Answering the Bell: High School Start Times and Student Academic Outcomes

In this policy brief, we assess the associations between high school start times in North Carolina and a set of student engagement and achievement outcomes. Across all students, we find that later school start times are associated with reduced probabilities of student suspensions and reduced test scores in biology. For disadvantaged student subgroups, we find that later school start times are associated with positive results across a range of outcomes, including fewer absences, higher grade point averages, and higher Algebra I test scores. These subgroup results suggest that later start times may narrow gaps in school engagement and student achievement. Moving forward, we call for a suite of studies to complement this initial analysis and encourage school districts to evaluate evidence and make start time decisions that will benefit the engagement and learning of their students.

Introduction

Does starting school later in the day improve the academic outcomes of middle and high school students? This question has garnered significant attention in recent years as school districts consider ways to boost student engagement and performance in school and as research documents shifts in adolescent sleep cycles (later sleep-wake cycles) and the importance of sufficient sleep (8.5 to 9.5 hours a night) to the cognitive functioning of adolescents. While there are potential barriers—transportation, after-school activities, parent schedules and childcare—delaying school start times is a way to help address adolescent sleep concerns,[1] with initial research indicating that later school start times benefit student attendance, course grades, and exam scores. In this policy brief, we contribute to the emerging research on school start times by assessing the associations between high school start times in North Carolina and measures of student engagement and achievement in school. Importantly, this work extends previous analyses by estimating statewide results and results for policy relevant student subgroups. This research identifies key questions for continued work and can inform state and school district decisions on school start times.

Background

Around the onset of puberty, many adolescents experience biological changes that impact the timing of their sleep. Specifically, the secretion of nocturnal melatonin–which aids falling asleep—is delayed, circadian rhythms shift to preference the evening, and the pressure to fall asleep accumulates more slowly. All this results in a phase delay to adolescents' sleep-wake cycle that makes it difficult to fall asleep before 11:00 PM and wake up before 8:00 AM. Despite these sleep changes, adolescents still need 8.5 to 9.5 hours of sleep a night. Early school start times may make it challenging for middle and high school students to get the sleep they need and consequently, fatigued students may be less engaged and successful in school. Initial studies indicate that later start times benefit driving safety, student attendance, course grades, and exam scores. Based on

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[1] Middle and high school students attending schools with later start times report getting more sleep and feeling less fatigued than their peers attending schools that start earlier.

this sleep and education research, in 2014, the American Academy of Pediatrics issued a recommendation for middle and high schools to start no earlier than 8:30 AM.

In this policy brief, we use data on high school start times, provided by the North Carolina Department of Public Instruction (NCDPI), for the 2011-12 through 2014-15 school years. Our analyses focus on traditional public high schools[2] and include five student-level academic outcomes: absences, whether the student was ever suspended during the year, course grades, End-of-Course (EOC) test scores, and ACT scores. We consider absences, suspensions, and course grades to be measures of student engagement in school (acknowledging that grades are also measures of achievement); EOC and ACT scores are measures of student achievement. To determine whether later start times are associated with desired academic outcomes, we estimate overall models and models to assess whether

later start times differentially benefit economically-disadvantaged, minority, or low-performing students.

We caution that our results are not causal; rather, they represent associations between later school start times and measures of student engagement and achievement. While all models control for a rich set of student and school covariates, we acknowledge that there may be school and/or district characteristics associated with start times and student outcomes that we do not include in analyses. Analyses focused on changes in start times within schools—rather than examining variation in start times across schools—would help address this concern, however, very few high schools alter their start times during the study period.[3] Therefore, our models assess the extent to which variation in start times across high schools is associated with variation in student outcomes.

Table 1: High School Start Times in North Carolina

School Characteristics	Overall	Before 7:30	7:30-7:59	8:00-8:29	8:30 and After
School Start Time	8:00	7:18	7:43	8:05	8:43
Student Enrollment	1012.13	1548.20	881.25	830.91	1081.92
City	29.60	77.36	15.18	3.00	60.19
Suburban	7.98	0.00	6.85	12.61	6.17
Town	7.29	0.00	9.52	11.41	2.47
Rural	55.12	22.64	68.45	72.97	31.17
Percent Economically-Disadvantaged	49.27	39.78	52.60	51.84	48.12
Percent Minority	45.98	55.83	44.70	39.45	52.65
Performance Composite	56.52	61.27	53.53	54.55	58.50
Exceeds Expected Growth	33.64	59.61	20.78	23.28	46.67
Meets Expected Growth	31.21	24.63	34.51	32.19	31.25
Does Not Meet Expected Growth	35.15	15.76	44.71	44.53	22.08
Short-Term Suspension Rate (Per 100)	28.65	27.04	28.30	27.99	31.67
Average Teacher Salary Supplements	3114.24	5219.18	2523.18	2255.40	3770.88
Unique School Count	410	72	91	171	89
School-by-Year Count	1591	265	336	666	324

Note: This table displays school characteristics for all high schools in our sample (overall) and for high schools in each of our start time categories.

[2] We exclude early-college, alternative, special education, vocational, and hospital schools.

[3] Durham Public Schools changed the start times for their high schools in the 2016-17 school year. Now high schools in the district start at 9:00 AM (instead of 7:30 AM). This will provide a valuable opportunity to assess how changes in start times are associated with student outcomes.

What time do high schools start in North Carolina?

As of 2011–12 the average start time for middle and high schools in the United States was 8:03 AM. Forty-two states reported that 75 to 100 percent of their middle and high schools started before 8:30 AM, with only 18 percent of middle and high schools starting at 8:30 AM or later. As shown in Table 1, data for the North Carolina high schools in our sample are comparable to these national values. The average high school start time in our data is 8:00 AM; 20 percent of the schools in our sample start at 8:30 AM or later.

High schools that start early (before 7:30 AM) or late (8:30 AM and later) are predominantly in urban environments, whereas those that start from 7:30 AM to 8:29 AM are concentrated in rural and town settings. Many Charlotte-Mecklenburg and Wake County high schools are in the earliest start time category while many Cumberland County, Guilford County, Winston-Salem Forsyth, and Chapel Hill-Carrboro high schools are in the latest start time category. These early and late start times for urban districts are likely a product of needing to run multiple waves of school buses each morning and afternoon. Given these urban concentrations, high schools that start early or late enroll more students, have more minority students,

and pay higher teacher salary supplements. High schools in these early and late start time categories are also higher performing based on performance composite values and percentages of schools exceeding expected growth.

Are later school start times associated with student engagement and achievement?

Table 2 presents findings from models with a continuous measure of school start times (top panel) or indicators in reference to high schools starting before 7:30 AM (bottom panel). Across all students there is not a strong or consistent set of associations between later school start times and measures of student engagement and achievement. Later start times are associated with a reduced probability of students ever being suspended; this result is strongest in high schools starting at 8:30 AM or later. Specifically, starting school one hour later is associated with a 1.3 percentage point decrease in the probability of a student being suspended during the academic year. Conversely, later start times are associated with significantly lower adjusted-average student achievement in biology; these negative findings are consistent across all start time categories.[4]

Table 2: Are later school start times associated with student engagement and achievement?

	Student Absences	Ever Suspended	Course Grades	EOC Biology	EOC Algebra I	EOC English I/II	ACT Composite
Start Time	0.221	-0.013**	0.012	-0.038*	0.014	-0.011	0.107
7:30 to 7:59	0.168	-0.011	0.038	-0.074*	-0.004	-0.025	0.059
8:00 to 8:29	0.250	-0.000	0.034	-0.068*	-0.009	-0.040**	-0.092
8:30 or Later	0.330	-0.025**	0.032	-0.073*	0.016	-0.014	0.184

Note: This table displays results from models estimating the associations between high school start times and student academic outcomes. The bottom panel displays findings in reference to schools starting before 7:30 AM. +, *, and ** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

[4]In models excluding Charlotte-Mecklenburg and Wake County (the largest two districts in the state and districts with early high school start times), there is not a significant relationship between start times and student achievement in biology.

Table 3: Do Later Start Times Benefit the Engagement of Student Subgroups?

	Student Absences	Ever Suspended	Course Grades
Economically-Disadvantaged Students (EDS)			
Start Time	**0.517****	**-0.010****	-0.019
Start Time*EDS	**-0.672****	-0.007	**0.069****
Minority Students (MS)			
Start Time	**0.747****	**-0.008***	**-0.046****
Start Time*MS	**-1.012****	-0.009+	**0.110****
Low-Performing Students (LPS)			
Start Time	**0.430****	**-0.012****	-0.006
Start Time*LPS	**-0.740****	-0.008	**0.081****

Note: This table displays results from models interacting the school start time variable with indicators for economically-disadvantaged, minority, or low-performing students. +, *, and ** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Are later school start times associated with outcomes for student subgroups?

Prior research suggests that certain student subgroups benefit more from later start times.[5] Therefore, we estimated separate models interacting our start time variable with indicators for economically-disadvantaged, minority, and low-performing students.[6] On average, these are students with higher numbers of absences and suspensions and lower course grades and exam scores.

Regarding measures of student engagement in school, Table 3 indicates that in high schools with later start times economically-disadvantaged, minority, and low-performing students have fewer absences than their disadvantaged peers attending schools with earlier start times. For example, minority students attending a high school starting at 8:30 AM, rather than 7:30 AM, average one fewer days absent. Conversely, more advantaged student subgroups (e.g. white students) average more absences in high schools that start later. Regarding behavior, students are less likely to be suspended in high

schools that start later; minority students are also less likely to be suspended in schools that start later versus those that start earlier. Finally, as with absences, economically-disadvantaged, minority, and low-performing students attending high schools with later start times have higher grade point averages than their disadvantaged peers attending schools with earlier start times.

Turning to measures of achievement, Table 4 indicates that students—both advantaged and disadvantaged student groups—attending high schools with later start times are scoring lower in biology. In Algebra I, economically-disadvantaged, minority, and low-performing students attending high schools with later start times outperform their disadvantaged peers attending schools with earlier start times. For example, economically-disadvantaged students attending a high school starting at 8:30 AM, rather than 7:30 AM, have adjusted-average achievement 2.3 percent of a standard deviation higher. Finally, low-performing students attending high schools with later start times score lower in English I/II but higher on the ACT than their low-performing peers attending high schools with earlier start times.

[5]For example, when assessing the associations between middle school start times in Wake County and EOG test scores, Edwards (2012) finds stronger results for students at the lower end of the test score distribution.

[6]We define low-performing students as those scoring more than one standard deviation below the mean on their 8th grade mathematics or reading EOG exam.

Table 4: Do Later Start Times Benefit the Achievement of Student Subgroups?

	EOC Biology	EOC Algebra I	EOC English I/II	ACT Composite
Economically-Disadvantaged Students (EDS)				
Start Time	**-0.040***	0.000	-0.008	0.129
Start Time*EDS	0.002	**0.023***	-0.008	-0.067
Minority Students (MS)				
Start Time	**-0.043***	-0.014	-0.008	0.081
Start Time*MS	0.006	**0.047****	-0.007	0.047
Low-Performing Students (LPS)				
Start Time	**-0.036+**	0.006	-0.008	0.023
Start Time*LPS	-0.015	**0.022***	**-0.016+**	**0.254****

Note: This table displays results from models interacting the school start time variable with indicators for economically-disadvantaged, minority, or low-performing students. +, *, and ** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Discussion

To our knowledge this is the first research to leverage statewide student-level data to assess the associations between high school start times and academic outcomes for all students and key student subgroups. This is an important research agenda to advance, as changes in start times may represent an effective school reform with low financial costs. Across all students, we find that later school start times are associated with reduced probabilities of students being suspended and lower student test scores in biology. There are no positive results for student test scores (EOC or ACT), absences, or course grades. Generally, these results are less robust than those from previous research. This may reflect a true lack of significant findings for later high school start times in North Carolina and/or limitations in the data. Such limitations include omitted variables that are associated with student outcomes and district/school start time decisions and an inability to assess changes in start times within schools.

While there were few significant results in our analyses of all students, we found evidence that economically-disadvantaged, minority, and low-performing students may benefit from later school start times. Relative to their equally disadvantaged peers, disadvantaged students attending schools with later start times had fewer absences, higher course grades, and higher Algebra I test scores. Additionally, we found that minority students are less likely to be suspended and that low-performing students earn higher ACT scores in high schools that start later. These subgroup results suggest promise in narrowing gaps in school engagement and student achievement. Continued research is necessary to further assess the extent to which disadvantaged student subgroups benefit from starting school later.

Moving forward, we believe a suite of further studies—examining middle schools in North Carolina, assessing changes in start times within schools, gathering qualitative data in districts/schools making start time changes—would benefit the state of knowledge on school start times. While there are potential barriers to start time changes, we encourage school districts to evaluate evidence and make decisions that will benefit the engagement and learning of their students.

For more research on this topic

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