures of sleep duration (24-hour time diaries and self-reported "usual" sleep hours), self-reported sleep duration and time-diary sleep were only weakly correlated with each other, and only self-reported sleep hours were inversely associated with overweight.[127]

In summary, despite a number of methodologic limitations, the body of evidence from studies assessing the relationship between short sleep and increased overweight/obesity risk in adolescents is both compelling and potentially far-reaching in its public health implications. More research is urgently needed to identify specific metabolic, inflammatory, and hormonal mechanisms as well as the interactions among sleepiness and activity levels, mood, cognition, and behavioral responses in this complex equation. Moving forward, both community-based obesity prevention programs, such as "Let's Move" (http://www.letsmove.gov), and clinical treatment programs for overweight and obese teenagers should include consideration of sleep as an important variable in the relative success or failure of these interventions.

Drowsy Driving in Adolescents

It is now well recognized that daytime sleepiness and fatigue are associated with an increased rate of motor vehicle crashes.[128–131] The fact that sleepiness could be a major factor in individuals without known sleep disorders was not universally accepted until the landmark paper[132] by Pack et al in 1995. This group reviewed crash reports from the state of North Carolina between 1990 and 1992 in which the driver was judged to have fallen asleep behind the wheel. In the 85% of crashes in which intoxication was not thought to be a contributing factor, the majority (55%) occurred in individuals 25 years or younger. Crashes in this younger age range generally occur at night, unlike crashes with older adults, which typically occur during the mid-afternoon,[133,134] and tend to occur predominantly when the drowsy driver is alone.[135–137] In addition, young male drivers are more likely to be involved in sleep-related crashes than are young female drivers.[132,134,136]

Sleepiness while driving is a common complaint among adolescents[136] and college students.[137] In a study of high school students with driver's licenses, one-fifth reported poor-quality sleep, almost two-thirds complained of daytime sleepiness, 40% reported having sleepiness while driving, and 11% reported having had an automobile crash in which sleepiness was the main cause. Being sleepy behind the wheel and poor-quality sleep at night also seem to increase the risk of having an automobile crash in college students.

Countermeasures may potentially help prevent traffic accidents in this age range. Avoidance of driving when sleep deprived and not drinking alcohol before getting behind the wheel are obvious solutions. Other countermeasures that have some empiric support in adults and may be effective in adolescents include planned napping.[138,139]

CONCLUSIONS

Adolescent sleep loss poses a serious risk to the physical and emotional health, academic success, and safety of our nation's youth. The prevalence and effects of insufficient sleep may be further magnified in high-risk adolescents. Pediatricians have the opportunity to make significant inroads into addressing the health risk that sleep loss presents through screening and health education efforts. Many of the factors that have been shown to contribute significantly to the current "epidemic" of insufficient sleep in teenagers, such as electronic media use, caffeine consumption, and early school start times, are potentially modifiable and, as such, are important intervention points in anticipatory guidance in the clinical setting. On the local and national levels, pediatricians need to advocate for educational, administrative, and health policies that promote healthy sleep and reduce the risk factors for sleep loss in adolescents.

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REFERENCES

1. Millman RP; Working Group on Sleepiness in Adolescents/Young Adults; AAP Committee on Adolescence. Excessive sleepiness in adolescents and young adults: causes, consequences, and treatment strategies. *Pediatrics*. 2005;115(6):1774–1786
2. American Medical Association, American Academy of Sleep Medicine. *Resolution 503: Insufficient Sleep in Adolescents*. Chicago, IL: American Medical Association, American Academy of Sleep Medicine; 2010
3. Sleep Health. Healthy People 2020 topics and objectives. Available at: www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=38. Accessed November 14, 2013
4. National Sleep Foundation. 2006 Teens and sleep. Sleep in America Polls. Washington, DC: National Sleep Foundation; 2006. Available at: www.sleepfoundation.org/article/sleep-america-polls/2006-teens-and-sleep. Accessed November 14, 2013
5. Huang YS, Wang CH, Guilleminault C. An epidemiologic study of sleep problems among adolescents in North Taiwan. *Sleep Med*. 2010;11(10):1035–1042
6. Yang CK, Kim JK, Patel SR, Lee JH. Age-related changes in sleep/wake patterns among Korean teenagers. *Pediatrics*. 2005;115(suppl 1):250–256
7. Brand S, Hatzinger M, Beck J, Holsboer-Trachsler E. Perceived parenting styles, personality traits and sleep patterns in adolescents. *J Adolesc*. 2009;32(5):1189–1207
8. Pallesen S, Saxvig IW, Molde H, Sørensen E, Wilhelmsen-Langeland A, Bjorvatn B. Brief report: behaviorally induced insufficient sleep syndrome in older adolescents: prevalence and correlates. *J Adolesc*. 2011;34(2):391–395
9. Pérez A, Roberts RE, Sanderson M, Reininger B, Aguirre-Flores MI. Disturbed sleep among adolescents living in 2 communities on the Texas-Mexico border, 2000-2003. *Prev Chronic Dis*. 2010;7(2):A40
10. Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health*. 2010;46(2):124–132
11. Urner M, Tornic J, Bloch KE. Sleep patterns in high school and university students: a longitudinal study. *Chronobiol Int*. 2009;26(6):1222–1234
12. Arora T, Broglia E, Pushpakumar D, et al. An investigation into the strength of the association and agreement levels between subjective and objective sleep duration in adolescents. *PloS One*. 2013;8(8):e72406
13. 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
14. Loessl B, Valerius G, Kopasz M, Hornyak M, Riemann D, Voderholzer U. Are adolescents chronically sleep-deprived? An investigation of sleep habits of adolescents in the southwest of Germany. *Child Care Health Dev*. 2008;34(5):549–556
15. Noland H, Price JH, Dake J, Telljohann SK. Adolescents' sleep behaviors and perceptions of sleep. *J Sch Health*. 2009;79(5):224–230
16. 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
17. Gupta R, Bhatia MS, Chhabra V, et al. Sleep patterns of urban school-going adolescents. *Indian Pediatr*. 2008;45(3):183–189
18. Olds T, Maher C, Blunden S, Matricciani L. Normative data on the sleep habits of Australian children and adolescents. *Sleep*. 2010;33(10):1381–1388
19. Patel NP, Grandner MA, Xie D, Branas CC, Gooneratne N. "Sleep disparity" in the population: poor sleep quality is strongly associated with poverty and ethnicity. *BMC Public Health*. 2010;10:475
20. Spilsbury JC, Storfer-Isser A, Drotar D, et al. Sleep behavior in an urban US sample of school-aged children. *Arch Pediatr Adolesc Med*. 2004;158(10):988–994
21. Dollman J, Ridley K, Olds T, Lowe E. Trends in the duration of school-day sleep among 10- to 15-year-old South Australians between 1985 and 2004. *Acta Paediatr*. 2007;96(7):1011–1014
22. Moore M, Kirchner HL, Drotar D, Johnson N, Rosen C, Redline S. Correlates of adolescent sleep time and variability in sleep time: the role of individual and health related characteristics. *Sleep Med*. 2011;12(3):239–245
23. Marco CA, Wolfson AR, Sparling M, Azuaje A. Family socioeconomic status and sleep patterns of young adolescents. *Behav Sleep Med*. 2011;10(1):70–80
24. Dodor BA, Shelley MC, Hausafus CO. Adolescents' health behaviors and obesity: does race affect this epidemic? *Nutr Res Pract*. 2010;4(6):528–534
25. Daniel LC, Boergers J, Kopel SJ, Koinis-Mitchell D. Missed sleep and asthma morbidity in urban children. *Ann Allergy Asthma Immunol*. 2012;109(1):41–46
26. McHale SM, Kim JY, Kan M, Updegraff KA. Sleep in Mexican-American adolescents: social ecological and well-being correlates. *J Youth Adolesc*. 2011;40(6):666–679
27. Clinkinbeard SS, Simi P, Evans MK, Anderson AL. Sleep and delinquency: does the amount of sleep matter? *J Youth Adolesc*. 2011;40(7):916–930
28. Mednick SC, Christakis NA, Fowler JH. The spread of sleep loss influences drug use in adolescent social networks. *PLoS ONE*. 2010;5(3):e9775
29. Gau SS, Soong WT, Merikangas KR. Correlates of sleep-wake patterns among children and young adolescents in Taiwan. *Sleep*. 2004;27(3):512–519
30. Randler C, Bilger S. Associations among sleep, chronotype, parental monitoring, and pubertal development among German adolescents. *J Psychol*. 2009;143(5):509–520
31. Majori S, Pasqualetto C, Mantovani W, et al. Self-reported sleep disorders in secondary school students: an epidemiological and risk behavioural analysis. *J Prev Med Hyg*. 2009;50(2):102–108
32. Singleton RA, Jr, Wolfson AR. Alcohol consumption, sleep, and academic performance among college students. *J Stud Alcohol Drugs*. 2009;70(3):355–363
33. Danner F, Phillips B. Adolescent sleep, school start times, and teen motor vehicle crashes. *J Clin Sleep Med*. 2008;4(6):533–535
34. Roberts RE, Roberts CR, Duong HT. Sleepless in adolescence: prospective data on sleep deprivation, health and functioning. *J Adolesc*. 2009;32(5):1045–1057
35. Glozier N, Martiniuk A, Patton G, et al. Short sleep duration in prevalent and persistent psychological distress in young adults: the DRIVE study. *Sleep*. 2010;33(9):1139–1145
36. Carskadon MA, Vieira C, Acebo C. Association between puberty and delayed phase preference. *Sleep*. 1993;16(3):258–262
37. Roenneberg T, Kuehnle T, Pramstaller PP, et al. A marker for the end of adolescence. *Curr Biol*. 2004;14(24):R1038–R1039
38. Jenni OG, Achermann P, Carskadon MA. Homeostatic sleep regulation in adolescents. *Sleep*. 2005;28(11):1446–1454
39. 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

40. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: a review. *Sleep Med.* 2010;11 (8):735–742
41. Crowley SJ, Carskadon MA. Modifications to weekend recovery sleep delay circadian phase in older adolescents. *Chronobiol Int.* 2010;27(7):1469–1492
42. Calamaro CJ, Mason TB, Ratcliffe SJ. Adolescents living the 24/7 lifestyle: effects of caffeine and technology on sleep duration and daytime functioning. *Pediatrics.* 2009;123(6). Available at: www.pediatrics.org/cgi/content/full/123/6/e1005
43. Munezawa T, Kaneita Y, Osaki Y, et al. The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: a nationwide cross-sectional survey. *Sleep.* 2011;34(8):1013–1020
44. Shochat T, Flint-Bretler O, Tzischinsky O. Sleep patterns, electronic media exposure and daytime sleep-related behaviours among Israeli adolescents. *Acta Paediatr.* 2010;99(9):1396–1400
45. Eggermont S, Van den Bulck J. Nodding off or switching off? The use of popular media as a sleep aid in secondary-school children. *J Paediatr Child Health.* 2006;42 (7–8):428–433
46. Van den Bulck J. Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. *Sleep.* 2004;27(1):101–104
47. Johnson JG, Cohen P, Kasen S, First MB, Brook JS. Association between television viewing and sleep problems during adolescence and early adulthood. *Arch Pediatr Adolesc Med.* 2004;158(6):562–568
48. Higuchi S, Motohashi Y, Liu Y, Maeda A. Effects of playing a computer game using a bright display on presleep physiological variables, sleep latency, slow wave sleep and REM sleep. *J Sleep Res.* 2005;14(3): 267–273
49. Punamäki RL, Wallenius M, Nygård CH, Saarni L, Rimpelä A. Use of information and communication technology (ICT) and perceived health in adolescence: the role of sleeping habits and waking-time tiredness. *J Adolesc.* 2007;30(4):569–585
50. Choi K, Son H, Park M, et al. Internet overuse and excessive daytime sleepiness in adolescents. *Psychiatry Clin Neurosci.* 2009;63(4):455–462
51. Dworak M, Schierl T, Bruns T, Strüder HK. Impact of singular excessive computer game and television exposure on sleep patterns and memory performance of school-aged children. *Pediatrics.* 2007;120 (5):978–985
52. Carskadon MA, Acebo C. Regulation of sleepiness in adolescents: update, insights, and speculation. *Sleep.* 2002;25(6):606–614
53. Van den Bulck J. Adolescent use of mobile phones for calling and for sending text messages after lights out: results from a prospective cohort study with a one-year follow-up. *Sleep.* 2007;30(9):1220–1223
54. Boivin DB, Duffy JF, Kronauer RE, Czeisler CA. Dose-response relationships for resetting of human circadian clock by light. *Nature.* 1996;379(6565):540–542
55. Zeitzer JM, Dijk DJ, Kronauer R, Brown E, Czeisler C. Sensitivity of the human circadian pacemaker to nocturnal light: melatonin phase resetting and suppression. *J Physiol.* 2000;526(pt 3):695–702
56. Higuchi S, Motohashi Y, Liu Y, Ahara M, Kaneko Y. Effects of VDT tasks with a bright display at night on melatonin, core temperature, heart rate, and sleepiness. *J Appl Physiol (1985).* 2003;94(5): 1773–1776
57. Wolfson AR, Carskadon MA. A survey of factors influencing high school start times. *NASSP Bull.* 2005;89(642):47–66
58. American Academy of Pediatrics, Adolescent Sleep Working Group, Committee on Adolescence, and Council on School Health. School start times for adolescents. *Pediatrics.* 2014;134(3)
59. 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
60. Wahlstrom K. Changing times: findings from the first longitudinal study of later high school start times. *NASSP Bull.* 2002; 86(633):3–21
61. Dexter D, Bijwadia J, Schilling D, Applebaugh G. Sleep, sleepiness and school start times: a preliminary study. *WMJ.* 2003;102(1):44–46
62. 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
63. 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
64. 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
65. 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
66. 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
67. Kristjansson AL, Sigfusdottir ID, Allegrante JP, James JE. Adolescent caffeine consumption, daytime sleepiness and anger. *J Caffeine Res.* 2011;1(1):75–82
68. 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
69. Pollak CP, Bright D. Caffeine consumption and weekly sleep patterns in US seventh-, eighth-, and ninth-graders. *Pediatrics.* 2003;111(1):42–46
70. Reissig CJ, Strain EC, Griffiths RR. Caffeinated energy drinks—a growing problem. *Drug Alcohol Depend.* 2009;99 (1–3):1–10
71. Orbeta RL, Overpeck MD, Ramcharran D, Kogan MD, Ledsky R. High caffeine intake in adolescents: associations with difficulty sleeping and feeling tired in the morning. *J Adolesc Health.* 2006;38(4):451–453
72. Roehrs T, Roth T. Caffeine: sleep and daytime sleepiness. *Sleep Med Rev.* 2008;12 (2):153–162
73. Gromov I, Gromov D. Sleep and substance use and abuse in adolescents. *Child Adolesc Psychiatr Clin N Am.* 2009;18(4):929–946
74. O'Dea JA. Consumption of nutritional supplements among adolescents: usage and perceived benefits. *Health Educ Res.* 2003;18(1):98–107
75. Bernstein GA, Carroll ME, Thuras PD, Cosgrove KP, Roth ME. Caffeine dependence in teenagers. *Drug Alcohol Depend.* 2002;66(1):1–6
76. Strain EC, Griffiths RR. Caffeine dependence: fact or fiction? *J R Soc Med.* 1995;88(8):437–440
77. Collins L, Graham JW, Rousculp SS, Hansen W. Heavy caffeine use and the beginning of the substance use onset process: an illustration of latent analysis. In: Bryant KJ, Windle M, West SG, eds. *The Science of Prevention: Methodological Advances from Alcohol and Substance Abuse Research.* Washington, DC: American Psychological Association; 1997:79–99
78. Miller MC. What are caffeine's psychological benefits and risks? *Harv Ment Health Lett.* 2005;22(3):8
79. Tennant FS, Jr, Detels R. Relationship of alcohol, cigarette, and drug abuse in

adulthood with alcohol, cigarette and coffee consumption in childhood. *Prev Med.* 1976;5(1):70–77

80. Martin CA, Cook C, Woodring JH, et al. Caffeine use: association with nicotine use, aggression, and other psychopathology in psychiatric and pediatric outpatient adolescents. *ScientificWorldJournal.* 2008; 8:512–516
81. Jaehne A, Loessl B, Bárkai Z, Riemann D, Hornyak M. Effects of nicotine on sleep during consumption, withdrawal and replacement therapy. *Sleep Med Rev.* 2009; 13(5):363–377
82. James JE, Kristjánsson AL, Sigfúsdóttir ID. Adolescent substance use, sleep, and academic achievement: evidence of harm due to caffeine. *J Adolesc.* 2011;34(4):665–673
83. Whalen DJ, Silk JS, Semel M, et al. Caffeine consumption, sleep, and affect in the natural environments of depressed youth and healthy controls. *J Pediatr Psychol.* 2008;33(4):358–367
84. Marczinski CA, Fillmore MT, Henges AL, Ramsey MA, Young CR. Effects of energy drinks mixed with alcohol on information processing, motor coordination and subjective reports of intoxication. *Exp Clin Psychopharmacol.* 2012;20(2):129–138
85. Lookatch SJ, Dunne EM, Katz EC. Predictors of nonmedical use of prescription stimulants. *J Psychoactive Drugs.* 2012;44 (1):86–91
86. Garnier-Dykstra LM, Caldeira KM, Vincent KB, O'Grady KE, Arria AM. Nonmedical use of prescription stimulants during college: four-year trends in exposure opportunity, use, motives, and sources. *J Am Coll Health.* 2012;60(3):226–234
87. Berkey CS, Rockett HR, Colditz GA. Weight gain in older adolescent females: the internet, sleep, coffee, and alcohol. *J Pediatr.* 2008;153(5):635–639, 639.e1
88. Harrison Y, Horne JA. The impact of sleep deprivation on decision making: a review. *J Exp Psychol Appl.* 2000;6(3):236–249
89. Beebe DW. Cognitive, behavioral, and functional consequences of inadequate sleep in children and adolescents. *Pediatr Clin North Am.* 2011;58(3):649–665
90. Chen MC, Burley HW, Gotlib IH. Reduced sleep quality in healthy girls at risk for depression. *J Sleep Res.* 2012;21(1):68–72
91. Howland RH. Sleep interventions for the treatment of depression. *J Psychosoc Nurs Ment Health Serv.* 2011;49(1):17–20
92. Okun ML, Luther J, Prather AA, Perel JM, Wisniewski S, Wisner KL. Changes in sleep quality, but not hormones predict time to postpartum depression recurrence. *J Affect Disord.* 2011;130(3):378–384
93. 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
94. Dahl RE, Ryan ND, Matty MK, et al. Sleep onset abnormalities in depressed adolescents. *Biol Psychiatry.* 1996;39(6):400–410
95. Lopez J, Hoffmann R, Armitage R. Reduced sleep spindle activity in early-onset and elevated risk for depression. *J Am Acad Child Adolesc Psychiatry.* 2010;49(9):934–943
96. 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
97. O'Brien EM, Mindell JA. Sleep and risk-taking behavior in adolescents. *Behav Sleep Med.* 2005;3(3):113–133
98. Catrett CD, Gaultney JF. Possible insomnia predicts some risky behaviors among adolescents when controlling for depressive symptoms. *J Genet Psychol.* 2009; 170(4):287–309
99. Coulombe JA, Reid GJ, Boyle MH, Racine Y. Concurrent associations among sleep problems, indicators of inadequate sleep, psychopathology, and shared risk factors in a population-based sample of healthy Ontario children. *J Pediatr Psychol.* 2010; 35(7):790–799
100. 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
101. Liu X. Sleep and adolescent suicidal behavior. *Sleep.* 2004;27(7):1351–1358
102. Liu X, Buysse DJ. Sleep and youth suicidal behavior: a neglected field. *Curr Opin Psychiatry.* 2006;19(3):288–293
103. An H, Ahn JH, Bhang SY. The association of psychosocial and familial factors with adolescent suicidal ideation: a population-based study. *Psychiatry Res.* 2010;177(3): 318–322
104. 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
105. Leproult R, Van Cauter E. Role of sleep and sleep loss in hormonal release and metabolism. *Endocr Dev.* 2010;17:11–21
106. Van Cauter E, Spiegel K, Tasali E, Leproult R. Metabolic consequences of sleep and sleep loss. *Sleep Med.* 2008;9(9 suppl 1): S23–S28
107. Van Cauter E, Knutson KL. Sleep and the epidemic of obesity in children and adults. *Eur J Endocrinol.* 2008;159(suppl 1):S59–S66
108. Countryman AJ, Saab PG, Llabre MM, Penedo FJ, McCalla JR, Schneiderman N. Cardiometabolic risk in adolescents: associations with physical activity, fitness, and sleep. *Ann Behav Med.* 2013;45(1):121–131
109. 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
110. Gupta NK, Mueller WH, Chan W, Meininger JC. Is obesity associated with poor sleep quality in adolescents? *Am J Hum Biol.* 2002;14(6):762–768
111. Seicean A, Redline S, Seicean S, et al. Association between short sleeping hours and overweight in adolescents: results from a US suburban high school survey. *Sleep Breath.* 2007;11(4):285–293
112. Liou YM, Liou TH, Chang LC. Obesity among adolescents: sedentary leisure time and sleeping as determinants. *J Adv Nurs.* 2010;66(6):1246–1256
113. Snell EK, Adam EK, Duncan GJ. Sleep and the body mass index and overweight status of children and adolescents. *Child Dev.* 2007;78(1):309–323
114. Al Mamun A, Lawlor DA, Cramb S, O'Callaghan M, Williams G, Najman J. Do childhood sleeping problems predict obesity in young adulthood? Evidence from a prospective birth cohort study. *Am J Epidemiol.* 2007; 166(12):1368–1373
115. Matthews KA, Dahl RE, Owens JF, Lee L, Hall M. Sleep duration and insulin resistance in healthy black and white adolescents. *Sleep.* 2012;35(10):1353–1358
116. Al-Disi D, Al-Daghri N, Khanam L, et al. Subjective sleep duration and quality influence diet composition and circulating adipocytokines and ghrelin levels in teenage girls. *Endocr J.* 2010;57(10):915–923
117. Weiss A, Xu F, Storfer-Isser A, Thomas A, levers-Landis CE, Redline S. The association of sleep duration with adolescents' fat and carbohydrate consumption. *Sleep.* 2010;33(9):1201–1209
118. Martinez-Gomez D, Eisenmann JC, Gomez-Martinez S, et al; AFINOS Study Group. Sleep duration and emerging cardiometabolic risk markers in adolescents. The AFINOS study. *Sleep Med.* 2011;12(10):997–1002
119. Beebe DW, Lewin D, Zeller M, et al. Sleep in overweight adolescents: shorter sleep, poorer sleep quality, sleepiness, and sleep-disordered breathing. *J Pediatr Psychol.* 2007;32(1):69–79
120. Kang KT, Chou CH, Weng WC, Lee PL, Hsu WC. Associations between adenotonsillar hypertrophy, age, and obesity in children with obstructive sleep apnea. *PLoS One.* 2013;8(10):e78666

121. Kheirandish-Gozal L, Etzioni T, Bhattacharjee R, et al. Obstructive sleep apnea in children is associated with severity-dependent deterioration in overnight endothelial function. *Sleep Med.* 2013;14(6):526–531
122. Van Hoorenbeeck K, Franckx H, Debode Pet al. Metabolic disregulation in obese adolescents with sleep-disordered breathing before and after weight loss. *Obesity (Silver Spring).* 2013;21(7):1446–1450
123. Ingram DG, Matthews CK. Effect of adenotonsillectomy on C-reactive protein levels in children with obstructive sleep apnea: a meta-analysis. *Sleep Med.* 2013;14(2): 172–176
124. Knutson KL. Sex differences in the association between sleep and body mass index in adolescents. *J Pediatr.* 2005;147 (6):830–834
125. Sun Y, Sekine M, Kagamimori S. Lifestyle and overweight among Japanese adolescents: the Toyama birth cohort study. *J Epidemiol.* 2009;19(6): 303–310
126. Calamaro CJ, Park S, Mason TB, et al. Shortened sleep duration does not predict obesity in adolescents. *J Sleep Res.* 2010;19(4):559–566
127. Knutson KL, Lauderdale DS. Sleep duration and overweight in adolescents: self-reported sleep hours versus time diaries. *Pediatrics.* 2007;119(5). Available at: www.pediatrics.org/cgi/content/full/119/5/e1056
128. Garbarino S, Nobili L, Beelke M, De Carli F, Ferrillo F. The contributing role of sleepiness in highway vehicle accidents. *Sleep.* 2001;24(2):203–206
129. Connor J, Whitlock G, Norton R, Jackson R. The role of driver sleepiness in car crashes: a systematic review of epidemiological studies. *Accid Anal Prev.* 2001;33 (1):31–41
130. Connor J, Norton R, Ameratunga S, et al. Driver sleepiness and risk of serious injury to car occupants: population based case control study. *BMJ.* 2002;324(7346): 1125
131. Philip P, Akerstedt T. Transport and industrial safety, how are they affected by sleepiness and sleep restriction? *Sleep Med Rev.* 2006;10(5):347–356
132. Pack AI, Pack AM, Rodgman E, Cucchiara A, Dinges DF, Schwab CW. Characteristics of crashes attributed to the driver having fallen asleep. *Accid Anal Prev.* 1995;27(6): 769–775
133. Lowden A, Anund A, Kecklund G, Peters B, Akerstedt T. Wakefulness in young and elderly subjects driving at night in a car simulator. *Accid Anal Prev.* 2009;41(5): 1001–1007
134. Åkerstedt T, Kecklund G. Age, gender and early morning highway accidents. *J Sleep Res.* 2001;10(2):105–110
135. 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
136. Pizza F, Contardi S, Antognini AB, et al. Sleep quality and motor vehicle crashes in adolescents. *J Clin Sleep Med.* 2010;6(1): 41–45
137. Taylor DJ, Bramoweth AD. Patterns and consequences of inadequate sleep in college students: substance use and motor vehicle accidents. *J Adolesc Health.* 2010; 46(6):610–612
138. Sagaspe P, Taillard J, Chaumet G, Moore N, Bioulac B, Philip P. Aging and nocturnal driving: better with coffee or a nap? A randomized study. *Sleep.* 2007;30(12): 1808–1813
139. Smith-Coggins R, Howard SK, Mac DT, et al. Improving alertness and performance in emergency department physicians and nurses: the use of planned naps. *Ann Emerg Med.* 2006;48(5):596–604, 604. e1–e3

Insufficient Sleep in Adolescents and Young Adults: An Update on Causes and Consequences

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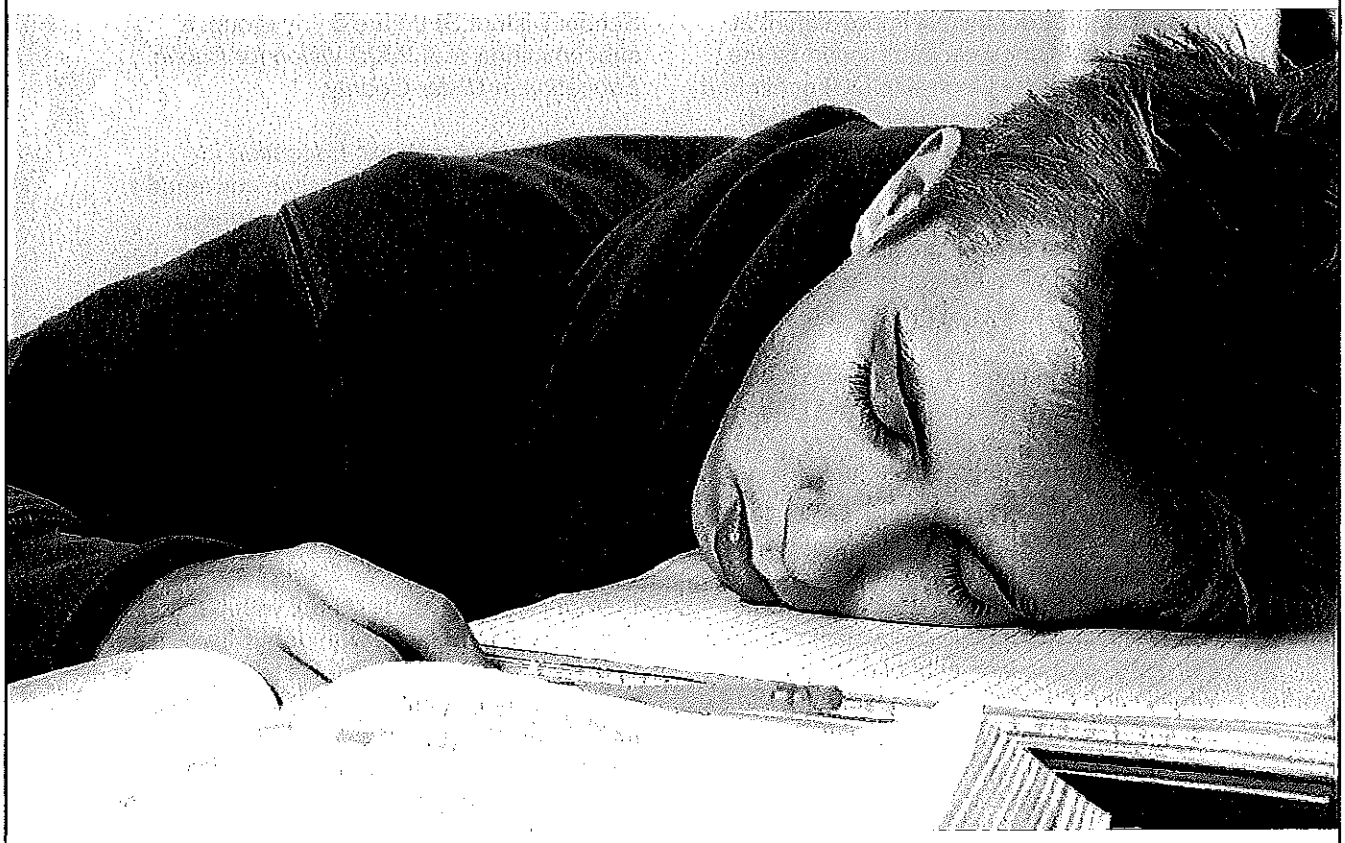
A 2020 VISION

FOR PUBLIC EDUCATION in ULSTER COUNTY

Later School Start Times for Adolescents

August 2014



The Center for Research, Regional Education and Outreach, SUNY New Paltz

Ulster County School Boards Association

Later School Start Times for Adolescents

The idea of later school start times for adolescents has become a front burner issue across the nation in recent months, in part as a result of the convergence of two streams of research (New York Times, 2014; Washington Post, 2014). First, biological scientists have shown that late-rising teenagers are not just lazy, as stereotypically assumed. Rather there is an emerging consensus among these researchers that sleep cycles change as children mature into adolescence, causing teenagers to fall asleep later in the evening and sleep later into the morning. Meanwhile a parallel body of research has identified multiple benefits of adequate sleep for adolescents. Recently, a study conducted by researchers at the Center for Applied Research and Educational Improvement at University of Minnesota, and funded by the Center for Disease Control (CDC) confirmed multiple academic, emotional, social, and health benefits that derive from additional sleep afforded by later school start times (Wahlstrom, 2014). Importantly, this study also shows that when school starts later—and is thus aligned with adolescent sleep cycles—adolescents actually get more sleep.

It was in recognition of these findings that U.S. Secretary of Education Arnie Duncan endorsed the idea of starting high school later in the day (August, 2013). In the last 10 years, school districts in California, Oklahoma, Georgia, New York, Connecticut, North Carolina, Kentucky, and Minnesota have changed schedules to accommodate later start times for their adolescent students. Currently, countywide school districts in Virginia and Maryland are considering changing the times of their first school bell, as are urban districts in St. Paul, MS and Richmond, VA. In 2009, members of the U.S. House of Representatives introduced House Concurrent Resolution 176 (also known as the Zzz's to A's Resolution) in support of later school start times, and in 2014, a landmark bill passed by the Maryland legislature requires state health officials to conduct a study on the sleep needs of students and the experiences of schools that have shifted to later start times. These actions have propelled what has been a local conversation to a national, and statewide, arena (Washington Post, 2014; Kelley & Lee, 2014).

This policy brief summarizes the research on later school start times for adolescents and provides a framework for thinking about the implementation of this idea in Ulster County, New York. It is the work of the School and School District Structure study group, a subcommittee of *A 2020 Vision for Public Education in Ulster County.*

A 2020 Vision for Public Education in Ulster County was a symposium convened in November, 2013 to begin the process of proactively shaping a vision for public education in the county's communities. Stakeholders from eight Ulster County school districts gathered to use a regional lens to engage questions of teaching and learning, accountability, and school and school district structure. In doing so they self-consciously began the process of generating thoughts and ideas about ways to promote county-wide, regional thinking in the service of improving educational delivery. The School and School District Structure study group, with participation from numerous stakeholders with diverse perspectives, from multiple Ulster County school districts, continued this work through monthly meetings. Participants identified and researched issues for further consideration by the larger 2020 group. School start times for adolescents is one of these issues.

A policy brief of the School and School District Structure Study Group by
Tony Fletcher, President of the Board of Education in the Onteora Central School District, and
Robin Jacobowitz, PhD, Education Projects Director at CRREO

...there is an emerging consensus among these researchers that sleep cycles change as children mature into adolescence, causing teenagers to fall asleep later in the evening and sleep later into the morning.

Sleep and adolescents

Getting sufficient sleep is an important factor in the overall health for people of all ages, affecting memory and learning, attention capacity, and a range of emotional and physical health outcomes (Moller-Levet et al., 2013; Foster et al., 2013; Payne, 2011; Knutson, 2007). The amount of needed sleep, and the patterns and cycles of that sleep, differ for people of different ages. For youth, the circadian timing that drives sleep shifts as children develop into adolescence; wakefulness-inducing hormones (cortisol) persist longer throughout the day and sleep-inducing hormones (melatonin) are trigged later in the evening and last longer into the morning. This causes adolescents to fall asleep later at night and wake later in the morning than younger children or adults (Carskadon et al., 1997; Wolfson & Carskadon, 1998; Crowley et al., 2007). The presence in adolescents of sleep-inducing hormones (melatonin) further into the morning makes early morning functioning even more difficult for these youth (Carkasdon et al., 1998). The difference between adolescent circadian rhythms and those of younger children and adults is as wide as three hours. (Kelley & Lee, 2014).

This does not mean that teenagers need less sleep. Researchers find that adolescents still require at least 9 hours of sleep each night (Hansen et al., 2005; National Sleep Foundation, 2000; Carskadon et al., 1998). It is physiologically natural for adolescents to fall asleep late at night and then sleep later into the following morning.

Notwithstanding this reality, the school day for adolescents usually begins between 7:00—7:45am. Moreover, students are required to rise early enough to board the bus or pull out of their driveways up to an hour in advance of these start times. Combined with the biologically-driven predisposition to stay up later, this makes getting the optimum 9 hours of sleep unlikely (Hansen et al., 2005; National Sleep Foundation, 2000; Carskadon et al., 1998). The result is a "circadian misalignment" with observable negative consequences for education and youths' physical and mental health more generally (Hasler & Clark, 2013, pp. 558; see also Wahlstorm et al., 2014; Leger et al., 2013; Willingham, 2012; O'Malley & O'Malley, 2008; Hansen et al., 2005).

Negative effects for adolescents are academic, social, mental, and physical, and include:

- **Academic complications**

  Research demonstrates that insufficient sleep is associated with decreased memory capacity and decreased capacity to sustain attention during the performance of academic tasks (Beebe et al., 2010). Studies show lower scores on quizzes and higher incidents of "inattentive" and "sleepy" behaviors—e.g. yawning or putting one's head on the desk—for students who were deprived of adequate sleep than for these same students when they received adequate sleep (Beebe et al., 2010). Another study finds that less sleep—even if a student stays awake to study—results in greater academic problems, such as poor quiz scores or difficulty understanding academic material, and that these problems compound as the effects of lack of sleep accumulate over students' high school careers (Gillen-O'Neel et al., 2013).

- **Greater risk-taking behaviors**

  Research finds greater risk-taking behaviors, such as substance abuse (use of alcohol, cigarettes, marijuana); sexual activity, aggression, and lack of physical exercise, among adolescents who report insufficient sleep (fewer than 8 hours) (McKnight-Eily et al., 2011; see also Hasler & Clark, 2013; O'Malley & O'Malley, 2008; National Sleep Foundation, 2000).

- **Greater risk for depression**

  Studies show that students who get inadequate sleep are more likely to suffer from depression, experience anxiety, and express suicidal thoughts (McKnight-Eily et al., 2011; Moore et al., 2009). Researchers have also found a relationship between sleep and adolescents' own sense of their emotional state, mood, and ability to regulate and control their emotions. Sleep-deprived adolescents (who get fewer than 8 hours of sleep) report more feelings of anxiety, irritability and hostility than their well-rested peers (Baum et al., 2014; Carskadon & Acebo, 2004). In one study, these self-reports are corroborated by parental reports (Baum et al., 2014).

- **Poorer physical health**

  Incidents of obesity are higher among adolescents who get insufficient sleep: "for each hour of lost sleep, the odds of obesity increased by 80%" (Gupta, 2002, pp. 762). Athletes who got less than eight hours of sleep were 1.7 times more likely to suffer an injury than those who got more than eight hours of sleep (Milewski et al., 2014).

- **Greater risk of injury from accidents**

  Research has found a relationship between adolescent car accidents and lack of sleep; in a study of driving records of 17—24 year olds, young people who reported the least sleep were 21 percent more likely to have been involved in a car accident than those who reported the most sleep (Martiniuk et al., 2013; see also Cirignotta, 2010).

Research that specifically explores the impact of later school start times finds multiple positive outcomes for adolescents in these areas of risk. And, importantly, research shows that adolescents get more sleep when school starts later and is thus more closely aligned with their natural sleep cycle (Wahlstorm, 2014; Boergers et al., 2014; Perkinson-Gloor et al., 2013; Edwards, 2012; Owens et al., 2010). Positive academic and health outcomes from later school start times include:

- **Better academic performance**

  Researchers find higher grade point averages in core academic classes (Wahlstrom et al, 2014), higher grades in general (Carrell et al., 2011; Perkinson-Gloor et al., 2013; Short et al, 2013), and generally higher test scores (Edwards, 2012) for adolescents in schools with later start times.[1]

- **Reduced tardiness and absences**

  Studies find an increase in attendance, a decrease in lateness, and a decrease in excused absences in schools that have moved to later start times (Wahlstrom, 2014; Drake et al, 2003).

- **Less depression**

  In a study of the impact of school start time on students' sleep habits and depressive mood, researchers surveyed students before a delay in start time was implemented (8:00am) and after (8:25am); on average, students report getting more sleep and experiencing fewer incidents of depression than prior to the change in school start time (Boegers et al, 2014; see also Owens et al, 2010). More generally, 92% of parents whose adolescent children attended school before and after a change to a later start time reported that "their children are easier to live with as a result of the change (to a later school start time)" (Wahlstrom, KCRW radio interview, 4/7/14).

- **Fewer car accidents**

  In Fayette County, KY, adolescent car crashes were reduced by more than 16% in the two years subsequent to instituting a later start time for high schools

1 Empirical evidence about outcomes on standardized tests is inconsistent (see Wahlstrom et al., 2014 and Hintichs et al., 2011).

(Danner 2008). In Teton County, WY, the year after the high school first bell was delayed from 7:35am to 8:55am, car accidents for 16-18 year olds reduced from 23 to 7, a 70 percent reduction (Walhstorm, 2014).[2] Likewise, in a study of adolescent car accidents and school start times, researchers found significantly higher accident rates for teenagers in a county with an earlier school start time than in a neighboring county with a later school start time. In both counties the majority of these accidents occurred during the morning commute to schools (Vorona et al., 2011).

Findings from the most recent research reveal "empirically-based positive outcomes for adolescents whenever the start time of their high school is moved to a later time—with the starting time of 8:30 AM or later clearly showing the most positive results" (Wahlstorm, 2014, pp. 52). It is this research, within the context of the larger body of empirical evidence about adolescents' sleep needs and sleep cycles that has prompted educators and policy makers at the local, state, and national levels to advocate for later start times for schools attended by adolescents.

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Wahlstorm, 2014, pp. 52).

Hurdles, and solutions, to altering school start times

Despite overwhelming empirical evidence about the benefits of sleep for all aspects of adolescent health, and the misalignment between adolescent sleep needs and school start times, hurdles to the implementation of later school start times persist. Researchers who documented the process of changing to later start times have identified the following hurdles and potential solutions (Wahlstrom et al, 2014; see also sleepinfairfax.org):

- **Extracurricular participation**

  There is a concern that later school start times—and therefore later school end times—will limit students' ability to participate in sports, other after-school activities, and part-time employment. Evidence is mixed. Some districts saw an increase in participation in sports and others noticed improved athletic performance (National Sleep Foundation, 2000). Researchers also found that most employers asked student-employees to begin work after 4:00pm, so a later school end time did not impact employment (National Sleep Foundation, 2000). However, another study found that in urban settings later start times did result in less student participation in extracurricular and social activities and also created conflicts for students who worked after school, sometimes diminishing their earnings (Freeman and Wahlstorm, 1997). This same study found no effect of later start times on extracurricular participation and employment for suburban students. This remains an important issue that warrants close attention at the implementation phase of later start times.

  Strategies for addressing extracurricular participation: Overall, districts that have shifted their school start times later have found ways to address concerns about extracurricular participation. These include providing lighting for sports fields so that practice can run later during seasons with early nightfall, and/or scheduling extra games and practices on weekends. Another idea has been to incorporate,

2 This large reduction int teenage accidents was noted for two out of the four districts in Wahlstrom's study (2014); the third district saw a smaller reduction (6%) and the fourth district saw an increase (9%). Walhstrom attributes the increases in the fourth district to the geographic circumstances of that district.

where possible, an "activity period" into the school day so that, effectively, the day would not end later, even as it starts later. (In some schools, the last period of the day is a student-optional period during which some clubs operate or students may seek extra help if needed. Sports practices begin, generally, after this period has ended.)

- **Transportation**

  Bus schedules are often linked and shared among schools and grade levels within a district; buses that drop high school students at school then return to pick up younger students. Moving the start time for students in upper grades may require a shift in transportation for other schools as well.

  Strategies for addressing transportation: Solutions that do not involve the addition of bus runs include moving all the start times back so that all students go to school later, or "flipping" the start times of all district schools so that younger students go to school earlier and older students go to school later. Moving to a single bell schedule, so that all schools begin at the same time, can mean adding more buses, which is not always a feasible option with tight school district budgets.

- **Child care**

  Some families use their older children to provide childcare for the younger ones while parents are still at work. "Flipping" the schedule, so that younger children leave for school—and get home—earlier than older children can present childcare challenges in the afternoon. Relatedly, if school districts move the start time of all schools to later in the morning, then some families may encounter morning childcare problems.

  Strategies for addressing childcare issues: Some districts have worked with local organizations to provide additional before or after-school care for younger students. Others have worked with community partners to provide extra-curricular activities for younger students.

In Ulster County, region-specific hurdles have hindered the efforts of school districts to enact later school start times. For example, alignment with the countywide Board of Cooperative Educational Services (BOCES) schedule is an issue. BOCES provides classes on a regional basis to high school students from all of its component school districts. If one district unilaterally decides to push the start of its high school to later in the morning, this may impact the ability of that district's students to get to a BOCES class on time.

Another regional issue is the scheduling of athletic events, since Ulster County districts compete against one another in sports.

Both of these challenges—the BOCES schedule and athletics—could be addressed through an alignment of Ulster County school districts' schedules and a simultaneous shift to later school start times. The BOCES schedule could then be adjusted accordingly and athletic competitions scheduled, as currently, at the end of the school day. Alternatively, BOCES could, perhaps, establish a two-tiered schedule to accommodate different start times of component districts.

The range of educational and other benefits of later school start times for adolescents are compelling and well-established in the research. Most hurdles are logistical. This does not mean that these hurdles are not real or meaningful. However, it does mean that they are surmountable. How might this be done? How have others accomplished it?

Process of making the switch: case studies of implementation

There are many ways to implement later start times: "flip" the timing of high school and elementary schools so that high school students begin school later and elementary school students begin school earlier; move the start times of all schools to later in the morning; add additional buses so as to transport students of all ages to school concurrently; delay start time and maintain end time; or provide flexible start and end times.

There is growing experience with the change process. Already in New York State, Glens Falls switched its high school start time from 7:45am to 8:26am, and is reporting positive results; assistant high school principal Elisabeth Collins reported that data show, "our students are getting up to 30 minutes more of sleep a night, our discipline write-ups have lessened, our tardiness rate is not as severe as it was 2 years ago. And another very important point is that the students are failing fewer courses in their day" (Radio interview, KCRW, 4/3/14; Brian Lehrer show, 4/10/14; see also http://www.gfsd.org/News/2013-14/041514NYCsleep.cfm). More recently in Ulster County, the New Paltz school district has begun conversations about shifting the start time of its high school to later in the morning. Across the nation we are seeing that moving to later start times is, generally, a one-to two-year process, beginning with community conversations and forums about the benefits of later start times, and then moving on to discussions about logistics. Following are two case studies that briefly describe this process. [3]

Arlington, VA

Arlington Public Schools is a countywide school district located outside of Washington, DC. At the time that the district moved to later start times for its high schools, in 2001, it had 30 schools and approximately 19,000 students. (In comparison, all Ulster County districts together enrolled, collectively, approximately 24,300 students in the 2011-12 school year.) Prior to the change to later high school start times, there was a four-tier transportation protocol; high school began at 7:30am, middle school and upper elementary at 8:10am, early elementary at 8:50am and alternative schools at 9:20am. Arlington began its process by establishing, with community input, the five conditions that would have to be met for change to be implemented:

- any change to school start times would have to improve teaching and learning,
- no school would start before 7:50am,
- no one group would be disadvantaged by the change,
- extracurricular activities would not be significantly impacted, and,
- as funding was constrained, the change could not require additional buses.

Once the school board decided, after a comprehensive review of the research, to proceed with later high school start times, the superintendent appointed an interdepartmental team to study how to implement the change. This team developed twelve possible scenarios for implementation; each was studied for feasibility. All meetings were open to stakeholder participation. One committee, dedicated completely to public engagement, reached out to the community through newsletters and updates to PTAs, school district employee newsletters, press releases, updates on the district webpage, and an email account dedicated to receiving—and responding to—questions and concerns from the community about the start time change. Crucially, engagement with the public allowed all stakeholders to have input into the change. Also important, public engagement continued after a final proposal was selected; the team that was responsible for the implementation of delayed high school start times addressed critical implementation issues, and their solutions, through a series of white papers that were distributed to the community.

Arlington's transition to later high school start times took approximately two and a half years. High schools there now begin at 8:15am, middle schools at 7:50am, and elementary schools at 8:00am, 8:25am, or 9:00am. An informal post-change survey revealed that high school students felt more alert and better prepared for school, high school teachers noted an increase in participation and student attention, and parents reported better attitudes from their high school students. However, middle school students—who now begin school the earliest—reported feeling less alert.

Wilton School District, CT

The Wilton School District implemented a new start time for high school students in the fall of 2003. At that time, there were 4,300 students in the Wilton School District, served in 5 school buildings (two k-2 buildings, one 3-5 building, one middle school and one high school. The high school enrollment was about 1200 students). Prior to the change grades 6-12 began at 7:35 a.m. and grades 3-5 at 8:15am. The K-2 schools began at 9:00am. A three-level bus route accommodated these three different start times.

3 This information was taken directly from the Start Later for Excellence in Education Proposal website, www.sleepinfairfax.org/docs/CS.Arlginton.pdf, www.sleepinfairfax.org/docs/CS.Jessamine.pdf.

The shift to a later start time for the high school followed a two-year public engagement process—initiated by the Wilton League of Women Voters. The League played a convening, public awareness, and support role throughout this two-year process, attending multiple PTA meetings, convening its own public information sessions, and developing and implementing (in conjunction with the Norwalk Hospital Center for Sleep Disorders) a survey to garner student and staff input into the process. A major source of resistance to later start times was fear that change would preclude participation in the Wilton Sports Council, which represents local sports leagues. Public engagement efforts included working with the Council, which eventually came to support the idea.

In 2003, Wilton initiated a change in its school start times, flipping the schedule so that grades 3-5 begin at 7:35am and grades 6-12 begin at 8:15am. Start times for K-2 remain unchanged. Outcomes from the shift were predominately positive. Teachers reported better behavior and attention from students; interestingly, there was an increase in the participation in athletics. Parents reported more positive behavior and a survey, conducted by the Norwalk Hospital Sleep Disorders Clinic, found that students were getting more sleep. Students reported getting better grades. There were scheduling issues that arose with athletic events that were not played at home; in many instances, athletes were pulled from class earlier to attend away games. Overall, Wilton residents felt that the shift to later start times was a success.

Conclusion and next steps

Later school start times for adolescents is just one of several issues that the School and School District Structure study group, a subcommittee of the *A 2020 Vision for Public Education in Ulster County*, will present to participants in the larger 2020 Vision initiative for further consideration and possible action.

The mission of 2020 is to promote county-wide, regional thinking in the service of improving educational delivery. In Ulster County, the regional obstacles to implementation of a later school start time include scheduling with Ulster BOCES in the delivery of valuable educational services to students and potential coordination of sports programming. Aligning schedules and calendars, regionally, could mitigate these obstacles.

The research on later school start times is compelling and clear. Now education stakeholders in Ulster County must come together to decide whether this is a change that we want to embrace and if so, how we should go about doing that. While decisions must be locally-based and supported, regional implementation can facilitate the process.

The School and School District Structure study group hopes that the issue of later school start times will be the subject of thoughtful, measured delliberation at the reconvening of *A 2020 Vision for Public Education in Ulster County* in December, 2014.

Resources

Baum, K. T., Desai, A., Field, J., Miller, L. E., Rausch, J., Beebe, D. W. (2014). Sleep restriction worsens mood and emotion regulation in adolescents. *The Journal of Child Psychology and Psychiatry, 2.* Pp. 180-190.

Beebe, D. W., Rose, D., Amin, R. (2010). Attention, learning, and arousal of experimentally sleep-restricted adolescents in a simulated classroom. *Journal of Adolescent Health, 47,* pp. 523–525.

Boergers, J., Gable, C. J., Owens, J. A. (2014). Later school start time is associated with improved sleep and daytime functioning in adolescents. *Journal of Developmental Behavioral Pediatrics, 35(1),* pp. 11-17.

Carrell, S.E., Maghakian, T., Wes, J.E. (2011) A's from Zzzz's? The causal effect of school start time on the academic achievement of adolescents. *American Economic Journal: Economic Policy 3,* pp. 62-81.

Carskadon, M. A., Acebo, C., Richardson, G. S., Tate, B. A., Seifer, R. (1997). An approach to studying circadian rhythms of adolescent humans. *Journal of Biological Rhythms, 12(3),* pp. 278-289.

Carskadon, M. A., Wolfson, A. R., Acebo, C., Tzischinsky, O., Seifer, R. (1998). *Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. Sleep, 21(8),* pp. 871-881.

Crowley, S. J., Acebo, C., Carskadon, M.A. (2007). Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep Medicine, 8,* pp. 602-12.

Danner, F., Philips, B. (2008). Adolescent sleep, school start times, and teen motor vehicle crashes. *Journal of Clinical Sleep Medicine, 4(6),* pp. 533-535.

Edwards, F. (2012). Early to rise? The effect of daily start times on academic performance. *Economics of Education Review, 31(6),* pp. 970-983.

Foster, R. G., Peirson, S. N., Wulff, K., Winnebeck, E., Vetter, C., Roenneberg, T. (2013). Sleep and circadian rhythm disruption in social jetlag and mental illness. *Progress in Molecular Biology and Translational Science, 119,* pp. 325-346.

Gillen-O'Neel, C., Huynh, V. W., Fuligni, A. J. (2013). To study or to sleep? The academic costs of extra studying at the expense of sleep. *Child Development, 84(1),* pp. 133–142.

Gupta, N. K., Mueller, W. H., Chan, W. and Meininger, J. C. (2002), Is obesity associated with poor sleep quality in adolescents?. *American Journal of Human Biology, 14,* pp. 762–768.

Hansen, M., Janssen, I., Schiff, A., Zee, P. C., Dubocovich, M. L. (2005). The impact of school daily schedule on adolescent sleep. *Pediatrics, 115(6),* pp. 1555-1561.

Hasler, B. P., Clark, D. B. (2013). Circadian misalignment, reward-related brain function, and adolescent alcohol involvement. *Alcoholism, Clinical, and Experimental Research, 37(4),* pp. 558-565.

Hinrichs, P. (2011). When the bell tolls: The effects of school starting times on academic achievement. *Education Finance and Policy, 6(4),* pp. 486-507.

Hoffman, J. (2014, March 13). *To keep teenagers alert, schools let them sleep in.* New York Times. http://well.blogs.nytimes.com/2014/03/13/to-keep-teenagers-alert-schools-let-them-sleep-in/

Kelley, P., Lee, C. (2014). *Later school start times in adolescence: Time for change.* Education Commission of the States: Denver, CO. http://www.ecs.org/clearinghouse/01/12/19/11219.pdf

Knutson, K.L., Spiegel, K., Penev, P., Van Cauter, E. (2007). The metabolic consequences of sleep deprivation. *Sleep Medicine Reviews, 11,* pp. 163-178.

Leger, D., Beck, F., Richard, J. B., & Godeau, E. (2012). Total sleep time severely drops during adolescence. PLOS ONE, *7(10),* e45204. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0045204

Martiniuk, A.L.C., Senserrick, T., Lo, S., Williamson, A., Du, W., Grunstein, R., Woodward, M., Glozier, N., Stevenson, M., Norton, R., Ivers, R. (2013). Sleep-deprived young drivers and the risk for crash. The DRIVE prospective cohort study. *JAMA Pediatrics, 167(7),* pp. 647-655.

McKnight-Eily, L., Eaton, D. K., Lowry, R., Croft, J. B., Presley-Cantrell, L., Perry, G. S. (2011). Relationships between hours of sleep and health-risk behaviors in US adolescent students. *Preventive Medicine, 53,* pp. 271-273.

Milewski, M., Skaggs, D.L., Bishop, G.A., Pace, J.L., Ibrahim, D.A., Wren, T.A.L., Barzdukas, A. (2014). Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. *Journal of Pediatric Orthopaedics, 34(2),* pp. 129-133.

Moore, M., Kirchner, H.L., Drotar, D., Johnson, N., Rosen, C., Ancoli-Israel, S., Redline, S. (2009). Relationships among sleepiness, sleep time, and psychological functioning in adolescents. *Journal of Pediatric Psychology, 34(10),* pp. 1175-1183.

National Sleep Foundation. (2000). *Research report and resource guide. Adolescent sleep needs and patterns.* National Sleep Foundation: Washington DC.

O'Malley, E. B., O'Malley, M. B. (2008). Chapter 7. School start time and its impact on learning and behavior. *In Sleep and Psychiatric Disorders in Children and Adolescents, First Edition.* Informa Healthcare: UK.

Owens, J. A., Belon, K., Moss, P. (2010). Impact of delaying school start time on adolescent sleep, mood, and behavior. *JAMA Pediatrics, 164(7),* pp. 608-614.

Payne, J. D. (2011). Learning, memory, and sleep in humans. *Sleep Medicine Clinics, 6,* pp. 15–30. doi:10.1016/j.jsmc.2010.12.005 http://ndsamlab.weebly.com/uploads/9/6/8/2/9682359/19payne_sleepmedclin2011-1.pdf

Perkinson-Gloor, N., Lemola, S., Grob, A. (2013). Sleep duration, positive attitude toward life, and academic achievement: The role of daytime tiredness, behavioral persistence, and school start times. *Journal of Adolescence, 36.* pp. 311-318.

Short, M. A., Gradisar, M., Lack, L. C., Wright, H. R. (2013). The impact of sleep on adolescent depressed mood, alertness and academic performance. *Journal of Adolescence, 36.* pp. 1025-1033.

Vorona, R.D., Szklo-Coxe, M., Wu, A., Dubik, M., Ware, J. C. (2011). Dissimilar Teen Crash Rates in Two Neighboring Southeastern Virginia Cities with Different High School Start Times. *Journal of Clinical Sleep Medicine, 7(2)*, pp. 145-151.

Wahlstrom, K., Freeman C. (1997). *School Start Time Study: Final Report Summary.* The Center for Applied Research and Educational Improvement, College of Education and Human Development, University of Minnesota.

Wahlstrom, K., Dretzke, B., Gordon, M., Peterson, K., Edwards, K., & Gdula, J. (2014). *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.

Wolfson A.R., Carskadon M. (1998). Sleep schedules and daytime functioning in adolescents. *Child Development, 69(4)*, pp. 875–887.

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SLEEP Research - Links to Web Pages With Information About:

I. Adolescents and sleep

- Children's National Medical Team (contracted by FCPS) has been tasked with developing several workable scenarios to start FCPS high schools after 8:00 am to improve students' mental and physical health, academic performance, and safety. http://www.smartschoolstart.org/

Summaries of Sleep Research with Links to Primary Sources Organized by Topic:

- http://schoolstarttime.org
- http://startschoollater.pbworks.com/w/page/58217472/Start School Later Reference List

Harvard Medical School, Division of Sleep Medicine:

- Home Page - Healthy Sleep
- Sleep, Learning, and Memory Summary of why sleep is important to learning and memory
- Matt's Story: Rethinking School Start Times (video 4:12 minutes)
- Sleep, Learning, and Memory (video1:52 minutes)
- Why Sleep Matters (Video: 6:12 minutes) Summary of what researchers are learning about why sleep is important to health, safety, longevity, and learning and memory

National Institutes of Health, US Department of Health and Human Services

- *Your Guide to Healthy Sleep* a general discussion about sleep in general, including teens. Check the sections on 'How Much Sleep is Enough' and 'What Does Sleep Do For You' (a 2.6 MB pdf file requiring a fast connection.)

Educating Youth about Sleep and Drowsy Driving
Awake at the Wheel Brochure
Other materials for teens and teachers of teens

1. *On Your Mark, Get Set...Sleep!*
2. *Zzzzz - How Much Is Enough?Other materials for teens and teachers of teens*
3. *Why Johnny Can't Stay Awake in Class*

The National Sleep Foundation (NSF):

- NSF Homepage
- Back to School Sleep Tips

- Teens and Sleep
- *Adolescent Sleep Needs and Patterns: Research Report and Resource Guide* (this is a 3MB file, so you will need a fast internet connection to dowload it.)

FCPS Transportation Task Force:

- *Facts about Sleep and Adolescents* (Appendix E of the TTF Final Report March 2008)

Centers for Disease Control and Prevention (DHS CDC):

- Sleep and Sleep Disorders

Washington Post :

- Schools Waking Up to Teens' Unique Sleep Needs - January 10, 2006
- For Teens, Advice on How to Get More Sleep - January 26, 2006
- Parents, Teenagers Think More Zzzz's May Yield Some A's - January 29, 2006

New York Times:

- The Early Bird Gets the Bad Grade - By NANCY KALISH, January 14, 2008

Public Broadcasts:

- NBC Today's Family, msnbc.com video - October 17, 2007 : *Is Your Teen Getting Enough Sleep?* "Lack of sleep leads to a sleepy teen nation", "Generation 'Z'"
- National Public Radio, Morning Edition, Allison Aubrey - January 18, 2007 : *Helping Teens Make Peace with Sleep*
- National Public Radio, Morning Edition, Michelle Trudeau - January 18, 2007 : *High Schools Starting Later to Help Sleepy Teens* (Children who get less sleep may develop symptoms of depression and low self-esteem)
- Frontline: *Inside the Teenage Brain* Several articles on sleep and learning
- National Public Radio, All Things Considered, February 11, 2004 : *Sleep Loss Takes Toll on Teens* (Children who get less sleep may develop symptoms of depression and low self-esteem)
- CNN Video: "Teens and Sleep Patterns" Clicking on this link will open a new window at CNN. When the window opens, please wait for the video to load. (May require CNN subscription to see.)

Other:

- © Snooze or Lose: *10 "No War" Ways To Improve Your Teen's Sleep Habits*
- More Great Snooze or Lose Articles from NYMag.com
- Sleepeducation.com *"Teens & School Start Times"*
- Science News for Kids, *"Getting Enough Sleep"*
- Seasonal Rhythms-Fall Issue: *Sleepy Teens* (summary of teens sleep-wake cycle)
- International Symposium: *Contemporary Perspectives on Adolescent Sleep* (1997 Conference Summary--contains links to each sleep expert who presented at the meeting, including Carskadon, Wahlstrom, Dahl, and Ferber)

- National Academies Press: *Sleep Needs, Patterns and Difficulties of Adolescents: Summary of a Workshop* (2000)
- Dr. Greene.org: *Sleep Deprivation And ADHD* (how sleep deprivation can be mistaken for ADHD)

II. Benefits of later start times from school districts that have already made the change and from other districts that hope to make the change.

SLEEP in Fairfax:

- How Later High School Start Times Relate to Sports and Jobs (October 2005)
- Change Management and Elements of Success 6.10.12
- Research on School Districts with Start Times of 8:00 or Later

2005 Case Studies from the National Sleep Foundation (NSF):

Each of the documents listed below provides a description of how another school district successfully transitioned to later morning start times for high school students. NSF includes information about the bell schedules before and after the change, a profile of each school district, specific challenges posed within each district and corresponding solutions. Each document describes how districts implemented the change, who championed it, how they managed the transitio. It's also exciting to read about the benefits achieved after the bell schedule change. Both Wilton and Fayette did studies comparing various factors before and after the high schools switched to later morning start times.

- NSF: *Changing School Start Times: Arlington, VA* Changing School Start Times: Arlington, VA: CS.Arlington.pdf
- NSF: *Changing School Start Times: Denver, CO* Changing School Start Times: Denver, CO: CS.Denver.pdf
- NSF: *Changing School Start Times: Fayette, KY* Changing School Start Times: Fayette, KY: CS.Fayette.pdf
- NSF: *Changing School Start Times: Jessamine, KY* Changing School Start Times: Jessamine, KY: CS.Jessamine.pdf
- NSF: *Changing School Start Times: Wilton, CT* Changing School Start Times: Wilton, CT: CS.Wilton.pdf

University of Minnesota:

- ResearchWORKs: *Later start times for high school students* http://education.umn.edu/Pubs/ResearchWorks/sleep.html
- *Minneapolis Public Schools Start Times Study (Executive Summary, 2001)* http://education.umn.edu/CAREI/Reports/SST-2001ES.pdf
- Other reports are available at the University of Minnesota website: Center for Applied Research and Educational Improvement (CAREI) Scroll down in the Archived Reports to find the title "*School Start Time Study*" (or use the find function,<Ctrl>+F)

Other:

- *Urban Educator* Minneapolis Study Shows More Sleep Increases Student Attendance http://www.cgcs.org/urbaneducator/oct_vol_10_no_8_article_11/oct_vol_10_no_8_article_11.html
- *Gray Matters: The Teenage Brain*(explains why the teenage brain is not ready for sleep at 9 pm-- first-hand testimony about the benefits of later school start times) http://www.talkaboutsleep.com/sleepdisorders/childrensdisorders_teens.htm

III. Research that shows additional reasons to make secondary school start times later in the morning:

Scientific Journals and Newspaper Articles:

- From the ***Los Angeles Times***, based on a study published in the Aug. 1, 2007 issue of the journal ***Sleep*** Dangerous solutions from the pharmaceutical industry... http://www.latimes.com/features/health/la-hew-sleep6aug06,1,2172089.story?coll=la-headlines-health

Crime Statistics:

Department of Justice Office of Juvenile Justice and Delinquency Prevention

- *Juvenile Offenders and Victims: 1999 Statistics* (show that serious violent crime committed by juveniles peaks in the hours immediately after the close of school.) http://www.ojjdp.ncjrs.gov/ojstatbb/nr2006/downloads/chapter3.pdf

Sports and Sleep:

The Importance of Enough Sleep: Some practical tips for sleep and sports performance in teenagers

There are many good reasons for teenagers to get more sleep than they do, but once again reality can get in the way of a good plan. So do the best you can to get as close as you can to 9 hours of sleep for your teen. At the very least there are special situations when you'll want to pay special attention to "sleep preparation" for performance. Do you have an important tournament or championship game coming up? How about a national team tryout? A college identification camp where you'll be traveling east through several time zones? Read this brief article for some tips: SidelineSportsDoc Blog - The Source For Sideline Injury Management

From the May 23, 2011 edition of the Sideline Sports Doc Blog:

- SidelineSportsDoc Blog - The Source For Sideline Injury Management

NPR reports on a Stanford University study:

- New research adds to a growing body of evidence showing the perks of a good night's sleep. A study from researchers at Stanford University finds that extra hours of sleep at night can help improve football players' performance on drills such as the 40-yard dash and the 20-yard shuttle. http://www.npr.org/templates/story/story.php?storyId=127478147

National Sleep Foundation

- *Sleep and Sports: Get the Winning Edge!* (sleep deprivation has a negative affect on sports performance) http://www.sleepfoundation.org/site/c.huIXKjM0IxF/b.2419139/k.AE9B/Sleep_and_Sports_Get_the_Winning_Edge.htm

American Psychiatric Association

- Sleep May Be Athletes' Best Performance Booster (strategies that could help ensure that an athlete's performance doesn't become a victim of too little sleep.) http://pn.psychiatryonline.org/cgi/content/full/40/16/21

Science Daily

- Sleep Extension Improves Athletic Performance And Mood (June 10, 2009) - Athletes who extended their nightly sleep and reduced accumulated sleep debt reported improvements in various drills conducted after every regular practice, according to new ... > read more
- Extra Sleep Improves Athletic Performance (June 10, 2008) - Extending their sleep to 10 hours per day enabled Stanford swimmers to improve their 15-meter sprint times, reaction times, turn times and kick strokes. Alertness and mood also improved. Results ... > read more
- Extra Sleep Improves Athletes' Performance (June 14, 2007) - Athletes who get an extra amount of sleep are more likely to improve their performance in a game. Significant improvements in athletic performance were observed with extended sleep times, including ... > read more
- Lack Of Sleep Can Affect Athletic Performance In Teens (May 11, 2005) - Adolescents who don't get enough sleep might be jeopardizing their athletic performance, and high school sports teams on the west coast may be at a disadvantage if they play east coast rivals, says ... > read more

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SLEEP in Fairfax
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The Examiner WASHINGTON

Lawmaker calls for study on school start times

BY SUSAN FERRECHIO | SEPTEMBER 30, 2014 | 2:16 PM

A House Democrat announced Tuesday she'll introduce a bill compelling federal educators to study whether schools should open later in the morning.

Rep. Zoe Lofgren, D-Calif., said the legislation would require the Department of Education to conduct a study on the relationship between school start times and adolescent health and academic performance.

Lofgren's proposal would inject federal education officials into what has been an intensely debated local issue as schools districts nationwide wrestle with proposals to delay start times for high schools.

Lofgren is a longtime proponent of later start times for high schools, which some experts say would help teenagers who some believe are naturally prone to staying up late at night.

She's introduced several bills related to later start times. Two years ago, Lofgren introduced a non-binding resolution advising the nation's high schools to ring opening bells at 9 a.m., but the proposal went nowhere.

Currently, most high schools begin classes between 7 a.m. and 8 a.m.

"As I have long advocated, and as the American Academy of Pediatrics recently confirmed, adjusting school start times can be an important tool to improve students' health and performance," Lofgren said Tuesday. "This study will help local school districts recognize and use new information about the importance of sufficient sleep and the impact that school start times can have on adolescent well-being."

In Fairfax County, Va., the school board has debated a proposal to move high school start times 40 minutes later. The move drew protests from some parents and the public, though others support the idea. It would cost $5 million for dozens of new buses and it would require middle school students to head to class up to one half-hour earlier.

Republicans, who run the House, haven't indicated whether Lofgren's proposal will get consideration in committee or on the House floor, but the GOP in general has mostly resisted efforts to bring federal control or influence into local school systems.

Lofgren spokesman Peter Whippy acknowledged Lofgren's past attempts to introduce bills relating to later start times haven't gone far, but said mounting research showing the health benefits of later start times could sway leaders to consider it more seriously this time.

"A department study would be invaluable to school districts looking to implement later start times," Whippy said.

The New York Times

Parenting

To Keep Teenagers Alert, Schools Let Them Sleep In

By Jan Hoffman

March 13, 2014 1:20 pm

COLUMBIA, Mo. – Jilly Dos Santos really did try to get to school on time. She set three successive alarms on her phone. Skipped breakfast. Hastily applied makeup while her fuming father drove. But last year she rarely made it into the frantic scrum at the doors of Rock Bridge High School here by the first bell, at 7:50 a.m.

Then she heard that the school board was about to make the day start even earlier, at 7:20 a.m.

"I thought, if that happens, I will die," recalled Jilly, 17. "I will drop out of school!"

That was when the sleep-deprived teenager turned into a sleep activist. She was determined to convince the board of a truth she knew in the core of her tired, lanky body: Teenagers are developmentally driven to be late to bed, late to rise. Could the board realign the first bell with that biological reality?

The sputtering, nearly 20-year movement to start high schools later has recently gained momentum in communities like this one, as hundreds of schools in dozens of districts across the country have bowed to the accumulating research on the adolescent body clock.

In just the last two years, high schools in Long Beach, Calif.; Stillwater, Okla.; Decatur, Ga.;, and Glens Falls, N.Y., have pushed back their first bells, joining early adopters in Connecticut, North Carolina, Kentucky and Minnesota. The Seattle school board will vote this month on whether to pursue the issue. The

superintendent of Montgomery County, Md., supports the shift, and the school board for Fairfax County, Va., is working with consultants to develop options for starts after 8 a.m.

New evidence suggests that later high school starts have widespread benefits. Researchers at the University of Minnesota, funded by the Centers for Disease Control and Prevention, studied eight high schools in three states before and after they moved to later start times in recent years. In results released Wednesday they found that the later a school's start time, the better off the students were on many measures, including mental health, car crash rates, attendance and, in some schools, grades and standardized test scores.

Dr. Elizabeth Miller, chief of adolescent medicine at Children's Hospital of Pittsburgh, who was not involved in the research, noted that the study was not a randomized controlled trial, which would have compared schools that had changed times with similar schools that had not. But she said its methods were pragmatic and its findings promising.

"Even schools with limited resources can make this one policy change with what appears to be benefits for their students," Dr. Miller said.

Researchers have found that during adolescence, as hormones surge and the brain develops, teenagers who regularly sleep eight to nine hours a night learn better and are less likely to be tardy, get in fights or sustain athletic injuries. Sleeping well can also help moderate their tendency toward impulsive or risky decision-making.

During puberty, teenagers have a later release of the "sleep" hormone melatonin, which means they tend not to feel drowsy until around 11 p.m. That inclination can be further delayed by the stimulating blue light from electronic devices, which tricks the brain into sensing wakeful daylight, slowing the release of melatonin and the onset of sleep. The Minnesota study noted that 88 percent of the students kept a cellphone in their bedroom.

But many parents, and some students, object to shifting the start of the day later. They say doing so makes sports practices end late, jeopardizes student jobs,

bites into time for homework and extracurricular activities, and upsets the morning routine for working parents and younger children.

At heart, though, experts say, the resistance is driven by skepticism about the primacy of sleep.

"It's still a badge of honor to get five hours of sleep," said Dr. Judith Owens, a sleep expert at the Children's National Medical Center in Washington. "It supposedly means you're working harder, and that's a good thing. So there has to be a cultural shift around sleep."

Last January, Jilly decided she would try to make that change happen in the Columbia school district, which sprawls across 300 square miles of flatland, with 18,000 students and 458 bus routes. But before she could make the case for a later bell, she had to show why an earlier one just would not do.

She got the idea in her team-taught Advanced Placement world history class, which explores the role of leadership. Students were urged to find a contemporary topic that ignited their passion. One morning, the teachers mentioned that a school board committee had recommended an earlier start time to solve logistical problems in scheduling bus routes. The issue would be discussed at a school board hearing in five days. If you do not like it, the teachers said, do something.

Jilly did the ugly math: A first bell at 7:20 a.m. meant she would have to wake up at 6 a.m.

She had found her passion.

She seemed an unlikely choice to halt what was almost a done deal. She was just a sophomore, and did not particularly relish conflict. But Jilly, the youngest of seven children, had learned to be independent early on: Her mother died when she was 9.

And she is energetic and forthright. That year, she had interned on a voter turnout drive for Missouri Democrats, volunteered in a French-immersion prekindergarten class, written for the student newspaper, worked at a fast-food pizza restaurant and maintained an A average in French, Spanish and Latin.

"It's about time management," she explained one recent afternoon, curled up in an armchair at home.

That Wednesday, she pulled an all-nighter. She created a Facebook page and set up a Twitter account, alerting hundreds of students about the school board meeting: "Be there to have a say in your school district's decisions on school start times!"

She then got in touch with Start School Later, a nonprofit group that provided her with scientific ammunition. She recruited friends and divided up sleep-research topics. With a blast of emails, she tried to enlist the help of every high school teacher in the district. She started an online petition.

The students she organized made hundreds of posters and fliers, and posted advice on Twitter: "If you are going to be attending the board meeting tomorrow we recommend that you dress up!"

The testy school board meeting that Monday was packed. Jilly, wearing a demure, ruffled white blouse and skirt, addressed the board, blinking owl-like. The dignitaries' faces were a blur to her because while nervously rubbing her eyes, she had removed her contact lenses. But she spoke coolly about the adolescent sleep cycle: "You know, kids don't want to get up," she said. "I know I don't. Biologically, we've looked into that."

The board heatedly debated the issue and decided against the earlier start time.

The next day Jilly turned to campaigning for a later start time, joining a movement that has been gaining support. A 2011 report by the Brookings Institution recommended later start times for high schools, and last summer Arne Duncan, the secretary of education, posted his endorsement of the idea on Twitter.

466

Join in the discussion.

The University of Minnesota study tracked 9,000 high school students in five districts in Colorado, Wyoming and Minnesota before and after schools shifted start times. In those that originally started at 7:30 a.m., only a third of students said they were able to get eight or more hours of sleep. Students who got less than that reported significantly more symptoms of depression, and greater use of caffeine, alcohol and illegal drugs than better-rested peers.

"It's biological — the mental health outcomes were identical from inner-city kids and affluent kids," said Kyla Wahlstrom, a professor of educational research at the University of Minnesota and the lead author of the study.

In schools that now start at 8:35 a.m., nearly 60 percent of students reported getting eight hours of sleep nightly.

In 2012, the high school in Jackson, Wyo., moved the first bell to 8:55 a.m. from 7:35 a.m. During that academic year, car crashes by drivers 16 to 18 years old dropped to seven from 23 the year before. Academic results improved, though not across the board.

After high schools in the South Washington County district, outside Minneapolis, switched to an 8:35 a.m. start, grades in some first- and third-period classes rose between half a point and a full grade point. And the study found that composite scores on national tests such as the ACT rose significantly in two of the five districts.

Many researchers say that quality sleep directly affects learning because people store new facts during deep-sleep cycles. During the rapid-eye-movement phases, the brain is wildly active, sorting and categorizing the day's data. The more sleep a teenager gets, the better the information is absorbed.

"Without enough sleep," said Jessica Payne, a sleep researcher and assistant professor of psychology at the University of Notre Dame, "teenagers are losing the ability not only to solidify information but to transform and restructure it, extracting inferences and insights into problems."

Last February, the school board in Columbia met to consider later start times. "It is really reassuring to know that students can have a say in the matter," Jilly told them. "So thank you, guys, for that."

The moment of decision arrived at the board's next meeting in March. Jilly sat in the front row, posting on Twitter, and addressed the board one last time. "I know it's not the most conventional thing and it's going to get some pushback," she said, referring to the later time. "But it is the right decision."

The board voted, 6 to 1, to push back the high school start time to 9 a.m. "Jilly kicked it over the edge for us," said Chris Belcher, the superintendent.

It is now seven months into the new normal. At Rock Bridge High School, the later end to the day, at 4:05 p.m., is problematic for some, including athletes who often miss the last period to make their away games.

"After doing homework, it gets to be 11:30 p.m. pretty quickly," said Brayden Parker, a senior varsity football player. "I would prefer to get home by dark and have more time to chill out."

The high schools in the district have tried to adjust, for example by adding Wi-Fi access to buses so athletes can do homework on the road. Some classes meet only one or two days a week, and are supplemented with online instruction. More sports practices and clubs convene before school.

Some parents and first-period teachers are seeing a payoff in students who are more rested and alert.

At 7:45 a.m. on a recent school day, Rock Bridge High, a long, one-story building with skylights and wide hallways, was sun-drenched and almost silent.

Then, like an orchestra tuning up, students gradually started arriving, some for debate club and choir, others to meet in the cafeteria for breakfast and gossip. Laughter crackled across the lobby, as buses dropped off more students, and others drifted in from the parking lots. The growing crowds could almost be described as civilized.

At 8:53 a.m., Jilly burst through the north entrance door, long hair uncombed and flyaway, wearing no makeup, lugging her backpack.

"Even when I am late to school now," she said, dashing down a corridor to make that 8:55 bell, "it's only by three or four minutes."

A version of this article appears in print on 03/14/2014, on page A1 of the NewYork edition with the headline: To Keep Teenagers Alert, Schools Start to Let Them Sleep In.

JOURNAL INTERACTIVE

Early school start times in question due to alarming impact on teens

By Andrew Phillips
Feb. 17, 2014

Joanne Lipo Zovic got up after midnight on a recent weekday to find her daughter Haley, a senior at Shorewood High School, and some classmates still studying for an exam.

Haley, 17, does not have a first-hour class this semester, so she didn't have to start school until 8:33 a.m. — giving her at least a little extra sleep.

It's a schedule many think should be the norm. The Shorewood district has formed a committee of parents, students and School Board members to help it consider whether to join two other area schools, and hundreds of others around the country, in pushing back high school start times.

At issue is whether the start of the school day — which has shifted earlier in recent decades, to around 7 a.m. for many local schools — is making it harder to educate teenagers.

Sleep researchers say adolescents' circadian rhythms, or "body clocks," are different from those of younger children and adults. Teenagers don't usually get sleepy until about 11 p.m. and aren't ready to wake up until nine hours later, about 8 a.m.

As a result, most middle school and high school students simply aren't ready for class to begin early in the morning, said Terra Ziporyn Snider, a science writer and the executive director of Start School Later, a national organization devoted to promoting what it says are healthier school schedules.

The time of day has real effects in the classroom, said Sarah Kopplin, who teaches seventh-grade geography and coaches high school girls track and cross country in the Shorewood district.

"It's pretty apparent that my first hour is significantly different in terms of their energy level from my second hour, even," Kopplin said. "They just don't feel as awake."

Unable to learn

Schools didn't begin starting before 8 a.m. until the 1970s, Ziporyn Snider said, when many districts sought cost savings by staggering bus schedules. A district may have a bus pick up and deliver high school students first, then go back out and get middle school students, then grade school students — and do the reverse in the afternoon.

In most cases, it was the older students in the earlier slots to prevent younger children from waiting in the dark at a bus stop, and to allow older students more time after school for extracurricular activities.

Around the same time, research began to emerge showing the effects sleep has on mental and physical health, as well as changes in circadian rhythms over the course of a person's life. That research has continued to show the profound impact of sleep deprivation on teenagers. According to the National Sleep Foundation, studies have shown:

- When it is time to wake up for school, a teenage body is still — biologically speaking — in the middle of the night.

- When they get to school, they are unable to learn properly, pay attention or solve problems at a normal level.

- Over time, their ability to cope with stress is compromised, leading to irritability and depression.

- They are at increased risk for drowsy driving, and substance abuse to cope with stress and depression.

When school administrators tried to change schedules back in the 1990s, Ziporyn Snider said, "they got so much pushback that they gave up. It's a political hot potato."

In 2002, researchers at the University of Minnesota published a landmark study showing higher grades and reduced rates of school tardiness, dropout and depression after two Minneapolis-area districts, including more than 7,000 middle- and high-school students, pushed back their start times by more than an hour.

Although well aware of that history, administrators at Shorewood have repeatedly said they are only looking into the issue to stay updated on best practices. And while the district's committee met for the second time last week to discuss its research into the topic, no proposals have been made. The district will hold a "big ideas" meeting Tuesday night to discuss the issue with community members, but any plan would have to clear several more hurdles before it could be put into action.

School officials also are discussing a more dramatic change to the school calendar, which might include a shorter summer vacation and longer breaks during the school year. That sort of adjustment would take several years to implement, a district spokeswoman said, and so far, the School Board is only researching the issue.

Few schools in the United States have tried altering their annual calendars, though a bill in the state Senate would eliminate the requirement of a 180-day school year and allow state aid for "interim sessions" employed by schools that use year-round calendars.

Too many stressors

Convincing people of the benefits of a later start time could be a tough sell, advocates admit. Parents, coaches and community members often protest the thought of athletic and work schedules being disrupted, while others are skeptical that a later start time will have any significant impact on students.

Lipo Zovic said changing school start times is just one piece of the puzzle. The volume of homework, multiple tests scheduled in the same week — it all contributes to the pressure on teenagers.

"I think there are things we can do to ameliorate some of the stressors that make this worse for kids," she said.

Haley and her 15-year-old brother Zachary both get less sleep when they take classes during first hour — which starts at 7:35 a.m. — or even an optional class starting at 6:45, Lipo Zovic said. But she acknowledged that, when neither of them starts until second period, they use the time to work out before school rather than getting extra sleep.

Two Milwaukee-area districts that have pushed back start times have seen success. Whitnall High School moved its start time from 7:15 to 7:45 a.m. in 2011. Whitnall Superintendent Lowell Holtz said the change has gone over "extremely well" among students, with no increased costs for the district.

In Greenfield, school officials moved the high school start time from 7:10 to 7:30 a.m. after years of discussion. Greenfield parent Dolores Skowronek said her children have appreciated the change, though she wishes the schedule had shifted even later.

"What we're doing now is not healthy, it's not safe, but people don't really quite believe that," Ziporyn Snider said.

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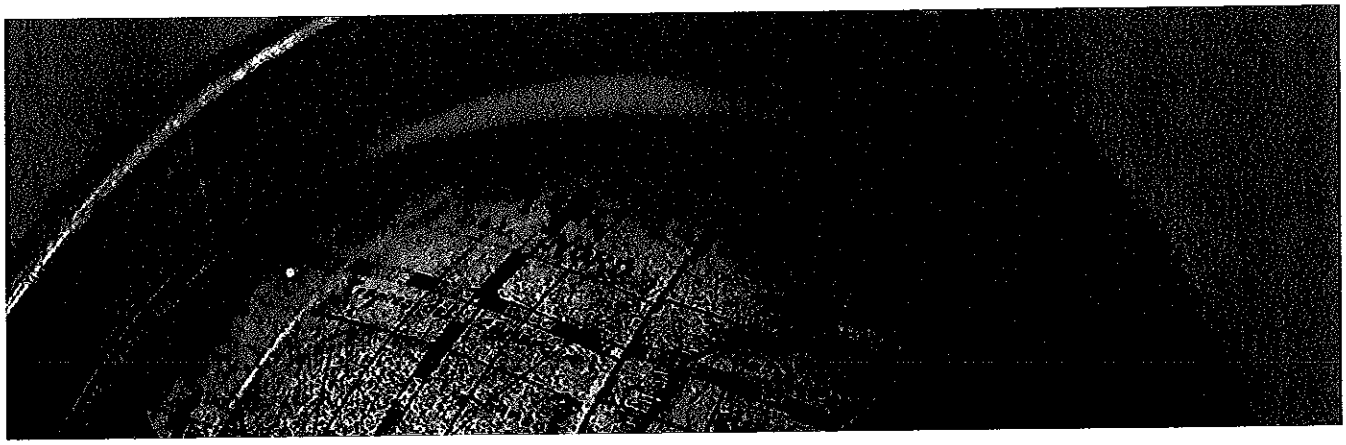

TEACHING + EDUCATION (/NEWS/TEACHING-EDUCATION)

Students' grades and health improve with later high school start times

New study from the University of Minnesota is first to examine multiple schools across the U.S.

March 12, 2014

Later high school start times improve student grades and overall health, according to a new University of Minnesota study, released today.

The three-year project, using data from more than 9,000 students attending eight high schools in three states, found that, when switching to a later start time:

- attendance, standardized test scores and academic performance in math, English, science and social studies improved.
- tardiness, substance abuse, symptoms of depression, and consumption of caffeinated drinks decreased.

In addition, the study found that there was a 70 percent drop in the number of car crashes involving teen drivers at Jackson Hole High School in Wyoming, which shifted to the latest start time of the eight schools (8:55 a.m.).

"The research confirmed what has been suspected for some time," said Kyla Wahlstrom, Ph.D., director of the U of M's Center for Applied Research and Educational Improvement (CAREI), which conducted the study. "High schools across the country that have later start times show significant improvements in many areas. The reduction of teen car crashes may be the most important finding of all, as the well-being of teens and the safety of the general public are interrelated."

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The study, funded by the Centers for Disease Control and Prevention (CDC), found that high schools that begin as late as 8:55 a.m. have 66 percent of students obtaining eight or more hours of sleep on school nights, which is the recommended amount for high school aged students. Schools that begin at 7:30 a.m. have an average of only 34 percent of students obtaining eight or more hours of sleep on school nights.

"Even a start time of 8:35 a.m. allows 57-60 percent of students to get eight or more hours of sleep, which is an important health benefit for a majority of students," said Wahlstrom. "Local school districts, school personnel, parents, and students need to understand the importance of sleep and to make choices using the knowledge from this and other studies."

In the first study to examine multiple schools in various locations across the U.S., student data were collected from eight schools that moved to later start times. Over the last three years, researchers surveyed St. Louis Park High School, Mahtomedi High School, Woodbury High School, Park High School, and East Ridge High School in Minnesota; Boulder High School and Fairview High School in Colorado; and Jackson Hole High School in Wyoming. Students were individually surveyed about their daily activities, substance use and sleep habits. Researchers then examined various health factors post-change in school start time and compared them with national average data.

The study also collected comparative data about students' academic performance, including grades, attendance, tardiness and performance on state and national standardized tests. Car crash data were also examined for the communities surrounding the participating high schools.

The full report (http://www.cehd.umn.edu/carei/sleepresources.html), "Examining the Impact of Later High School Start Times on the Health and Academic Performance of High School Students: A Multi-Site Study," includes an examination of the processes by which local school districts participating in the study made the decision to change to a later start time. Key participants in the discussions and the decision-making were interviewed.

"Our research provides evidence of clear benefits for students whose high schools start at 8:30 a.m. or later," said Wahlstrom. "More research needs to be done, but these findings are substantive and should provide more information for school districts considering a change in start time."

Please contact Steve Baker or Steve Henneberry to schedule interviews with Wahlstrom.

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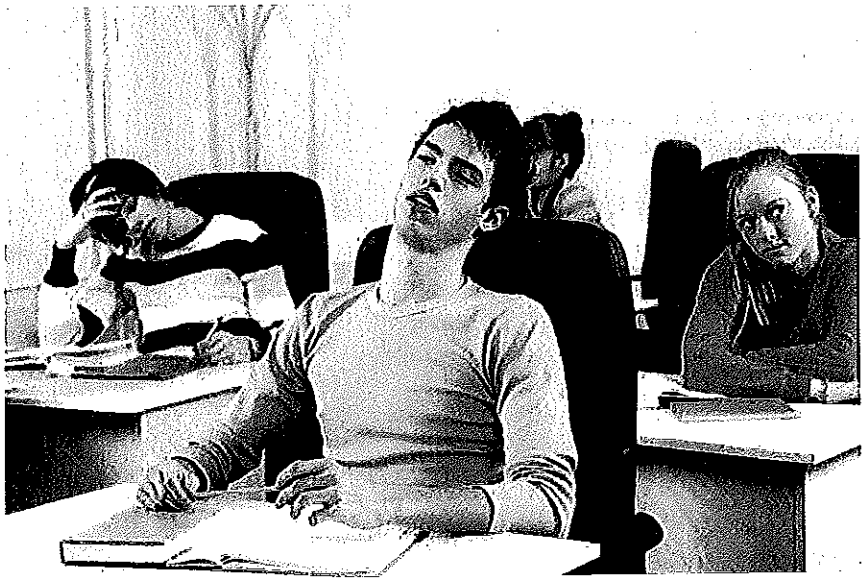
High School Notes

Later High School Start Times a Challenge for Districts

New research suggests academic benefits with later high school start times, but officials say logistical issues can make a shift difficult.



Improved academics and attendance, along with fewer teen car crashes, are among the benefits cited in a recent study on later high school start times.

By Alexandra Pannoni | March 24, 2014 | 8:00 a.m. EDT + More

It's no surprise to parents that most teens do not get enough sleep and often start first period cranky.

The start time of many high schools in the U.S. does not help. Many teens start learning before daylight breaks – about 40 percent of high schools start school before 8 a.m., according to data from the 2011-2012 school year from the National Center for Education Statistics.

Lack of adequate rest not only affects teens' moods, but their ability to learn, listen and concentrate, experts say.

But starting school later is associated with better academic performance, according to a February report by the University of Minnesota. Researchers studied data from the more than 9,000

students at eight public high schools before and after the schools made a shift to start classes at 8 a.m. or later.

Academic performance and attendance improved, and tardiness rates declined in schools with start times of 8:35 a.m. or later. The number of car crashes involving teen drivers went down, too, in a school that shifted its start time from 7:35 to 8:55 a.m. More than half of teens in the study who attended a school with a start time of 8:30 a.m. or later were able to get at least eight hours of sleep per night.

[Find out more about how more rest can help teens stay alert in class.]

While the evidence may support a movement to start high school later, adjusting school schedules can be a logistical nightmare for administrators. Schools have to consider factors such as students who work or take care of younger siblings, athletics and after-school activities.

The biggest challenge for administrators? Transportation, school officials say. Many school districts use the same buses to transport elementary, middle and high school students. A change in start time at the high school level thus usually means a change in start time at elementary and middle schools, too.

Academy School District 20 in Colorado Springs, Colo., was able to push back high school start times by transporting middle and high school students together on the same buses, says Superintendent Mark Hatchell. They also eliminated bus routes with few students, which also saved the district money.

"If you start too late, by the time your buses circle back and drop off middle school and elementary, then you are finishing in the dark, at least for us in the winter time," he says.

Classes at high schools in Academy School District 20 now begin at 7:45 a.m., versus 7:05 a.m., before the 2012 change. Hatchell says the later start time did not affect athletics or after-school activities.

"We've seen less tardies and, this is anecdotal, but happier students," he says.

[Get tips on how to teach healthy study habits to teens.]

Having students from the elementary, middle or high schools ride buses together was not a viable option for Ann Arbor Public Schools. The district conducted a study in 2012 to determine the costs and benefits of pushing back high school start times.

"I'm not saying it couldn't be done, but it would be a cultural shift of how we provide service here," says Liz Margolis, executive director of communications and community relations for the Michigan school district.

In order to push back high school start times, the elementary and high school schedules in Ann Arbor would have to be flipped. The idea received an overwhelmingly negative response from elementary school parents, Margolis says.

"A change to the elementary school start time, we really found, would disrupt the families' schedules," she says.

The district was also concerned about how the change would affect high school after-school activities, athletics and students who work after school.

Officials in Ann Arbor did find research that indicated some benefits related to academic performance and later high school start times, but ultimately believed the challenges would be too great to make a change.

For now, the first bell will still ring between 7:30 and 8:08 a.m. in Ann Arbor high schools.

A change in high school start times should be a community-by-community decision, Margolis says.

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★StarTribune

Minn. study: Later school start boosts grades, attendance, moods

Article by: Kelly Smith
Star Tribune
March 12, 2014 - 11:46 PM

Photo: High School
Melissa Phillip, Houston Chronicle

More high schools across Minnesota and the nation are starting later each morning — a move that could help teens not just in the classroom, but also on the road.

Findings of a University of Minnesota study released Wednesday are the first to conclusively link later morning school starts to higher test scores, better grades and fewer teen car crashes.

The latest study puts weight behind an issue hotly debated by parents, students and school leaders nationwide.

"People keep asking me, 'Is this [later school start times] really making a difference?' " said project director Kyla Wahlstrom, a former North St. Paul principal who's studied school start times for 17 years. "We didn't have the proof until now."

For three years, researchers at the university's Center for Applied Research and Educational Improvement analyzed data from more than 9,000 students at eight high schools in Minnesota, Colorado and Wyoming. Overall results showed a boost in attendance, test scores and grades in math, English, science and social studies for schools that shifted the school day later into the morning.

Schools also saw a decrease in tardiness, substance abuse and symptoms of depression. Some even had a dramatic drop in teen car crashes.

"The eight hours of sleep seems to be a tipping point for making healthy or unhealthy behavioral decisions," Wahlstrom said.

But, the study found, only 34 percent of students are getting the recommended eight hours of sleep when school starts at 7:30 a.m. compared with 66 percent of students getting eight hours of sleep at schools that start as late as 8:55 a.m.

The study, funded by a $300,000 grant from the Centers for Disease Control and Prevention in Atlanta, reaffirms what experts and school leaders have long suspected about better syncing school schedules to teen sleep patterns.

"There's really no downside in terms of outcomes for kids," Wahlstrom said.

Parents approve

The findings are catching the attention of schools nationwide, including Minnesota school leaders at Alexandria's high school, which just approved a later, 8:25 a.m. start next school year.

Years ago, Edina and Minneapolis high schools were among the first to make the change.

"A well-rested student body is a good, productive student body," Edina High School Principal Bruce Locklear said, adding that it would be difficult to revert to the earlier time. "It's a culture thing; the students believe in it and embrace it."

Parent Leanne Montgomery said the high school's 8:25 a.m. start worked better for her daughter before she graduated, while others, like her son, a sophomore, prefer an optional earlier arrival at 7:25 a.m. to take extra advanced classes.

"It's not for everybody; some just need to sleep," she said. "But for others, their internal clocks are different."

When Edina initially made the switch from a 7:20 a.m. start, some parents worried about the impact on busing, sports and child care. But according to another of Wahlstrom's previous studies, after one year, 92 percent of Edina parents surveyed preferred the later time. She also analyzed Minneapolis high schools' move from 7:15 a.m. to 8:40 a.m., finding a decrease in dropout rates and students' depression and an increase in grades.

More rested, less rushed

Not all schools have seen measurable benefits from starting later.

St. Louis Park High School, which was included in the U's latest study, didn't have conclusive academic results. Still, when Superintendent Rob Metz was principal, he remembers greeting students at 7:15 a.m. who were barely awake. Now, with an 8:20 a.m. start, he said teens are more rested and not as rushed.

The other metro schools in the study — Mahtomedi High School, Woodbury High School, Park High School and East Ridge High School — did see benefits such as Mahtomedi's significant increases in ACT test scores and attendance after moving from a 7:30 a.m. start time to 8 a.m. Plus, the number of student vehicle crashes dropped 65 percent, based on state data of drivers 16 to 18 years old.

Another school in the study, Jackson Hole High School in Wyoming, had a 70 percent drop in the number of teen crashes after the school switched from a 7:35 a.m. start time to 8:55 a.m. — the latest of all eight schools in the study.

"It makes sense, because kids who are sleep-deprived, like most people who are sleep-deprived, are more distracted," Wahlstrom said.

She cautions that the study doesn't prescribe later high school start times and she hopes to continue to study crash data. But with more high schools in Minnesota and across the country turning start clocks forward, she hopes the new findings help schools make a decision themselves.

"Schools are really complex, bureaucratic places and to make a shift like this is changing the norms of a community," she said. "I'm not saying this is a magic bullet, but clearly the more we're learning about teens and sleep, the more we can make good choices."

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Myths and Misconceptions

- It's too expensive to Start School Later.
- Aren't we coddling our kids by allowing them to Start School Later?
- Teenagers need to take responsibility. Early starts teach responsibility.
- If we start school later, students will just go to bed later.
- Kids just need to adhere to a good bedtime.
- It's safer to start high schools first instead of elementary schools.
- Extracurricular activities will suffer.
- School start time is not a federal issue. It should be determined by local districts.
- There's nothing wrong with the way things are now. We did it and turned out just fine.
- Later starts will keep parents from getting to work.

It's too expensive to start school later.

The idea that the only way to return to later, healthier school start times is to reroute or add buses at exorbitant costs is a myth. Communities that have put student health and well-being first have found a variety of creative solutions, sometimes even saving money in the process. Below are just a few examples:

- **Santa Rosa County (FL) (http://www.okaloosa.k12.fl.us/ruckel/about/docs/sleep.pdf) school district saved millions when it changed to later school start times in 2006. High schools start between 9 and 9:25 a.m. Elementary schools start at 7:30 a.m. This is a very highly ranked Florida public school system with competitive (football district champion!) athletic teams.**

- **The Wilton (CT) School District (http://www.sleepinfairfax.org/docs/CS.Wilton.pdf) maintained its three-tiered bus schedule (which is generally thought to save money), and achieved a more appropriate starting time for teenagers by flipping the upper elementary start, at 8:15 a.m., with the 7:35 a.m middle school/high school start.**

- **Schools in Moore County, NC (http://www.thepilot.com/news/2011/oct/09/high-schools-students-adjusting-later-start/)created a dual-route bus system in which elementary schools and high schools share buses on separate routes. School officials estimate that the changes save about $700,000 a year.The plan shifted high school start times 45 minutes later, with school beginning at 9 am and dismissing at 4 p.m.**

- **West Des Moines School District (http://www.npr.org/templates/story/story.php?storyId=6896471) in IA found a way to start high schools later by reducing the number of buses needed, saving the district $700,000 annually.**

- In the Mahtomedi School District (MN) (http://www.npr.org/templates/story/story.php?storyId=6896471), high schools found a way to start 35 minutes later by shortening passing periods, another no cost solution. An added bonus: no impact on after-school activities, better attendance, and less sleeping in class.

- Jessamine County, KY (http://www.fcps.edu/fts/taskforce07/documents/finalreport/appendixu.pdf) moved its high school start from 7:30 a.m. to 8:30 a.m. without adding bus drivers. Middle schools now start at 8:50 a.m. and elementary schools at 8 a.m.

- Arlington, VA (http://www.fcps.edu/fts/taskforce07/documents/finalreport/appendixu.pdf) changed high school start times from 7:30 a.m. to 8:19 a.m. without increased expenditure of resources.

- Fairfax County Public Schools (http://www.fcps.edu/fts/taskforce07/documents/belltimepart2.pdf) in VA have been provided with both low-cost and no-cost options to move their high school start times to 8:00 a.m. or later by an independent consultant.

- Every single public school in Ohio (/uploads/9/7/9/6/9796500/ohio_cost_savings_or_neutrality.docx) that switched to later hours due to sleep research (with the exception of Parma, which did so primarily to save money) did so at no cost, or, in some cases, cost savings.

Other "out-of-box" solutions are out there, including, but not limited to:

- Consolidating busing to provide service more efficiently where it is actually being used
- Providing sidewalks, safer paths, and walkways to allow more students the ability to walk or bike to school during daylight hours
- Allowing for online class periods or "virtual learning"
- Providing elective bus service, where riders pay for bus service
- Replacing private bus service with public transportation

^ Back to Top

Aren't we coddling our kids by allowing them to Start School Later?

Requiring high schools to start after 8:30 or 9:00 a.m. is no more coddling kids than installing car seats or booster seats in automobiles or eliminating indoor smoking in public locations. The latter interventions were originally seen as inappropriate and unnecessary but, with newer research, came to be viewed as mainstream public health measures. There is now ample evidence showing that taking steps to ensure safe, health school hours is no different.

Children might be said to be "coddled" when a parent or caregiver gives them something they don't really need merely to pacify them. Ensuring conditions that allow enough sleep is hardly in this category. Sleep is just as necessary as nutrition and exercise. And early school hours make adequate sleep impossible for many if not most adolescent students. One has to ask why it seems acceptable, even praiseworthy, to ensure that children have physical activity and enough to eat, but somehow indulgent to ensure that they have enough sleep.

^ Back to Top

Teenagers need to take responsibility. Early starts prepare teens for the real world.

Although many people seem to think otherwise, teenagers are still children - and growing ones at that. They are not adults, and their growing brain and bodies need on average 8.5 - 9.25 hours of sleep per night. Many teens simply cannot fall asleep before 11 p.m., due to shifted circadian rhythms (body clocks). Yes, poor planning, electronic and other distractions, and poor parenting can certainly contribute to the problem, but the fact that these circadian rhythm shifts appear in adolescent mammals as well as adolescent humans suggests that there's more to the story here than irresponsibility.

This is not a matter of will. It's a matter of biology. Allowing teenagers to drive while sleep deprived to teach them responsibility is comparable to giving a drunk driver keys to his car and expecting him to be responsible about it. And just because something must be done at a later point in life does not make it appropriate earlier in life. Asking teenagers to deprive themselves of sleep to "prepare" for the real world is like asking toddlers to skip their naps to prepare for fifth grade.

Secondary school also have some very significant differences with both college, military service, or employment. Very few colleges start classes before 8 a.m., and that most colleges give students the option of choosing classes that start later in the day. Very few jobs run from 7 a.m. until 2 p.m. either, nor do they involve doing calculus at 7 a.m. or going home with hours or homework every night. Furthermore, most people have some degree of choice in the hours they keep as adults. Middle and high school students are required by law to keep to schedules set by their school systems unless they have the means to home school or attend a private school.

^ Back to Top

If we start school later, students will just go to bed later.

This common misconception seems reasonable enough. But contrary to expectation, it has not proven true in studies of students who have had their schools shift to later start times. The landmark school start time study by Kyla Wahlstrom at the University of Minnesota (http://www.cehd.umn.edu/carei/publications/documents/Bulletin200212Wahlstrom.pdf) showed that starting school about 1/2 hour later resulted in teens getting a full hour of extra sleep each school night. Several subsequent studies have found the same thing: when schools move to later morning starts, students consistently got more sleep per school night because they went to bed at or near the same time each night and were able to rise later in the morning. Full citations and a discussion of this topic are available at http://schoolstarttime.org/delaying-school-start-times/will-students-squander-opportunity-extra-sleep/ (http://schoolstarttime.org/delaying-school-start-times/will-students-squander-opportunity-extra-sleep/).

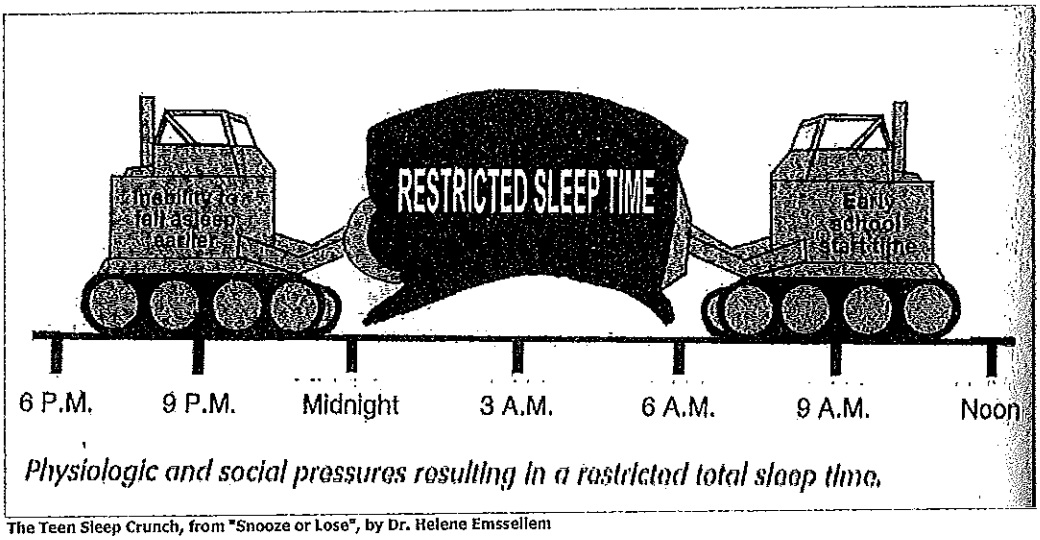
^ Back to Top

Kids just need to adhere to a good bedtime.

There's no question that student sleep can improve by reducing exposure to distractions, such as TV, cell phones, and computers and following other basic tenets of healthy "sleep hygiene." However, sleep research (http://www.sleepfoundation.org/article/hot-topics/backgrounder-later-school-start-times) shows that even teens with impeccable "sleep hygiene" cannot possibly get enough sleep if they need to get up in time to make 7 a.m. school bells or even earlier buses. This is because most simply cannot fall asleep before about until 11 p.m (http://www.sleepfoundation.org/article/hot-topics/backgrounder-later-school-start-times)., the time when most teenagers and young adult start producing enough melatonin, the hormone believed to help regulate sleep.

Teenagers require on average 8.5 – 9.25 hours of sleep per night, which is more than most adults require. For a teenager to get enough sleep for a 7:00 a.m. school start or a 5:30 am wake up call, she would have to be in bed and fast asleep by 8:30 p.m. Homework, extracurriculars, and electronics aside, this bedtime is counter to the natural, biological makeup of most high school students. Because of the shifted times in which adolescent brains produce melatonin, even the best laid plans often result in the teenager staring at the ceiling until well after 11 p.m.

The graphic below describes the way early school starts are, by design, creating a nation of sleep deprived teens.



The Teen Sleep Crunch, from "Snooze or Lose", by Dr. Helene Emssellem

^ Back to Top

It's safer to start high schools first instead of elementary schools.

Many school systems currently start high schools first and then recirculate buses two or three times to ferry middle and elementary school students to school later in the morning - an efficient and cost-saving approach. It is often suggested that high school and elementary schools hours be flipped so that high schools can start later at no additional cost. Such proposals usually meet with huge public outcry about the dangers of having first graders standing outside waiting for buses at 6 a.m.

What is overlooked in this outcry is that it is also unsafe to have 15-year-old girls standing on dark corners alone at 6 a.m. or to send new, sleep-deprived teen drivers out onto the roads at that time. A 2011 study (http://www.eurekalert.org/pub_releases/2011-04/aaos-crm041311.php), for example, found that the weekday crash rate among high schoolers in Virginia Beach, where classes began at 7:20-7:25 a.m. was significantly higher than in adjacent Chesapeake, VA, where classes started at 8:40-8:45. Another study in Fayette County, KY (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2603528/) linked a move to a later high school start time to a drop in the rate of teen car crashes.

It's not safe for any child, even a high school student, to walk to school or wait for buses in the dark. Age does nothing to make pedestrians more visible to drivers. Transportation departments should work to arrange bus runs and school opening times to keep ALL students safe, not just the youngest ones. The following stories point to tragedies that could have been averted with a later school start time. The cost of continuing to ignore the safety risks with early school start times is a high price to pay.

In Cary, NC (http://www.wral.com/news/local/story/4728439/), a 12-year old boy was struck prior to 7:00a.m. at his bus stop. A 13-year old girl in Fall River, MA (http://www.heraldnews.com/news/x13278492/Girl-injured-in-early-morning-accident-taken-to-Hasbro-Childrens-Hospital) was struck near her bus stop at 6:23a.m. More recently, a 9 year old girl was struck and killed (http://news.cincinnati.com/article/20120316/NEWS/303160038/Child-struck-by-car-killed-Westwood) in Westwood, OH in the early morning darkness while waiting for her bus.

Additionally, the early morning hours pose other risks to children. In Fairfax, VA (http://www.washingtonpost.com/local/fairfax-county-police-15-year-old-girl-sexually-assaulted-while-walking-to-school-bus/2012/02/10/gIQAPW0X3Q_story.html), a 15 year old girl was sexually assaulted while waiting at her school bus stop at 6:20a.m.

In October 2012, a 16-year old student was killed when attempting to walk in pre-dawn, overcast conditions to her high school in Germantown, MD (http://www.wusa9.com/news/article/227545/158/PHOTOS-Teen-Struck-Killed-In-Montgomery-Co-).

In December 2012, a student attempting to get to school in Laurel, MD during predawn hours was killed. This marks the third student pedestrian fatality at Fort Meade High School

(http://www.wjla.com/articles/2012/12/laurel-fatal-pedestrian-crash-kills-15-year-old-83300.html) in Anne Arundel County, MD. in the school year.

In March 2013, a student was struck and injured (http://montgomeryvillage.patch.com/articles/watkins-mill-student-struck-by-vehicle-walking-to-school-tuesday) by a vehicle while walking to school in the early morning in Watkins Mill, MD. A 55-year old man was killed in Gaithersburg, MD (http://montgomeryvillage.patch.com/articles/report-pedestrian-struck-killed-by-school-bus-on-clopper-road)by a school bus traveling on a busy intersection at 6:30am only a week later.

In April 2013, a Houston, TX area student was struck and killed (http://www.khou.com/news/local/Teen-killed-in-auto-pedestrian-accident-in-north-Harris-County--201428711.html) on his way to school on a dark morning.

A Florida student was struck and killed (http://www.wtsp.com/news/topstories/article/331322/250/Polk-teen-walking-to-school-hit-killed-in-crash?odyssey=tab|topnews|bc|large) in August 2013 as he made his way to school at 6:20am.

A Charlotte, NC student was struck by a vehicle (http://www.charlotteobserver.com/2013/09/05/4288373/student-hit-by-vehicle-in-nw-charlotte.html#.UiqY6j9GSSo) in September 2013 while waiting for his school bus at 6:15am. While that student only sustained minor injuries, another high school student was killed (http://www.charlotteobserver.com/2013/10/17/4394324/teen-pedestrian-killed-in-rowan.html#.UmI2qRAen4V) while traveling during pre-dawn hours in West Rowan County, North Carolina in October 2013.

Ensuring the safety of our children and others by eliminating early, darkened, unsafe bus stops and walking routes must become more of a priority than the expense of bus runs.

^ Back to Top

Extracurricular activities will suffer.

Schools start and end at very different times all over the country (and the world). Whether they dismiss at 1:40 p.m. or 3:30 p.m., schools manage to support athletics and other extracurricular activities. When communities change their school hours, the whole community adjusts accordingly. This is precisely what happened when many schools moved start times earlier in the 1980's. Just because something is done a certain way now doesn't mean it's the only, or the best, way to do things.

The evidence bears this out: starting school after 8:30 a.m. does not harm, and may even help, extracurricular performance. Here are just a few examples from the world of sports:

- After Wilton, CT (http://www.sleepinfairfax.org/docs/CS.Wilton.pdf) pushed their school start time later, the school won several state championships.
- Loudon County, VA has a top ranked football and girls soccer program with athletes earning athletic scholarships (http://www.washingtonpost.com/blogs/recruiting-insider/post/stone-bridge-all-met-dl-jonathan-allen-adds-offers-from-michigan-tennessee/2011/12/14/gIQAQWtHuO_blog.html). The starting bell at Loudoun high schools is 9:00 a.m.
- The high school start times for members of the Parade's All-America Football Team (/parade-all-america-football-team.html) shows that school hours have nothing to do with the possibility of athletic excellence. Twenty of the star athletes go to schools that start at 8:00am or later. 13 start earlier than 8:00am. The remaining 13 athletes did not have start times available.

None of this even considers the potential benefits to athletes (or anyone!) of getting enough sleep. A Stanford University study (http://teensneedsleep.files.wordpress.com/2011/05/mah-et-al-2011-effects-of-sleep-extension-on-athletic-performance.pdf), released in March 2011 found that athletes who sleep more perform better, and in October 2012,the American Academy of Pediatrics (http://www.aap.org/en-us/about-the-aap/aap-press-room/Pages/Lack-of-Sleep-Tied-to-Teen-Sports-Injuries.aspx) cited another study showing that "[a]dolescent athletes who slept eight or more hours each night were 68 percent less likely to be injured than athletes who regularly slept less." That is part of the reason why coaches from schools that have moved the school day later have surprisingly positive things to say (http://kent.patch.com/blog_posts/sports-injuries-and-school-start-times-doing-the-math) about the change.

^ Back to Top

School start time is not a state or federal issue. It should be determined by local districts.

Many aspects of school policy are regulated by state and federal government, particularly when local school systems cannot or will not set policies to protect basic rights, including rights to health, safety, and education. This has been proven to be the case with respect to the issue of school start times since the 1990's.

Specific school hours must be set locally to reflect specific demographics, topography, values, and budgets. However, establishing a barebones minimum before which schools should not begin mandated instruction is as fundamental as requiring schools to turn on the heat when the temperature falls below a certain level. The idea of setting a minimum standard is simply to provide a boundary to protect children from being forced to adhere to school starts that negatively impact their health and safety. Whether this minimum is set through law or regulation, and whether, ultimately, it is set at a federal, state, or even local level, it needs to be established to protect children.

Starting school at later, safe, healthy hours is universally beneficial to all children. This is along the same vein as Child Labor Laws and Child Car Seat Restraint Laws.

The United States has a long history of recognizing the protection of health and safety as a core function of government, and over the years many measures to protect individuals from harm o (http://www.nejm.org/doi/full/10.1056/NEJMp1303819?query=TOC)riginally thought of as overly intrusive or misguided are now accepted as essential (http://www.nejm.org/doi/full/10.1056/NEJMp1303819?query=TOC). Many federal mandates have been enacted to ensure minimum levels of health and safety for all children. A few examples are:

- Federal nutrition standards for school meals
- Federally mandated school wellness policies
- Federal gun free schools / zero tolerance
- Federally approved child-safety seats
- The Lead Contamination Control Act of 1988

The number of state laws to protect child health and safety (http://www.rwjf.org/en/blogs/new-public-health/2014/04/test_post_phlr_info.html) is even greater, including laws to reduce sodium in food, protect against sports-related traumatic brain injuries, and prevent drunk driving.

Because many local school districts have competing interests, such as cutting costs, politics and logistics, they have not always put the safety and welfare of children as the utmost priority. This is why a federal mandate or related regulation is a sensible and well-precedented way to preserve the health, safety, and well-being of all children.

^ Back to Top

There's nothing wrong with the way things are now. We did it and we turned out just fine.

There is a prevailing notion that children should be able to wake and start school earlier because farmers woke early, because children of yesteryear walked long distances to school, and because generations before experienced extreme hardships and survived.

In the case of farmers, while they were up at dawn to perform work, they also had long periods of rest during the day and during the winter season when the ground rested. Additionally, farmers did not have the requirements of homework, sports, and extra-curricular activities in addition to a minimum required number of hours of instructional time that today's children are expected to have in order to gain college admission and compete for gainful employment.

According to the National Research Center for Women and Families (http://www.center4research.org/2010/09/early-morning-classes-sleepy-students-and-risky-behaviors/), (NRC), most schools in the 1950's and 1960's started between 8:30-9:00 a.m. The extremely early starts to the 7:00 hour were the direct result of staggering start times of high schools, middle schools, and elementary schools in order to utilize fewer buses and drivers. Expecting children to adapt to the demands of rising earlier

because that is what was always done is equivalent to expecting children to drink adulterated milk or ride bikes without helmets because that's what children did in the past.

Another fallacy is that conditions today are precisely like those of the past. Yes, many children today still walk to school, but walking today is often in the dark and involves wrestling with high traffic conditions and higher local speed limits that didn't exist in the 1960's and before.

Finally, the "good enough for us" mentality flies in the face of every parent's dream to give his or her children a better future. Farmers worked the soil and many parents sacrificed so their children could have a chance to go to college and have a better future. Most parents do not want their children to just survive. They work hard and raise their children so that their children can thrive. While there are differences of opinion on how parents achieve this, the research is clear: "early school schedules can undermine teenagers' ability to learn, to drive safely, and to get along with others. They can even increase the likelihood of smoking, drug abuse, and teen pregnancy." (NRC) Remember: just because we *can* do something, doesn't mean we *should*.

The facts are clear: We DIDN'T do this (go to school so early), and we are not "just fine."

^ Back to Top

Later start times will keep parents from getting to work.

For every family concerned that a later start time will hurt their job is one who is hurt right now by the early start times.

- Consider the high school teacher who needs to be at work by 6:30 a.m. but whose elementary school-aged kids don't start school until 9 or 9:30.
- Consider all the children who come home in the early afternoon to empty houses because parents aren't back from work until 5:30 or 6 p.m.
- Consider the parents who can't work at all because of the limited window of time between getting the youngest child to class and the oldest child home. A teen going to school from 7 a.m.-2 p.m., a middle schooler from 8 a.m.-2:30 p.m., and an elementary schooler from 9:15-3:15 p.m. means that by the time all the kids are safely in class, the oldest child is ready to come home.

Until school and work schedules are perfectly aligned, some families are going to find those schedules problematic. Usually there are solutions to these problems, whether it is private childcare, before and afterschool care, or flexible work hours. Regardless, moving a middle or high school time to 8 a.m. or later is not the cause of these problems, and, in fact, resolves as many problems as it may seem to cause.

In addition, it's important to remember that we're generally talking about starting middle and high schools later. The children concerned are 12 -18 years old, and usually do not need the same kind of parental supervision to get to school that younger children need. The fact that parents concerned about lack of supervision defend 7 a.m. start times, which go hand-in-hand with 2 p.m. dismissal times, or that they defend 7 a.m. start times for teenagers but accept 9:15 a.m. start times for first graders, suggests that the real concern isn't childcare or work.

Even concerns about driving to work in rush hour are based on entirely unfounded speculation, not only because different families have different hours but because traffic patterns themselves are impacted not just by school hours but by complex adjustments communities make to them. In many communities it is the school buses themselves - and people driving their kids to school, in part to overcome early hours – that create the bulk of the traffic. If school hours shift, so will traffic patterns, so it's hard to say in advance just how any specific school start time relates to "rush hour." Predictions are especially challenging given that in many communities ridership on school buses is low for high schoolers who choose to drive themselves or their friends to avoid the early hours. It's entirely possible that when school hours are later, bus ridership wil increase, relieving a great deal of traffic. This is speculation, but so are fears about gridlock if schools change hours in any way.

^ Back to Top

Start School Later, Inc. is a 501(c)(3) non-profit organization dedicated to healthy, safe, equitable school hours.

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High school start times debated

By Kristi Nix | Posted: Thursday, October 23, 2014 9:43 am

Pearland Independent School District officials were recently asked by the school board to weigh the pros and cons of moving the start-times for high school classes back by 15 minutes to an hour recently. Deputy Superintendent Nan Weimer presented a report of the findings at a board meeting held Tuesday (Oct. 14).

Currently, buses pick up high school students at 6:15 a.m. and classes start at 7:30 a.m., Weimer said.

School officials considered several different alternatives including starting classes 15 to 30 minutes later and switching the start time for high school students with elementary school students, who currently start classes at 8:15 a.m.

Although moving classes forward by 15 minutes caused minimal problems, Weimer said traffic was an issue as buses might be delayed due to increased congestion on the roads. Moving classes back an additional half-hour was more problematic due to increased traffic, logistics involved with extracurricular activities and after-school jobs for high school students.

"Right now high school students have time to go home and do their homework," she said. "But, if they get home later in the day they wouldn't be able to have jobs is what some parents told us."

The proposed changes were considered by a number of school administrators including assistant superintendents and principals as well as the directors of athletics, food service, transportation and special education. The focus group also included parents, students and community representatives, Weimer said.

Following the report, trustees discussed the alternatives and the reason the changes were under consideration.

Research supports starting classes at 8:30 a.m.

Trustee Lance Botkin said he had read a study published in the American Pediatric Society that said high school students shouldn't start classes before 8:30 a.m.

"It's not just they (students) need sleep," Botkins said. "The problem is in our society we look at sleep as a luxury. It's a necessity. Sleep deprivation causes a lot of behavioral issues."

Trustee Charles Gooden Jr. said he appreciated Botkin's enthusiasm but hadn't had a chance to study the American Pediatric Report.

"I appreciate your passion and your preparation. I am going to speak for myself and say you are way ahead of me. All we (trustees) got was this presentation. Obviously we're not about to make decision on this tonight," Gooden said.

"What we got tonight was all the negative things. We didn't hear the positive things. We did n't see how it can help students," Botkins said and asked if the issue could be tabled for future discussion pending more research by district officials.

Superintendent Dr. John Kelly said he supported the discussion but thought the recommendations made by administrators should be the deciding factor.

"I appreciate that this is on the agenda because I think this has been an issue for Lance first and also the research that has come out does make a case for it," Kelly said. "But where I come down on it is that we've got three very good high school principals who say the status quo is what they think is better and I'm not willing to substitute my judgment there or really even the board's. I guess every decision in the district could be subject to board approval but this is something normally the administration would decide."

Trustee Andrew Solomon said he appreciated the common sense approach to the issue but also thought the research was worth further consideration.

"The studies are interesting. The studies are about science and the science of kids and their brain development and their sleep patterns. When I read the studies I was surprised and skeptical. But, there have been follow-up studies that seem to support the initial studies that it really does matter," Solomon said.

"I've read a number of studies over the past couple of years and I certainly wouldn't argue with the researchers in any of those studies. I think the missing piece here is that our students aren't asking for this," Weimer said. "Where this has changed recently in other places across the country, the students brought forth the research and fought that battle. We're not hearing that in our schools and I think that is the missing piece for us."

After almost an hour of passionate debate, no action was taken by the board. Board President Rusty DeBorde asked that district officials take a closer look at the issue and if they felt it was worth reconsideration, the door was open for further board discussion. Otherwise, no further action was needed.

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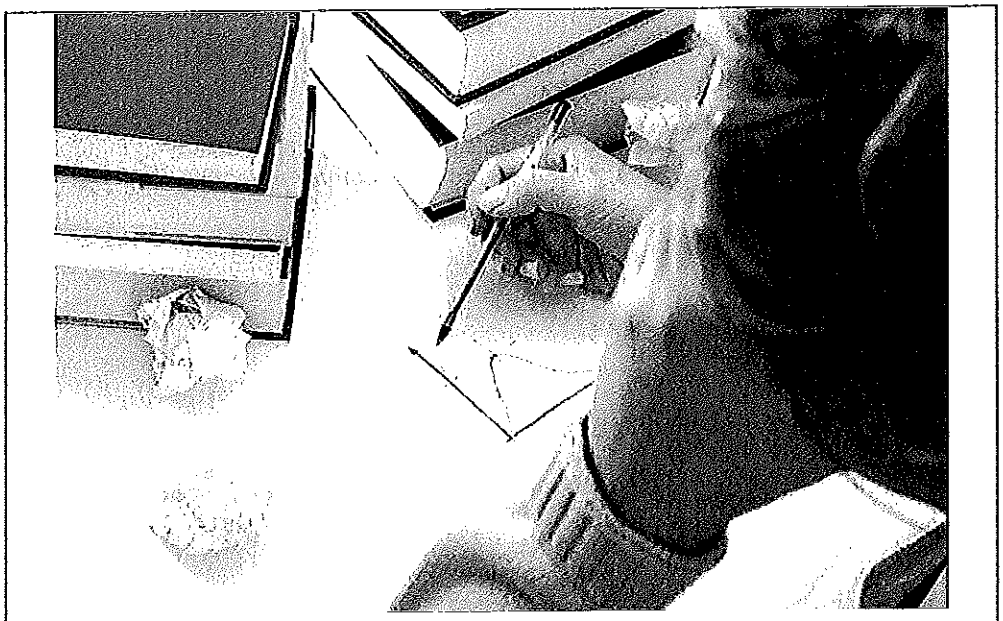
Later school start times improve sleep and daytime functioning in adolescents

Date: January 15, 2014

Source: Lifespan

Julie Boergers, Ph.D., a psychologist and sleep expert from the Bradley Hasbro Children's Research Center, recently led a study linking later school start times to improved sleep and mood in teens.

The article, titled "Later School Start Time is Associated with Improved Sleep and Daytime Functioning in Adolescents," appears in the current issue of the *Journal of Developmental & Behavioral Pediatrics*.



A new study links later school start times to improved sleep and mood in teens.

Credit: © Photographee.eu / Fotolia

"Sleep deprivation is epidemic among adolescents, with potentially serious impacts on mental and physical health, safety and learning. Early high school start times contribute to this problem," said Boergers. "Most teenagers undergo a biological shift to a later sleep-wake cycle, which can make early school start times particularly challenging. In this study, we looked at whether a relatively modest, temporary delay in school start time would change students' sleep patterns, sleepiness, mood and caffeine use."

Boergers' team administered the School Sleep Habits Survey to boarding students attending an independent high school both before and after their school start time was experimentally delayed from 8 to 8:25 a.m. during the winter term.

The delay in school start time was associated with a significant (29 minute) increase in sleep duration on school nights, with the percentage of students receiving eight or more hours of sleep on a school night jumping from 18 to 44 percent. The research found that younger students and those sleeping less at the start of the study were most likely to benefit from the schedule change. And once the earlier start time was reinstituted during the spring term, teens reverted back to their original sleep levels.

Daytime sleepiness, depressed mood and caffeine use were all significantly reduced after the delay in school start time. The later school start time had no effect on the number of hours students spent doing homework, playing sports or engaging in extracurricular activities.

Boergers, who is also co-director of the Pediatric Sleep Disorders Clinic at Hasbro Children's Hospital, said that these findings have important implications for public policy. "The results of this study add to a growing body of research demonstrating important health benefits of later school start times for adolescents," she said. "If we more

closely align school schedules with adolescents' circadian rhythms and sleep needs, we will have students who are more alert, happier, better prepared to learn, and aren't dependent on caffeine and energy drinks just to stay awake in class."

Story Source:

The above story is based on materials provided by **Lifespan**. *Note: Materials may be edited for content and length.*

Journal Reference:

1. Julie Boergers, Christopher J. Gable, Judith A. Owens. **Later School Start Time Is Associated with Improved Sleep and Daytime Functioning in Adolescents.** *Journal of Developmental & Behavioral Pediatrics*, 2013; 1 DOI: 10.1097/DBP.0000000000000018

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Should high school start later? Research says grades go up, accidents go down (poll)

College Representatives talk to Kalamazoo area high school students
Delaying high school start times appears to have significant benefits for teens, research shows. *(File photo)*

Brian Smith | bsmith11@mlive.com By **Brian Smith | bsmith11@mlive.com**
Follow on Twitter
on March 14, 2014 at 10:48 AM, updated March 14, 2014 at 12:10 PM

LANSING -- Research from the University of Minnesota says those bleary eyes in high schools across the country may have their roots in physiology, not late-night XBox sessions.

A **study of 9,000 high school students** in Minnesota, Colorado and Wyoming found that when classes begin at 8:30 or later, teens have higher grades and better attendance rates - and the number of car crashes involving teen drivers dropped by 70 percent.

By delaying start times to 8:35 or later, more than half of students are able to sleep eight hours or more, researchers concluded, which leads to better outcomes.

"Teens getting less than eight hours of sleep reported significantly higher depression symptoms, greater use of caffeine, and are at greater risk for making poor choices for substance use," the researchers wrote.

Delaying start times also encourages better academic performance, researchers concluded after analyzing GPAs and test scores for students before and after start times at the schools were delayed.

"Other positive findings include a significant reduction in local car crashes, less absenteeism, less tardiness, as well as higher test scores on national achievement tests," the report concludes.

The report does acknowledge potential problems with delaying start times, including the possible effects on after-school employment when classes end later, problems with school bus routing and less time for extra-curricular activities.

What do you think? Should high school classes start later, or should teens learn to adapt to being awake earlier?

*Brian Smith is the statewide education and courts reporter for MLive. Email him at **bsmith11@mlive.com** or follow him on **Twitter** or **Facebook**.*

NATIONAL SLEEP FOUNDATION

http://sleepfoundation.org/sleep-news/school-start-time-and-sleep

School Start Time and Sleep

Home >> Sleep News >> School Start Time and Sleep

"Early to bed, early to rise makes a man healthy, wealthy and wise," said Ben Franklin. But does this adage apply to teens? Research in the 1990s found that later sleep and wake patterns among adolescents are biologically determined; the natural tendency for teenagers is to stay up late at night and wake up later in the morning. This research indicates that school bells that ring as early as 7:00 a.m. in many parts of the country stand in stark contrast with adolescents' sleep patterns and needs.

Evidence suggests that teenagers are indeed seriously sleep deprived. A recent poll conducted by the National Sleep Foundation found that 60% of children under the age of 18 complained of being tired during the day, according to their parents, and 15% said they fell asleep at school during the year.

On April 2 of 1999, Rep. Zoe Lofgren (D-CA), introduced a congressional resolution to encourage schools and school districts to reconsider early morning start times to be more in sync with teens' biological makeup. House Congressional Resolution 135 or the "ZZZ's to A's" Act would encourage individual schools and school districts all over the country to move school start times to no earlier than 8:30 a.m.

"I hope this is a wake up call to school districts and parents all over this country," said Lofgren. "With early school start times, some before 7:00 a.m., adolescents are not getting enough sleep.

"Over time, sleep deprivation leads to serious consequences for academic achievement, social behavior, and the health and safety of our nation's youth," the Congresswoman added. "We must encourage schools to push back their start times to at least 8:30 a.m. — a schedule more in tune with adolescents' biological sleep and wake patterns and more closely resembling the adult work day."

Lofgren's work has continued. This year (2014) The National Sleep Foundation (NSF) worked with U.S. Representative Zoe Lofgren to introduce legislation that addresses the relationship between school start times and adolescent health, wellbeing and performance. We encourage you to contact your Representatives and urge them to support this bill.

In fact, public opinion seems to side with Lofgren's "Zzz's to A's" resolution. According to the National Sleep Foundation's 2002 *Sleep in America* poll, 80% of respondents said high schools should start no earlier than 8:00 a.m. each day; nearly one-half of these respondents (47%) said start times should be between 8:00 and 8:30 a.m. Only 17% of those polled said high school classes should begin before 8:00 a.m.

EFFECTS:

A study by Dr. Kyla Wahlstrom at the University of Minnesota, demonstrates the impact of pushing back school start times. After the Minneapolis Public School District changed the starting times of seven high schools from 7:15 a.m. to 8:40 a.m., Dr. Wahlstrom investigated the impact of later start times on student performance, and the results are encouraging. Dr. Wahlstrom found that students benefited by obtaining five or more extra hours of sleep per week.

She also found improvement in attendance and enrollment rates, increased daytime alertness, and decreased student-reported depression. Many experts agree that adolescents require 81/2 to 91/4 hours of sleep each night, however, few actually get that much sleep.

Even with compelling research, changing school start times can be challenging for school districts. Administrators have to delay busing schedules. Coaches worry about scheduling practices and many parents rely on the current start times for reasons such as childcare or carpools.

Students are concerned that being in school later in the day means that it will cut into after-school jobs and other extracurricular activities. Still, there are convincing reasons to push back school start times. Mary Carskadon, PhD, a renowned expert on adolescent sleep, cites several advantages for teens to get the sleep they need:

- less likelihood of experiencing depressed moods;
- reduced likelihood for tardiness;
- reduced absenteeism;
- better grades;
- reduced risk of drowsy driving ; and
- reduced risk of metabolic and nutritional deficits associated with insufficient sleep, including obesity.

Dr. Carskadon is Director of the Chronobiology/Sleep Research Laboratory at Bradley Hospital in East Providence, R.I., and Professor, Department of Psychiatry and Human Behavior at the Brown University School of Medicine. She is a member of NSF's Sleep and Teens

Task Force. With the resumption of school classes in the fall, start times are likely to remain a hot topic. Thus far, individual schools or districts in 19 states have pushed back their start times, and more than 100 school districts in an additional 17 states are considering delaying their start times.

"Changing school start times is not the only step needed," says Dr. Carskadon. She also advocates reducing weekend sleep lag (staying up later). "It's important to add sleep to the school curriculum at all grade levels and make sleep a positive priority."

ADVOCACY:

Advocating for Sleep Friendly Schools can seem like a challenging task; however, here you will find tips, guides sample materials and case studies to support your efforts and help you conduct your advocacy campaign. Sleep is so important to all of us, and for teens it seems nearly impossible to get enough. So don't sleep on it; start today to help create sleep-friendly schools that promote healthy, safe and productive students!

General Advocacy Tips for Changing School Start Times

- Start early to educate the community and all parties involved. Use hard data and testimonials. Consider the research and what you hope to gain, not lose. Network with other schools to learn from their experience. Apply what you learn to your school district's particular challenges or concerns. Be prepared with concrete examples of the successes of others.
- Community engagement is key and this means invlolving parents, students, teachers, as well as transportation, cafeteria, and extracurricular personnel, coaches, employers and others impacted by this issue. Understand from the beginning that a change in start times will affect the entire community, and set out to make sure that all of these parties are involved in the process. Involve the community in a variety of ways (Email, letters, forums, surveys, etc.) and allow everyone the opportunity to express their opinions anonymously.
- Be clear about your goals. Keep your eye on the bottom line: the academic performance, health, safety and quality of life for students. Do not get overwhelmed by the logistics and obstacles, rather, continue to emphasize the positives of the overall goal. Students' needs are foremost.
- Be flexible as the process proceeds. Consider all of the issues, the needs and agendas of all parties. Identify potential sources of resistance and address their needs. Be prepared with research and the facts. Zealots generally are not effective.
- Have a clear plan. Gather a coalition and form organized committees. Develop a timetable. Decide on guidelines for the change and create goals to measure your progress.
- Communicate all along the way and especially through the implementation of the changes. Allow time to adjust and plan for these changes.

http://sleepfoundation.org/sleep-news/insufficient-sleep-among-high-school-students-associated-variety-health-risk-behaviors

Insufficient Sleep among High School Students Associated with a Variety of Health-Risk Behaviors

Home >> Sleep News >> Insufficient Sleep among High School Students Associated with a Variety of Health-Risk Behaviors

According to a study by the Center for Disease Control and Prevention, almost 70 percent of teens are not getting the recommended hours of sleep. This lack of sleep is associated with a variety of risky behaviors such as physical inactivity, alcohol consumption, cigarette smoking, fighting, and sexual promiscuity.

High school students participating in the 2007 national Youth Risk Behavior Survey were asked how much sleep they got on an average school night. Those who responded getting less than eight hours were categorized as getting insufficient sleep. Those who got eight or more hours of sleep were categorized as getting sufficient sleep.

Researchers found that 68.9 percent of responders reported inefficient sleep on an average school night. Responders who reported insufficient sleep were also more likely to engage in risky behavior.

Insufficient sleep was associated with the 10 risky behaviors examined below:

1. Drinking soft drinks one or more times a day. This does not include diet soft drinks
2. Not participating in 60 minutes of physical activity five or more days a week
3. Using computers three or more hours each day
4. Physical fighting one or more times
5. Smoking cigarettes
6. Smoking marijuana
7. Drinking alcohol
8. Sexual activity
9. Feeling sad or hopeless
10. Seriously considering suicide

Lela McKnight-Eily, PhD, Division of Adult and Community Health says, "Public health intervention is greatly needed, and the consideration of delayed school start times may hold promise as one of the effective steps in a comprehensive approach to address this problem."

NATIONAL SLEEP FOUNDATION

Backgrounder: Later School Start Times

Adolescents today face a widespread chronic health problem: sleep deprivation. Although society often views sleep as a luxury that ambitious or active people cannot afford, research shows that getting enough sleep is a biological necessity, as important to good health as eating well or exercising. Teens are among those least likely to get enough sleep; while they need on average 9 1/4 hours of sleep per night for optimal performance, health and brain development, teens average fewer than 7 hours per school night by the end of high school, and most report feeling tired during the day (Wolfson & Carskadon, 1998). The roots of the problem include poor teen sleep habits that do not allow for enough hours of quality sleep; hectic schedules with afterschool activities and jobs, homework hours and family obligations; and a clash between societal demands, such as early school start times , and biological changes that put most teens on a later sleep-wake clock. As a result, when it is time to wake up for school, the adolescent's body says it is still the middle of the night, and he or she has had too little sleep to feel rested and alert.

The consequences of sleep deprivation during the teenage years are particularly serious. Teens spend a great portion of each day in school; however, they are unable to maximize the learning opportunities afforded by the education system, since sleep deprivation impairs their ability to be alert, pay attention, solve problems, cope with stress and retain information. Young people who do not get enough sleep night after night carry a significant risk for drowsy driving ; emotional and behavioral problems such as irritability, depression, poor impulse control and violence; health complaints; tobacco and alcohol use; impaired cognitive function and decision-making; and lower overall performance in everything from academics to athletics.

The Biology of Adolescent Sleep

Research shows that adolescents require at least as much sleep as they did as children, generally 8 1/2 to 9 1/4 hours each night (Carskadon et al., 1980). Key changes in sleep patterns and needs during puberty can contribute to

excessive sleepiness in adolescents, which can impair daytime functioning. First, daytime sleepiness can increase during adolescence, even when teens' schedules allow for optimal amounts of sleep (Carskadon, Vieri, & Acebo, 1993). Second, most adolescents undergo a sleep phase delay, which means a tendency toward later times for both falling asleep and waking up. Research shows the typical adolescent's natural time to fall asleep may be 11 pm or later; because of this change in their internal clocks, teens may feel wide awake at bedtime, even when they are exhausted (Wolfson & Carskadon, 1998). This leads to sleep deprivation in many teens who must wake up early for school, and thus do not get the 8 1/2 - 9 1/4 hours of sleep that they need. It also causes irregular sleep patterns that can hurt the quality of sleep, since the weekend sleep schedule often ends up being much different from the weekday schedule as teens try to catch up on lost sleep (Dahl & Carskadon, 1995).

Adolescents in Study Show Changing Sleep Patterns

Since the 1970s, there has been a growing awareness of the changes in sleep patterns as children transition to adolescence. In a study at a summer sleep camp at Stanford during the 1970s, boys and girls who enrolled at 10-12 years of age were monitored every year for 5-6 years. While researchers had thought older children would need less sleep during the 10 hour nocturnal window they were given, from 10 pm to 8 am, they found that regardless of age, the children all slept about 9 1/4 of the 10 hours. As they progressed through adolescence, participants continued to get the same amount of sleep, but they no longer woke spontaneously before the end of the sleep window at 8 am (Carskadon et al., 1979). In addition, when the Multiple Sleep Latency Test (MSLT)—given at designated periods throughout the day to determine the speed of falling asleep, to measure sleepiness—was given to the adolescents, they showed more alertness at 8 pm than earlier in the day, and even greater alertness at 10 pm. Also, at midpuberty,

adolescents became sleepier in the middle of the day. According to the tests, more mature adolescents showed signs of reduced alertness during the day even though they slept an equivalent amount at night (Carskadon et al., 1980).

Changes in Melatonin

Another experiment, conducted by Dr. Mary A. Carskadon of Brown University, found that more mature adolescents had later circadian rhythm timing, based on melatonin secretions in saliva samples. This finding shows that melatonin secretion occurs at a later time in adolescents as they mature; thus, it is difficult for them to go to sleep earlier at night. The melatonin secretion also turns off later in the morning, which makes it harder to wake up early (Carskadon et al., 1998).

Another important finding from many studies is that the circadian timing system can be reset if light exposure is carefully controlled (Carskadon et al., 1997). In studies where adolescents are paid to keep a specific sleep schedule and wear eyeshades to exclude light during evening hours, measurements of melatonin secretion show that the rhythm had moved significantly toward a designated time. This means that with time, effort, and money, researchers can get adolescents to reset their clocks. This approach, however, is not necessarily realistic for teens who have full and busy lives. Nevertheless, the interaction of light exposure and sleep timing is important to keep in mind.

A Widespread and High-Impact Part of Teens' Lives

Findings of the tendency for adolescent sleep patterns to be delayed have been reported not only in North America, but also in South America, Asia, Australia and Europe (Andrade & Menna Barreto, 2002; Carskadon & Acebo, 1997; Ishihara, Honma & Miyake, 1990; Bearpark & Michie, 1987; Strauch & Meier, 1988; LeBourgeois et al., 2005; Thorleifsdottir et al., 2002). The diversity of such research supports the view that intrinsic developmental changes play a role in delayed sleep patterns in adolescents. This biological shift sets the stage for other social and environmental conditions that make it easier for these adolescents to stay awake at night and wake up sleepdeprived. The effects of changing sleep patterns are compounded by

the demands older students face in academics, extracurricular activities, social opportunities, after-school jobs, and other obligations.

"Sleep isn't a priority for teenagers, and it typically isn't made one by parents or schools."

--Jodi Mindell, PhD, Director of Graduate Program in Psychology, St. Joseph's University and Children's Hospital of Philadelphia

The School Start Time Issue

Adolescent sleep deprivation is largely driven by a conflict between teens' internal biological clocks and the schedules and demands of society. Therefore, it makes sense to look at school start times, which set the rhythm of the day for students, parents, teachers and members of the community at large.

"Given that the primary focus of education is to maximize human potential, then a new task before us is to ensure that the conditions in which learning takes place address the very biology of our learners."

Mary A. Carskadon, PhD, Director of E.P. Bradley Hospital Research Laboratory and professor in Department of Psychiatry and Human Behavior at Brown University School of Medicine

Research on School Start Times and Biology

In a project spearheaded by Dr. Mary A. Carskadon and colleagues, researchers investigated what would happen to sleep and circadian rhythms in a group of young people for whom the transition from junior high to senior high required a change in school starting time from 8:25 am to 7:20 am (Carskadon et al., 1998).

The 25 students completed the study at two time points, in the spring of 9th grade and autumn of 10th grade. The students kept their usual schedules, wore small activity monitors on their wrists, and kept diaries of activities and sleep schedules for two consecutive weeks. At the end, participants came to Carskadon's sleep lab for assessment of the onset phase of melatonin secretion, an overnight sleep study, and daytime testing with MSLT. The in-lab sleep schedule was fixed to each student's average school night schedule, based on data from the wrist monitors.

Carskadon and colleagues found that in the 10th grade:

- On a typical school morning, the students woke up earlier for high school, but only 25 minutes earlier instead of the 65

- minutes reflected in the start time change.
- Sleep onset times did not change, and averaged about 10:40 pm in both 9th and 10th grade.
- The average amount of sleep on school nights fell from 7 hours 9 minutes to 6 hours 50 minutes, which is significant because the students were already accumulating a sleep deficit.
- Nearly one-half of the 10th graders showed a reversed sleep pattern on the morning MSLT. This pattern is similar to the sleep disorder narcolepsy, moving immediately into REM sleep before non-REM sleep. The 12 students who showed this pattern did not have narcolepsy, but they did have a mismatch between their school day waking times and

their circadian rhythms. Indeed, at 8:30 in the morning, they fell asleep within three minutes.
- None of the students made an optimal adjustment to the new schedule; none was sleeping even 8 1/4 hours on school nights.

"Even without the pressure of biological changes, if we combine an early school starting time--say 7:30 am, which, with a modest commute, makes 6:15 am a viable rising time--with our knowledge that optimal sleep need is 9 1/4 hours, we are asking that 16-year olds go to bed at 9 pm. Rare is a teenager that will keep such a schedule. School work, sports practices, clubs, volunteer work, and paid employment take precedence. When biological changes are factored in, the ability even to have merely 'adequate' sleep is lost," Carskadon explains.

School Start Time Initiatives and Outcomes

2014

The National Sleep Foundation (NSF) worked with U.S. Representative Zoe Lofgren to introduce legislation that addresses the relationship between school start times and adolescent health, wellbeing and performance. We encourage you to contact your Representatives and urge them to support this bill.

MINNESOTA (1996)

Early results from schools that have changed their start times are encouraging. For example, successful high school start time changes were made in Edina and Minneapolis, Minnesota after the Minnesota Medical Association issued a 1993 resolution, Sleep Deprivation in Adolescents, based on the research that puberty resets teens' internal biological clocks. The schedule was changed from:

A 7:15 am-1:45

pm day to an 8:40 am-3:20 pm day in Minneapolis

A 7:25 am-2:10 pm day to an 8:30 am-3:10 pm day in Edina

RESULTS

The Center for Applied Research and Educational Improvement (CAREI) at the University of Minnesota conducted a study on the impact of changing school start times on academic performance, behavior and safety in urban and suburban schools (Wahlstrom, 2002). Results from three years of data from both Edina and Minneapolis showed:

- Improved attendance
- Increase in continuous enrollment
- Less tardiness
- Students making fewer trips to the school nurse

In suburban districts, students reported:

- Gaining an average of about one hour of sleep per night, since their bed times stayed the same even after the start time change.
- Eating breakfast more frequently
- Being able to complete more of their homework during school hours, because they were more alert and efficient during the day.

Grades showed a slight improvement, although the change was not statistically significant. Researchers noted that it was difficult to assess changes in grades due to differences in school schedules, course names, grading policies, student transience, and the subjective nature of grading by teachers.

Suburban teachers and principals reported:

- Students seemed more alert in class.
- Improvements in student behavior, with a calmer atmosphere in the hallways and cafeteria.
- Fewer disciplinary referrals to the principal.

Suburban counselors reported:

- Fewer students seeking help for stress relief due to academic pressures.
- Fewer students coming to them with peer relationship problems and difficulties with parents.

Urban teachers, on the other hand, did not see any general improvement in student behavior.

In suburban schools, after-school athletic and other activity practices and rehearsals were shortened, with students arriving home later; however, actual participation in extracurricular activities and after-school jobs remained at the same level after the start time change. Urban schools, on the other hand, reported fewer students being involved in extracurricular activities, as well as conflicts with after-school jobs and compromised earnings. While some coaches whose sports involved long practices and traveling long distances for events disliked the change, most coaches and activity leaders supported the change because they felt students were

less tired and more mentally alert at the end of the day.

Most suburban parents supported the change; urban parents had mixed reactions because of work schedules and transportation limitations. Both groups said their children were easier to live with, with fewer confrontations and more actual conversations and connecting time in the morning.

MASSACHUSETTS (2004)

Middle school students, many of whom are entering puberty and experiencing changes to their sleep patterns, have also benefited from later start times (Wolfson et al., 2007). In a study comparing 7th and 8th graders at two different schools—one starting at 7:15 am, the other starting at 8:37 am—the students who started school earlier reported inadequate sleep and

struggling to stay awake in school more often than the students who started later. While there was no difference in weekend sleep patterns between the students at the two schools, the students who started school later reported sleeping an hour longer on school nights than those with early start times. This difference was due to later rise times; there was no difference in bed times. Academic benefits were also apparent, as students whose school started earlier were tardy four times more often, and 8th grade transcripts showed significantly worse grades. These results occurred in the fall following the start time change, and these findings were replicated in the spring. Although students at both schools were not getting enough sleep, the negative effects of sleep deprivation were far more pronounced in the earlier starting school.

KENTUCKY (1998): PREVENTING DROWSY DRIVING CRASHES

Other school districts have focused on improved safety as a successful outcome of later start times. In fall 1998, a school district in Fayette County, Kentucky moved its start time from 7:30 am to 8:30 am, and students averaged up to 50 minutes more sleep per night. Comparisons in the collision rates of Fayette County teens revealed that the crash rate for 16-18 year olds dropped following the change, even while crash rates for 17-18 year olds actually rose in the rest of the state.

This finding is especially important considering data from the National Highway Traffic

Safety Administration, which estimates that up to 100,000 police-reported crashes annually are related to drowsiness, and that among drivers age 15-24, more than 1,500 fatalities each year are associated with such crashes. In a North Carolina state study, 55% of fall asleep crashes involved drivers 25 years old or younger.

Thus, unstable wakefulness and lapses in attention are not just detrimental to performance, like students missing an important piece of information from a teacher—they can also be dangerous, such as a sleepy driver missing a stop sign and causing a fatal accident.

Collaborating in the Best Interests of Students

Many schools across the country are working to synchronize school clocks with students' body clocks, so that teens are in school during their most alert hours and can achieve their full academic potential. Working to bring school start times in line with teens' sleep needs presents a number of challenges and opportunities. Individual communities can vary greatly in their priorities and values; factors to consider include bell schedules of elementary and middle schools; transportation; athletic programs and extracurricular activities; use of schools for community activities; student employment; and safety issues for younger students who either may be waiting for a bus in the dark or need supervision of older siblings after school. There are also safety issues for older students, since violent activities, sex, recreational use of alcohol or drugs, and criminal and other risky behaviors frequently occur between 2 and 4 pm, according to data from the Federal Bureau of Investigation. It is also important that any consideration of a school start time change takes into account the impact on families, including transportation, dependence on teens' income, chores and other family responsibilities, and teens' mood and behavior at home.

Changing a school's start time involves a wide array of people--parents, teachers, students, principals, school boards, superintendents, counselors and healthcare professionals, among others. The impact is felt at a community level, but it is also felt individually, and the individuals who are affected need to have their views heard and acknowledged so that discussions can move forward in search of common

ground.

Obviously, moving bell times is one major step in a larger picture of ensuring that adolescents get the sleep they need. It will not put more hours in the day, so it is important for teens to know about their sleep needs and have the skills to make a conscious effort to get a good night's sleep. Many teens assume they are expected to function with a lack of sleep, but sleep is not optional; it is biologically necessary. If sleep is incorporated into educational efforts, teens will be armed with information that will enable them to use a later school start time to their advantage.

Changing Times: Findings From the First Longitudinal Study of Later High School Start Times

Kyla Wahlstrom

In the early 1990s, medical research found that teenagers have biologically different sleep and wake patterns than the preadolescent or adult population. On the basis of that information, in 1997 the seven comprehensive high schools in the Minneapolis Public School District shifted the school start time from 7:15 a.m. to 8:40 a.m. This article examines that change, finding significant benefits such as improved attendance and enrollment rates, less sleeping in class, and less student-reported depression. Policy implications are briefly discussed, acknowledging this to be a highly charged issue in school districts across the United States.

Recent research information about the sleep needs of adolescents and the influence of sleep on learning and behavior has captured the attention of school districts across the United States. Physicians, parents, school board members, and others are asking school administrators and policymakers to acknowledge the medical evidence about the biological sleep patterns of teenagers and to adjust school schedules accordingly. The discussions and debates have been intense because this is a multifaceted issue. School administrators are being asked to weigh the factual information about the biology of adolescents' sleep patterns against the competing demands of teachers' work preferences, athletic and afterschool activity schedules, and bus transportation schedules. This article presents findings from a 4-year study in a large, urban school district that altered high school start times significantly from 7:15 a.m. to 8:40 a.m. This change affected more than 12,000 secondary students within a total K–12 population of nearly 51,000 students.

Theoretical Perspectives

The findings of adolescent sleep researchers have, within the past 12 years, provided compelling evidence that sleep deprivation and sleep lag syndrome are common problems among U.S. teenagers. Adolescents are substantially

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sleep deprived when high schools begin classes much before 8:15 a.m. Sleep deprivation can have many negative consequences on cognition. Sleep deprivation is associated with memory deficits (Anderson, Petros, Beckwith, Mitchell, & Fritz, 1991; Dahl, 1996), impaired performance and alertness (Barron, Henderson, & Spurgeon, 1994; Carskadon, 1994; Pilcher & Huffcutt, 1996), as well as time-on-task decrements and optimum response shifts (Cooper, 1994; Wolfson & Carskadon, 1996). The specific loss of REM (rapid eye movement) phase sleep also results in memory loss (Poirel & Larouche, 1987). Callan (1995) found that REM sleep affects information processing, whereas Maas (1995) listed the consequences of REM sleep loss for adolescents to include unintended sleep; increased irritability, anxiety, and depression; decreased socialization and humor; hypersexuality; mental fatigue; and decreased ability to handle complex tasks and be creative.

Previous research conducted in the first year of the change to a later start in Edina, Minnesota (see Fredrickson, Wahlstrom, & Wrobel, 1999; Wahlstrom, 1999b; Wahlstrom & Freeman, 1997), and in Rhode Island (see Carskadon, Wolfson, Tzischinsky, & Acebo, 1995) has documented initial outcomes, finding clear statistical evidence that students who do not experience a sleep lag syndrome report higher grades, less depression, and fewer at-risk behaviors for dropping out of school. However, the examination of longitudinal data to determine the relationships among student achievement, behaviors, and temporal learning conditions has been, up until now, an uncharted area of inquiry.

If changing the high school start time to a later hour appears to result in positive outcomes, then why are schools not quickly moving to that course of action? From an educational administrative and policy perspective, making such a change is difficult because there are many interrelated factors that determine when schools begin the school day. Districts administrators who have considered starting the high school day later have encountered intense resistance from individuals and groups that assume that their interests will be negatively affected (Wahlstrom, 1999a).

Background

Effective with the 1997–1998 school year, the Minneapolis Public School District changed the starting time of its seven comprehensive high schools to 8:40 a.m. and changed the dismissal time to 3:20 p.m. Prior to 1997, classes began at the high schools at 7:15 a.m. and were dismissed at 1:45 p.m. In the 1997–1998 school year, the Minneapolis School Board asked the Center for Applied Research and Educational Improvement (CAREI) in the College of Education and Human Development at the University of Minnesota to examine the impact of the later start on its students, staff, families, and community members. (The information from that study can

be found online at http://education.umn.edu/carei/Programs/start_time/default.html).

In the fall of the 2000–2001 school year, the Minneapolis Public School District asked CAREI to examine the longitudinal data about student grades and attendance and to readminister the School Sleep Habits Survey (developed in 1994 by researchers at the Bradley Hospital/Brown University Research Lab; see www.sleepforscience.org/contentmgr/showdetails.php?id=93) to high school students. The district was interested in knowing whether the positive outcomes that were evident during the first year of the change were persisting over the long term.

Method

The quantitative data for the longitudinal study came from several sources. The school district provided data files on all letter grades earned by all students in the seven high schools over the course of 6 years—3 years prior to the change and 3 years after the change. The district and the Minnesota State Department of Education provided data on attendance, ethnicity, tardiness, graduation rates, and rates of continuous enrollment.

In addition, longitudinal data is available from a stratified random sample of 1,200 Minneapolis secondary students in grades 9–12 (of a total population of 12,000 students). These students twice completed a norm-referenced written questionnaire, the School Sleep Habits Survey (once in Year 1, in 1997, and again in Year 4, in 2001), about their study, work, sleep, and school habits as well as their preferences. Qualitative data were also collected in student focus groups in each of the seven high schools in Year 1 and again in Year 4. Additional individual interviews were conducted with teachers, administrators, and parents. These interviews are discussed in detail in the Findings section.

The source for the attendance data analyzed in this study is the data repository for the State of Minnesota, the Minnesota Automated Reporting Student System (MARSS). Data are entered into the MARSS database for every school district in the state. Attendance data for the Minneapolis Public School District were available and retrievable for a 5-year period, from 1995 to 2000. Therefore, the study team has data for 2 years when the school district high schools began classes at 7:15 a.m. (the 1995–1996 and 1996–1997 school years) and data for 3 years when high school began at 8:40 a.m. (the 1997–1998, 1998–1999, and 1999–2000 school years). Thus, the data set used in these analyses contains a total of 50,962 students, enrolled in grade 9–12 in seven Minneapolis high schools over 5 years. Finally, the urban district of Minneapolis—as measured by demographic characteristics such as ethnic composition, poverty rates, and family mobility rates—is considered to be typical of other major urban areas throughout the country.

Ethnic categories are established by the MARSS system. School districts are required by law to report annually the numbers of enrolled students into the following categories as labeled by MARSS: American Indian/ Alaskan Native; Asian/Pacific Islander; Hispanic; Black, not of Hispanic origin; and White, not of Hispanic origin.

Caveat About Grade 12 Data

The numerical findings listed for grade 12 students may often seem inaccurate or not possible. This is due to several factors. First, students in grade 12 often carry lighter class loads if they have completed most of their required classes, and so attend school for only part of a day. Furthermore, many students in grade 12 are past the mandatory age for attending school, hence the total enrollment in 12th grade often declines significantly from enrollments reported for 11th grade.

Another confounding characteristic is that students in grade 12 voluntarily choose to come to school and, as a result, are generally motivated to be there, tending to have rather high levels of attendance. Students who struggle academically with school have often chosen to drop out of school by 12th grade, thereby making the group of students who remain appear more capable. In reviewing the data from this study, one will notice that findings for grade 12 students are rarely statistically significant.

Continuous Enrollment

Continuous enrollment is a numerical measure that tracks the frequency with which students stay in a given school or stay within the high schools in the district, as opposed to transferring into and out of a school or the district multiple times. Several studies of student performance conducted by the Minneapolis Public School District Department of Research, Evaluation, and Assessment have found that students who remain in their schools or remain in the district have much higher scores on achievement tests and have much higher rates for graduation and school completion than do those students who move from school to school (see www.mpls.k12.mn.us/departments/REA/index.html). For the longitudinal evaluation reported here, continuous enrollment refers to a student staying in the same high school within the Minneapolis district for 2 contiguous years.

One of the factors in this variable that may contribute to a student not remaining continuously enrolled is the district's tardiness policy. In that policy, a student who has more than eight unexcused absences or tardies per semester for any one class is automatically dropped from that class. Therefore, a student who oversleeps and/or misses the school bus in the morning, thereby being tardy for or missing the first hour or two of school, is automatically dropped from those classes' enrollment lists. To avoid having these dropped

classes show up on a transcript, a student will often withdraw from that school and re-enroll in a neighboring school, one still within the Minneapolis Public School District. At times, there have been so many students shuffling from school to school that the transferred transcripts could not keep up with all of the moves. Having a later start for the first hour of class appears to enable more students to not oversleep and to arrive at school on time.

Findings

Enrollment

A key finding of this study is that the percentage of high school students who were continuously enrolled in the same district or in the same school had statistically significantly risen since the 1995–1996 school year. Concurrently, the percentage of students who were not continuously enrolled had decreased significantly. This means that an increasing number of students were staying in the same district or in the same school for 2 or more years, and the number of students who moved in and out of the district or moved from school to school declined steadily.

As previously noted, students in grades 9 and 10 change schools often for various reasons, including poor attendance or poor grades. By the time students reach grades 11 and 12, they often remain in the same school because they are near completion and discover it is no longer to their benefit to change schools. Also, students in grade 12 typically are past the mandatory age requirement for attending school, therefore they voluntarily choose to attend school. The researchers expected that the percentage of students continuously enrolled would be greater for those in grades 11 and 12 than for students in grades 9 and 10; but they also found that there was a statistically significant increase in the percentage of students in grades 9 and 10 who remained in the same school for 2 or more years (see Table 1).

It is important to note that during this time there were no other significant policy changes in the school district that might have compromised or otherwise affected the students' choices to stay in the same school. Minneapolis Public School District has a history of providing many choices for students, including open enrollment options and magnet schools. All of those opportunities were in existence both before and after the start time was changed. In other words, initiatives to keep students engaged in school were already in place before 1995, and yet the later start time still appears to have made a significant difference in keeping students in the same school.

Attendance

Attendance findings by grade level. Attendance patterns of students enrolled in grades 9–12 in Minneapolis high schools were categorized into two

Table 1. Percentage of Enrollment Rate in the Same School

	Grade 9		Grade 10		Grade 11	
School year	Continuous	Noncon	Continuous	Noncon	Continuous	Noncon
1995–1996	49.0	51.0	54.4	45.6	60.8	39.2
1996–1997	52.2	47.8	58.7	41.3	64.0	36.0
1998–1999	58.1	41.9	63.4	36.6	66.8	33.2
1999–2000	57.8	42.2	65.6	34.4	68.5	31.5

Note. Noncon = noncontinuous enrollment.

groups: students who were continuously enrolled in the same high school for 2 or more years and students whose enrollment was discontinuous (students who made frequent moves into and out of many high schools over the course of their 4-year high school career). Researchers examined data regarding attendance behavior before and after the changes in school start time. The findings for the second group are notable.

Students in grades 9 to 11 who remained in the same high school for 2 or more continuous years had consistently high rates of attendance, between 93% and 95%. Attendance for high school seniors was slightly more variable, with a range from 89% to 93% (see Table 2.) There were no significant differences between the years with the early start and the later start for any of the groups in grades 9 to 12 who were continuously enrolled in the same school.

Notable differences occurred, however, in the average attendance rates for students in grades 9 to 11 who were not continuously enrolled for 2 consecutive years in the same high school (see Table 2.) In the 2-year period (school years 1995–1996 and 1996–1997) when school started at 7:15 a.m., the average rate of attendance rate for noncontinuously enrolled students in grade 9 was 72%. During the 3 years after the later start time was in effect, the average rate climbed to nearly 76%. This change in attendance rate was highly statistically significant (at the .001 level). That is, the change in rate is not likely to be merely a chance occurrence. Equally notable were the improvements in attendance rates for students in grades 10 and 11. Their combined rates moved from an average of 73.7% with the early start to 77.5% with the later start, with the largest gains seen among students in grade 11.

Attendance rates for all high school seniors were variable by year, without significant differences after the later start time was initiated. This is likely attributable to the fact that those students chose to remain in high school when they otherwise could have legally withdrawn. They were committed to finishing high school regardless of what time of day school began.

Table 2. Percentage of Average Attendance Rates for Students in the Same School

	Grade 9		Grade 10		Grade 11		Grade 12	
Period	Enrolled	Not	Enrolled	Not	Enrolled	Not	Enrolled	Not
Prechange								
1995–1997	93	72	95	76	93	72	93	88
Postchange								
1997–1999	94	76	95	78	94	78	91	89
1998–2000	94	75	94	78	94	77	89	89

Note. Not = not enrolled for 2 consecutive years in the same school.

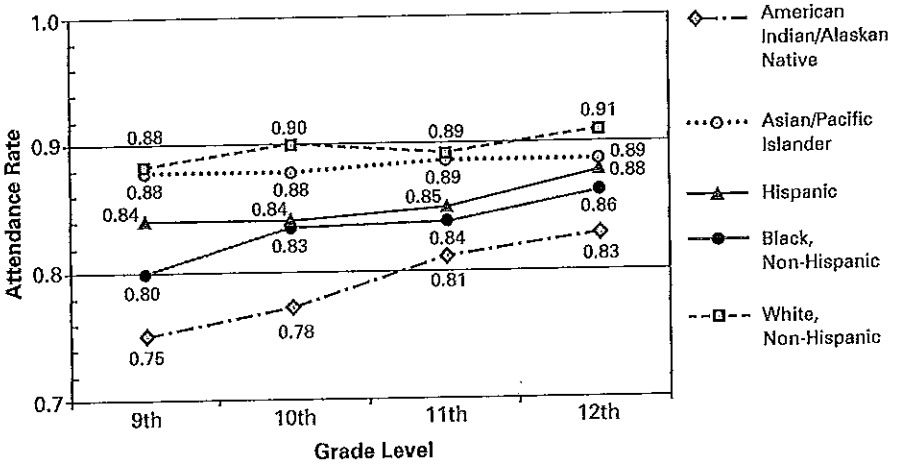
Attendance by ethnic group. All school districts report attendance data to the state annually. The state classifies students into one of five ethnic groups: American Indian/Alaskan Native; Asian/Pacific Islander; Hispanic; Black, not of Hispanic origin; and White, not of Hispanic origin. In examining the Minneapolis Public School District data for attendance rates of students by ethnic group, researchers observed two notable reasons for improvement in the attendance rates from pre- to postchange in start time. First, attendance improved as students progressed through grade level (e.g., 11th graders had better attendance than 9th graders). Second, after the change in start time, attendance improved for Asian, Hispanic, Black, and White students in grades 9 to 11. Among American Indian students, there was improvement in attendance grades 9 and 10, with a slight decrease in grade 11. Attendance rates for all ethnic groups in grade 12 were the same before and after the change in start time. The rate remains relatively high for 12th graders for all years, although the actual enrollment numbers of students enrolled in school have diminished steadily each year.

This information is summarized in two graphs. Figure 1 portrays data during the early start time, showing average attendance rates by ethnic group for the 2 years when the high schools started at 7:15 a.m. Again, one can see that attendance rates usually to improve as the students progress through grade level. Figure 2 illustrates the average attendance rates by ethnic group during the 3 years after the start time had been changed to 8:40 a.m. Attendance rates improved for Asian, Hispanic, Black, and White students in grades 9 to 11 from prior and after the change in start time.

Impact on Grades Earned

An analysis of letter grades earned in classes during the 3 years prior to and the 3 years after the change to a later start time was completed. This task was more complex and difficult than anticipated; there were more than a million data points. Data were anonymous, listed by student identification number. Issues of fair comparison within the data set arose for several reasons:

Figure 1. Early Start: Comparison of Average Attendance Rate by Ethnic Group



Course name. Titles of classes differed from school to school, so it was difficult to compare classes. For example, there were 642 differently named math classes among the seven high schools. This was also a problem in most other content areas (e.g., English, sciences, and social studies).

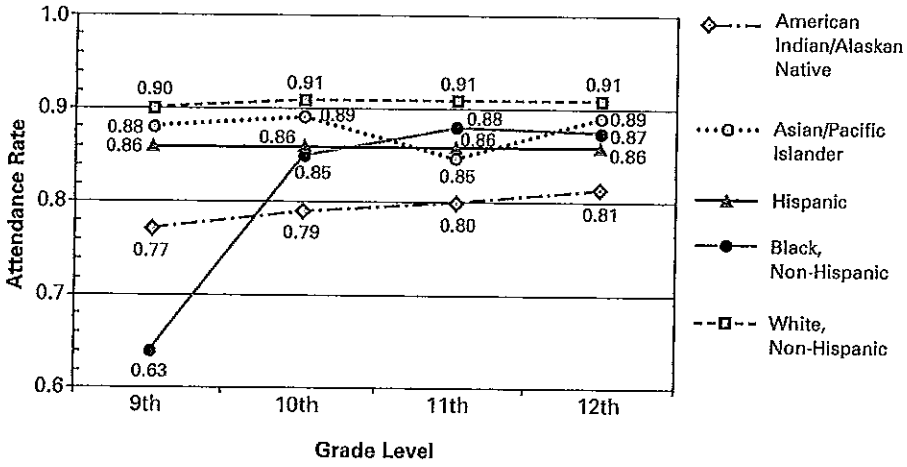
Schedule differences. Length of class periods (four periods of 90 minutes on the block schedule, versus a six- or seven-period day) and number of grading periods (semesters vs. trimesters) differed from school to school, making equitable comparisons difficult or impossible.

Student transience. Grades are kept by school, so if a student began a semester in one school and then moved in the middle of a semester to another school, then the class entries in the first school might be left blank for the listed courses, with the same student showing up in a different set of classes in the second school.

Data entry. If school personnel used a different spelling of a student's name when making an entry into the student record-keeping system or used an incorrect birth date, the assigned a new student identification number. Even with anonymous data, it was often apparent that the same student information had been entered into the system multiple times.

Missing data. Several hundred thousand data points (grades earned) were missing in the overall database. Grades earned were entered at the school level, and different schools achieved different levels of completeness in entering grades.

Figure 2. Later Start: Comparison of Average Attendance Rate by Ethnic Group



Given the numerous obstacles to obtaining "clean" data, the analysis took nearly a year. In the end, the comparison of students' letter grades for 3 years prior to the change (starting time of 7:15 a.m.) and 3 years after revealed a slight improvement in grades earned overall, but the differences were not statistically significant. The trend lines for letter grades earned for all grade levels 9 through 12 for the years of the later start time are on an upward (positive) slope. Students' self-report from a written survey on their grades earned corroborate this finding.

Grading is often a subjective action by teachers. Having a rubric in place to judge a student's output fairly is one way to guard against uneven assignment of letter grades for student work. It is also important to recognize that few teachers use a rubric for evaluating every student assignment. The possible variability in teachers' perceptions, therefore, adds incredible instability to the valid use of grades as a primary measure of impact for a new policy initiative, such as instituting a later high school start time. Additional issues complicating fair comparisons include possible grade inflation, grading policies that differ from district to district, and teacher turnover. A conclusion from the time-consuming and intensive data analysis examining actual grades earned is that districts will find it difficult to use letter grades when judging the efficacy of school start time changes.

Of the students who remained enrolled in Minneapolis high schools, few take either the SAT or the American College Test (ACT). Those students who do take these tests typically tend to be the most academically able, attend classes regularly, and are likely have study habits that supercede any tiredness they experience. As a result, it is difficult to compare their

scores with those of their suburban counterparts on nationally normed tests. It is equally problematic to compare the earned grades of Minneapolis students who took the SAT/ACT before and after the start time change because those students are a subsample of the total Minneapolis student population. They are likely to be academically successful no matter what the local policy is about the starting time of the school day.

Sleep Habits Survey: Selected Results

The School Sleep Habits Survey was administered to a stratified random sample of students in grades 9 through 12 in the Minneapolis Public School District in December 1997 (school year 1997–1998) and again in January 2001 (school year 2000–2001). In both years, all students surveyed attended schools with 8:40 a.m. start times. The survey was also administered in December 1997 to a stratified random sample of high school students in a demographically similar urban high school (anonymously identified as District B) who had a school start time of 7:30 a.m. Analysis of the complete data set, including all urban and suburban sites for which student survey data exists, is still in process; a sample of what has been found thus far is presented in Table 3.

Students in 1997 reported a mean weekend bedtime of 12:40 a.m., statistically similar to the weekend bedtime of 12:42 a.m. reported by students in 2001. Students in 1997 reported a mean weekend wake-up time of 9:51 a.m., and students in 2001 reported a mean weekend wake-up time of 9:49 a.m., not a statistically significant difference. The impact of circadian rhythms and similar weekend schedules (i.e., work, social life, and family time) in both years are likely contributing to the similar wake-up and bedtimes. That is, students in 1997 and 2001 were spending their time doing the same things during the same hours on the weekend and were therefore feeling tired, going to bed, and waking up at the same time.

Before the later school start time was instituted, many parents and administrators expressed a fear that students would merely use the later morning start time as an excuse to stay up an hour later on school nights. The data, however, show that this did not happen. Students continued to go to bed at the same time (approximately 15 minutes before 11 p.m.). This finding makes sense from a biological perspective, as it is likely that nighttime circadian rhythms were contributing to feelings of sleepiness around 11 p.m, regardless of what time the students woke up in the morning. Minneapolis students slept about an hour more each school night (due to the later school start time) than their peers whose school began at 7:30 a.m.

When additional data from the School Sleep Habits Survey were compared between those respondents whose high school started between 7:15 and 7:30 a.m. and those whose high school began at 8:30 a.m. or later, some of the

Table 3. A Comparison of Selected Sleep Survey Mean Scores From Minneapolis and District B High School Students

Survey items/scales	Minneapolis high schools (8:40 a.m. start) *N* = 467	District B (7:30 a.m. start) *N* = 169
School day rise time		
1997–1998	7:12 a.m.***	6:13 a.m.***
2000–2001	6:40 a.m.	6:19 a.m.
School night bedtime		
1997–1998	11:19 p.m.*	11:05 p.m.*
2000–2001	10:41 p.m.	11:18 p.m.
School night sleep total		
1997–1998	7 hr, 53 min***	7 hr, 7 min***
2000–2001	7 hr, 59 min	7 hr, 1 min
Daytime sleepiness	2.21**	2.50**
Sleepiness (10-item total)	15.38***	17.37***
Struggled to stay awake or fell asleep		
Reading, studying, doing homework	1.97***	2.39***
During a test	1.32**	1.48**
In a class at school	2.06***	2.45***
Doing work on a computer or typewriter	1.23	1.34
Sleep behavior (15-item total)	21.82*	23.26*
In the last 2 weeks		
Arrived late to class because overslept[a]	4.11**	3.77**
Fallen asleep in a morning class[a]	4.32***	3.90***
Fallen asleep in an afternoon class[a]	4.31	4.14
Depression (6-item total)	10.37*	10.89*
Days home sick over 2 weeks	0.75*	1.03*

[a]Higher values indicate lower frequency.

*Row mean values significantly different, $p \leq .05$.

**Row mean values significantly different, $p < .01$.

***Row mean values significantly different, $p < .001$.

findings were striking. For example, the survey contained questions that measured feelings and behaviors often associated with depression. The survey was not designed to be a diagnostic tool in terms of clinical depression, but the students' responses were generally indicative of their overall emotional state. Students were asked the multiple-part question, "During the last two weeks, how often were you bothered by or troubled by the following: (a) feeling too tired to do things; (b) having trouble going to sleep or staying asleep; (c) feeling unhappy, sad, or depressed; (d) feeling hopeless about the future;

(e) feeling nervous or tense; (f) worrying too much about things." Respondents replied to items a–f according to the following scale: 1 (*not at all*), 2 (*somewhat*), or 3 (*much*). The students whose high schools started at 8:30 a.m. or later reported statistically significant less depressive feelings on those questions than did the early start students (p ranged from $< .05$ to $< .001$.)

Similarly, scores on questions measuring daytime sleepiness, the struggle to stay awake in class, and sleepiness while doing homework all showed statistically significant better outcomes for the students whose school day started later. For example, students in late-start schools reported being less likely to arrive late to class because of oversleeping, or to fall asleep in a morning or afternoon class, or to feel sleepy while taking a test. They also reported statistically significant fewer feelings of sleepiness when at a computer, reading, or studying. (Detailed information about these findings can be found at: http://education.umn.edu/CAREI/Programs/start_time/VIIexec_summ.html).

Many of the benefits of the later start time were similar for both urban and suburban students, with their actual scores being nearly identical despite the differences in their local economic conditions. Again, if the need for and the benefits of more sleep are a biological phenomenon of the human body during the adolescent years, then one would expect those kinds of results, which are not related in any way to socioeconomic status.

Student Focus Group Findings

In spring of 2001, student focus groups were conducted at each of the seven Minneapolis high schools. The groups comprised either 9th and 10th grade students, or 11th and 12th grade students. Each group had about 6 respondents. Preliminary findings indicate that students cannot imagine returning to an earlier starting time because it would mean getting out of bed an hour earlier. Still, they have found that the later start time has had some negative, as well as positive, outcomes. The following quotations from students portray the range of opinions about aspects of the later start time.

About sleepiness in school, students said:

> I get awake by the time I get to school, but if it's earlier, I get so much more tired. I think my sleep schedule, especially, is much more towards the middle of the day. It's like, after midnight to about noon. So, it's a lot easier with a later start time because I don't fall asleep until that time anyway, so moving it back would just compress that.

> I think I'm awake at school. I've never fallen asleep at school. I don't fall asleep during the day. I just don't. I find that if I stayed

up late—like 2 o'clock doing homework or whatever—then, even though I'm sleepy, I can hear stuff. But I'm a lot more detached and tired, and I can't concentrate nearly as well. Getting to bed earlier doesn't really help, because I don't fall asleep.

Sleeping in class?... It's mostly during the earlier hours. Like first hour, a lot of people sleep, second hour some people sleep. It kind of tapers off.

Students commented about the impact of the change on sports:

The problem that I have with the later start times is that [the last class] hour for me is really hard because that is when I play softball in the spring. Every time we have a match, I end up getting out early.

Yeah. And like last semester, or last spring, I had a really hard time keeping up with my sixth hour grade because I would keep getting out of class almost every day.

Sometimes, like when I have practice for football, it's real tiring. It starts around 3:30, ends around 6 sometimes, 5:30. I catch a city bus, and sometimes I don't get home until 8 or so. Now I'm not playing football. I'd rather have more time in the afternoon to do that.

And students registered their overall perspectives:

I think school starts at a good time. It's just that it would go a lot better if it was a little later, because people would have more time to actually get up and eat breakfast and do those little things they normally do to get themselves prepared to go anywhere else during the day if it wasn't school. And we get out at a good time. I think we're in a pretty comfortable spot, actually.

After school, I have to go home and do homework. That takes up all the time. I think if school started earlier, got up earlier, [I'd] probably have the time to focus and get everything done without rushing.

I don't think it [the later start] affects my grades, but it does affect my stress level.

Teacher Perspectives

In fall of 1996, 578 high school teachers (grades 10–12) in 17 suburban school districts responded to a written survey that asked them to indicate the time they believe high school classes should begin for optimal learning by students. The results in Table 4 show that more than half believe the optimal start time is between 8:00 and 8:30 a.m. It is also important to note that 92% of the teachers who responded to this survey teach in high schools that start between 7:15 and 7:35 a.m.

In spring of 1998, at the end of the first year that Minneapolis high schools had made the shift to an 8:40 a.m. start, 335 Minneapolis high school teachers responded (response rate of 67%) to a mailed written survey asking questions about their views of the effect of a later start time. Results from that survey indicated that more than 57% of the teachers reported a greater number students being more alert during the first two periods of the day than had been the case with the earlier start time. Of the respondents, 51.4% agreed or strongly agreed that fewer students were sleeping at their desks. They had evenly divided opinions about whether or not students expressed positive feelings about the change and were also evenly divided about whether or not the later start had had a positive impact on their teaching.

In contrast, during focus groups and interviews with suburban teachers whose high school changed to an 8:30 a.m. start time, most respondents expressed having experienced a positive effect from the later start. They were nearly unanimous in the view that students were more alert throughout the day. The teachers also cited the benefit of more team planning time in the morning before students arrive, and they stated that fewer students were sleeping at their desks during class.

In all districts with the later start in the morning, afterschool athletic and other activity practices, extended-day programs, and rehearsals were shortened, with students arriving home at a later hour than they did in 1997. However, actual participation rates in afterschool activities, including sports and cocurricular activities, remained at the same levels after the implementation of the later high school start time as they had been before the change. Coaches and activity leaders were generally supportive of the change because they saw students who were less tired and seemingly more mentally alert at the end of the day. A few coaches whose sports involved long practices and traveling long distances for events were outspoken about their dislike of the later start and dismissal time for the school day.

Administrator, Counselor, and Parent Perspectives

High school principals were personally interviewed about what changes, if any, they saw in their schools as a result of the change to a later start. The most common response was that the mood of the students in the hallways,

Table 4. High School Teacher Opinions of Optimal Start Time of First Class for Majority of Students

Time	*N*	Percentage
6:30	2	0.3
7:00	6	1.0
7:15	12	2.1
7:30	98	17.0
7:45	35	6.1
8:00	183	31.7
8:15	53	9.2
8:30	132	22.8
8:45	9	1.6
9:00	26	4.5
9:15	0	0
9:30	4	0.7
9:45	1	0.2
10:00	7	1.2
Other	1	0.2
No opinion	9	1.6
Total	**578**	**100**

during passing times, was now calmer. They also cited that calmness as being evident in their student cafeterias during lunch. As a result, 5 of the 8 principals noted that they were dealing with fewer disciplinary referrals to their offices. With fewer students arriving tardy, their offices were much less congested in the morning, and there were fewer record-keeping tasks associated with tardiness and students dropping out of their first-hour classes.

Seventeen school counselors and 3 school nurses also provided personal comments, noting that significantly fewer students were coming to them to report peer relationship problems and/or difficulties with their parents. They echoed the principals' perceptions that the overall mood in their schools was calmer, with the students' temperaments seeming much more even.

Parents who attended their child's high school conference were asked to complete a written surey; about 92% of suburban parents supported the change. Their negative comments centered on the later time that their children were now coming home after participating in afterschool activities or sports. Urban parents were interviewed in focus groups; their reactions were more mixed, often with negative comments related to changes required in work schedules and transportation limitations. Both urban and suburban parents noted that their high school children were "easier to live with." They

found that they were having fewer confrontations with their children in the morning about getting out of bed and getting to school on time. They also commented that they were having more actual conversations with their teenage children in the morning, finding that they had new "connection time" with their child.

Summary—Who Benefits?

Numerous "beneficiaries" of a later high school start time emerge from the evidence in the study. The students benefited the most. For example, attendance rates for all students in grades 9, 10, and 11 improved in the years from 1995 to 2000, with the greatest rate of improvement for grade 9 students. Furthermore, students who did not have a pattern of continuous enrollment in the school district showed a marked improvement in their daily attendance rates after the initiation of the later start time in 1997–1998.

Perhaps the most surprising finding was the discovery that Minneapolis high school students continue to get an hour's more sleep each school night than is the case for students whose schools begin an hour earlier. The increased sleep was a finding after the first year of the late start, and it continued to be true 4 years into the change. This is contrary to the fears and expectations that a later start would result in students staying awake an hour later on school nights. Instead, students in Minneapolis high schools get 5 more hours of sleep per week than do their peers in schools that start earlier in the day.

Educational Importance of the Study

The initial findings from this longitudinal study lead to important considerations for school administrators. Addressing the needs of students who are at-risk learners, at risk for dropping out of school, or both is a universal concern. These are often students who have insufficient credits for graduation because they have missed too many first and second hour classes. The study reveals that attendance rates improved significantly when the high schools initiated the later start time; this suggests that changing start times is one way to recapture those students who might otherwise not complete high school.

Skeptics of the possible benefits of a later start to the high school day frequently cite the need for objective evidence, such as improved grades, as proof that the initiative is worthwhile. The use of grades as a sole determinant of a new program's success is shortsighted. In reality, grades are often a rather subjective measure due to local factors such as grade inflation, curricular changes, teacher and administrator turnover, and changes in assessing student work. A minimum of 3 years' worth of grades is needed to gauge any possible changes, and the complicating factors noted here cause the utility of grades earned to be, at best, only one measure among many. There are other equally important measures of impact, such as student physical

and emotional well being, benefits associated with teaching and learning, and improved family relationships.

Furthermore, an important aspect of this study is the integration of the medical and educational research communities. It is not often that medical research has immediate relevance to discussions among educators. In this study, however, the biological sleep needs of adolescents and the structure of the school day become instant, and somewhat indivisible, partners. Similar studies on students have recently been completed in Brazil, Italy, and Israel (Andrade, Benedito-Silva, Domenice, Arnhold, & Menna-Barreto, 1993; Giannotti, Cortesi, & Ottaviano, 1997; Sadeh, Raviv, & Gruber, 2000). Those studies have revealed that the sleep–wake cycle for students in those countries is nearly identical to that found among students in the United States. In other words, the sleep phase shift occurring in adolescents' neurological systems is not culturally based; it is, instead, a phenomenon of human development.

The tension between acting on facts and the politics that ensue in a discussion about changing school start times is a key characteristic of this type of school reform effort. Interviews with principals, superintendents, and school board members revealed that making the decision to alter a school's start time—in effect, to alter the community's rhythm—is considered to be extremely risky behavior. This also appears to be true for the superintendent and for members of the school board, who revealed in interviews a fear of being replaced in their roles if the debate about a later start time divided and polarized the community. As a result, many districts have chosen not to change school starting times for any grade level.

Transportation costs are often cited as the reason that the change will not work in a district. In fact, neither the suburban school district of Edina, Minnesota nor the urban district of Minneapolis, Minnesota, found that the change to a later start increased their transportation costs. The same buses and routes were used; the only changes made were the times the buses used the routes.

As other districts consider the change to a later start for their high schools, it is clear that it is and will continue to be an extremely contentious decision because administrators do not want any local advocacy group or state policymaker to interfere in a decision normally made at the district level. The interrelated dynamics include the school board and their political relationship to the superintendent; the role of principals and their involvement in the decision; the role of data for and against the change; and the voices of teachers, students, and families and their perceived needs.

However, asking stakeholders in advance whether or not to make the change, without first impartially sharing and discussing the complete array of findings, will almost certainly lead to their disapproval of the idea. The process of change is unsettling to most people; change interferes with

feelings of stability and continuity. When routines are upset, it is human nature to react negatively. Thus, the mixed feelings of Minneapolis students, teachers, administrators, and parents are normal and should come as no surprise. Nevertheless, the fact that later school start times can now demonstrate some positive long-term effects should cause districts to seriously consider whether such a change might be feasible for them.

Good policy decisions are made with good data. The data from the Minneapolis study, combined with current knowledge of physiology of adolescent maturation and brain development, give some clear markers to districts concerned with the overall well being of their teenage students. This research is not intended to indict current and past practices for school start times, but rather (to paraphrase Ted Sizer) to "challenge the regularities of schooling" by better illuminating the path toward healthy policy decisions for all students.

References

Anderson, M. J., Petros, T. V., Beckwith, B. E., Mitchell, W. W., & Fritz, S. (1991). Individual differences in the effect of time of day on long-term memory access. *American Journal of Psychology, 104*(2), 241–255.

Andrade, M. M., Benedito-Silva, A. A., Domenice, S., Arnhold, I. J., & Menna-Barreto, L. (1993). Sleep characteristics of adolescents: A longitudinal study. *Journal of Adolescent Health, 14,* 401–406.

Barron, B. G., Henderson, M. V., & Spurgeon, R. (1994). Effects of time of day instruction on reading achievement of below grade readers. *Reading Improvement, 31*(1), 59–60.

Callan, R. J. (1995). Early morning challenge: The potential effects of chronobiology on taking the scholastic aptitude test. *The Clearing House, 68*(3), 174–176.

Carskadon, M. A. (1994). Measuring daytime sleepiness. In M. H. Kryger, T. Roth, & W. C. Dement (Eds.), *Principles and practice of sleep medicine* (2nd ed., pp. 961–962). Philadelphia: W. B. Saunders.

Carskadon, M. A., Wolfson, A. R., Tzischinsky, O., & Acebo, C. (1995). Early school schedules modify adolescent sleepiness. *Sleep Research, 24,* 92.

Cooper, R. (1994). The sleepy driver: Guidance for physicians. In R. Cooper (Ed.), *Sleep* (pp. 626–630). London: Chapman & Hall

Dahl, R. E. (1996). The impact of inadequate sleep on children's daytime cognitive functioning. *Seminars in Pediatric Neurology, 3*(1), 44–50.

Frederickson, J., Wahlstrom, K., & Wrobel, G. (1999, April). *The adolescent crisis: Can later school start times help?* Paper presented at annual meeting of American Educational Research Association; Montreal, Canada.

Giannotti, F., Cortesi, F., & Ottaviano, S. (1997). Sleep pattern daytime functioning and school performance in adolescence: preliminary data on an Italian representative sample. *Sleep Research, 26,* 196.

Maas, J. B. (1995). *Power sleep.* New York: Villard-Random House.

Pilcher, J. J., & Huffcutt, A. I. (1996). Effects of sleep deprivation on performance: A meta-analysis. *Sleep, 19*(4), 318–326.

Poirel, C., & Larouche, B. (1987). Human circadian patterns of memory processes: Chronopsychology of rates of forgetting, a rhythmometric study. *Psychological Reports, 61,* 3–12.

Sadeh, A., Raviv, A., & Gruber, R. (2000). Sleep patterns and sleep disruptions in school-age children. *Developmental Psychology, 36,* 291–301

Wahlstrom, K. L. (1999a). The prickly politics of school starting times. *Kappan, 80*(5), 344–347.

Wahlstrom, K. L. (Ed.) (1999b). *Adolescent sleep needs and school starting times.* Bloomington, IN: Phi Delta Kappa Educational Foundation.

Wahlstrom, K. L., & Freeman, C. M. (1997). *School start time study: Preliminary report of findings.* Minneapolis, MN: University of Minnesota, Center for Applied Research and Educational Improvement.

Wolfson, A. R., & Carskadon, M. A. (1996). Early school start times affect sleep and daytime functioning in adolescents. *Sleep Research, 25,* 117.