Table S1. Evidence Table.

Study Author(s) (Year)	Study Design (Study duration)	Sample size	Age/School year Range	School Start times	Key outcomes	Survey Instrument	Key Findings
Boergers et al. (2014)[33]	Prospective cohort *impact of change to a later start time in same school* (3 months)	N=197	15.6 yrs (mean)	T1: 8:00 AM T2: 8:25 AM	Mean bedtimes, wake times, and sleep duration for school nights and non-school nights, Daytime sleepiness, Caffeine consumption, fatigue-related school health clinic visits, self-reported grades, attendance and tardiness.	School Sleep Habits Survey	The delay in school start time was associated with a significant (29 min) increase in sleep duration on school nights. The percentage of students receiving 8 or more hours of sleep on a school night increased to more than double, from 18% to 44%. Students in 9th and 10th grade and those with lower baseline sleep Amounts were more likely to report improvements in sleep duration after the schedule change. Daytime sleepiness, depressed mood, and caffeine use were all significantly reduced after the delay in school start time. Sleep duration reverted to baseline levels when the original (earlier) school start time was reinstituted.
Borlase et al. (2013)[36]	Retrospective historical cohort *impact of change to a later start time in same school* (10 years)	1999: N=212 2008: N=455	13-18 yrs	T1: 9:30 AM T2: 10:30 AM	Median sleep timing variables (1999 and 2008), Daytime sleepiness(ESS), technologies in bedroom	Bradley Hospital/Brown University School's Sleep Habits Survey (*modified to reflect the New Zealand vernacular and education system*)	Year 12 students in 2008 were less likely to report sleep loss on school nights (OR=0.06, 95% CI=0.01–0.11) and were less sleepy (OR =0.58, 95% CI=0.34–0.98) than Year 12 in 1999 or than Year 11 in 2008, after controlling for gender (sleep loss, OR=0.31, 95%CI=0.19–0.53; sleepiness, OR=0.46, 95% CI= 0.28–0.75). In 2008, having more technologies was associated with less sleep on school nights. In 2008, Year 9 students with more technologies were more likely to report daytime sleepiness (OR=4.06, 95% CI=1.44–11.41) and being evening type (OR=3.38, 95% CI=1.27–9.01), after controlling for gender. In 2008 all year groups went to bed earlier than in 1999, possibly due to increased sleep awareness, but only Year 12 students sleep later on school mornings.
Carskadon et al. (1998)[8]	Prospective cohort *impact of change to an earlier start time in same schools* (2 junior high schools: from 2nd half of 9th grade in spring to 1st half of 10th grade in the fall)	N=40	14-16.2 yrs	T1 (9th grade): 8:25 AM T2 (10th grade): 7:20 AM	Sleep variables-school and non-school nights, Melatonin onset phase (DLSMO), overnight sleep monitoring, and multiple sleep latency test (MSLT).	Sleep diaries, Actigraphy (on laboratory nights)	According to actigraphy, students woke earlier on school days in 10th than 9th grade, but they did not go to sleep earlier and they slept less. DLSMO phase was later in 10th grade (mean = 2102) than 9th grade (mean = 2024). Sleep latency on MSLT overall was shorter in 10th (mean = 8.5 minutes) than in 9th (mean = 11. 4 minutes), particularly on the first test of the morning at 0830 (5.1 vs 10.9 minutes). Two REM episodes on MSLT occurred in 16% of participants in 10th grade; one REM episode occurred in 48%. When those with REM sleep on one or both morning MSLTs (n=11) were compared to those without morning REM, significant differences included shorter sleep latency on the first test, less slow wave sleep the night before, and later DLSMO phase in those who had morning REM.

Study Author(s) (Year)	Study Design (Study duration)	Sample size	Age/School year Range	School Start times	Key outcomes	Survey Instrument	Key Findings
Danner et al. (2008)[17]	Prospective cohort *impact of change to a later start time* (1 year)	Not specified	15-18 yrs	T1: 8:00 AM T2: 9:00 AM	Average hours of sleep per night, motor vehicle crash rate (17 to 18 years)	Sleep habits Survey completed before and after a change in school start times	Average hours of nightly sleep increased and catch-up sleep on weekends decreased. Average crash rates for teen drivers in the study county in the 2 years after the change in school start time dropped 16.5%, compared with the 2 years prior to the change, whereas teen crash rates for the rest of the state increased 7.8% over the same time period.
Dexter et al. (2003)[28]	Cross-sectional *comparison of 2 local high school with different start times*	School 1: N=193 School2: N=587	Sophomore and Junior year students	T1: 7:50 AM T2: 8:35 AM	Mean hours of sleep, Daytime sleepiness (ESS)	Student survey (unspecified)	Students in the early start school reported reduced sleep time and more sleepiness than their counterparts in the later starting school. ESS Score averages was not statistically significant.
Eliasson et al. (2002)[29]	Cross-sectional- *comparison of high school graders and 7th graders*	School 1: N=1000 School 2: N=200	9th-12th graders, 7th graders (comparison group)	Unspecified	Academic performance (GPA), sleep time and subjective feelings of sleepiness	Student survey (unspecified)	90% of students felt groggy on school days. Average sleep times- 6.7 hours on weekdays. 80% believed they did not get enough sleep. No correlation between sleep time and academic performance (self-reported GPA) across all grades.
Ming et al. (2011)[26]	Cross-sectional *from 5 high school programs*	N=1941	14-17 yrs	T1: before/at 7:30 AM T2: After 7:30 AM	TST (in categories) on school & weekend nights, Adequate sleep (Y/N), Daytime sleepiness (Y/N), night awakening (Y/N), prolonged sleep onset (Y/N), school performance grades.	Student survey (unspecified)	Students with a sleep length of less than 7 hours on both weekdays and weekends exhibited poorer performance. Earlier school start times were associated with a perception of poor sleep quality, shorter sleep duration and more sleep health problems.
Orzech et al. (2013)[30]	Cross-sectional *1 high school-data collected for 1 year*	N=51	14.5 yrs (mean)	Unspecified	Cultural influences on adolescent sleep	Semi-structured, in-person interview, participant observation and brief questionnaires	Teens reported that a primary source of information about sleep was their parents, other family members, and parents of their peers.
Owens et al. (2010)[20]	Prospective cohort *impact of change to a later start time* in 1 high school	N=201 (completed both surveys) same school	9th-12th grade	T1: 8:00 AM T2: 8:30 AM	Sleep patterns and behavior, daytime sleepiness, mood, data from the Health Center, and absences/tardies	Sleep Habits Survey before and after a change in school start time	After the start time delay, mean school night sleep duration increased by 45 minutes, and average bedtime advanced by 18 minutes (95% confidence interval, 7-29 minutes [t_{423}= 3.36;P .001]); the percentage of students getting less than 7 hours of sleep decreased by 79.4%, and those reporting at least 8 hours of sleep increased from 16.4% to 54.7%. Students reported significantly more satisfaction with sleep and experienced improved motivation. Daytime sleepiness, fatigue, and depressed mood were all reduced. Most health-related variables, including Health Center visits for fatigue-related complaints, and class attendance also improved.

Study Author(s) (Year)	Study Design (Study duration)	Sample size	Age/School year Range	School Start times	Key outcomes	Survey Instrument	Key Findings
Paksarian et al. (2015)[31]	Cross-sectional *Overall student response rate: 74.7%*	N=7308 (From 245 schools)	13-18 yrs	7:05-9:22 AM	Mean school start times, sleep patterns (TST)	The National Comorbidity Survey-Adolescent Supplement, World Health Organization Composite International Diagnostic Interview Version 3.0	Start time was positively associated with weeknight bedtime. Associations between start time and weeknight sleep duration were nonlinear and were strongest for start times of 8:00AM and earlier. Associations differed by sex and urbanicity, with the strongest association among boys in major metropolitan counties. Start time was negatively associated with sleep duration among boys in nonurban counties. Start time was not associated with weekend compensatory sleep.
Perkinson-Gloor et al. (2013)[21]	Prospective cohort	N=2716	15.4 ± 0.8 yrs (mean±SD)	T1: 7:40 AM T2: 8:00 AM	TST, Daytime sleepiness, sleep habits, behavioral persistence, and attitude toward life along with school climate and satisfaction with various aspects of the school. School grades in mathematics and German language were also obtained.	Online questionnaire	On average, participants' sleep duration was 8:36 h (SD=0:48 h). Sleeping less than an average of 8 h per night was related to more tiredness, inferior behavioral persistence, less positive attitude toward life, and lower school grades, as compared to longer sleep duration. Daytime tiredness and behavioral persistence mediated the relationship between short sleep duration and positive attitude toward life and school grades. Students who started school 20 minutes later received reliably more sleep and reported less tiredness.
Short et al. (2013)[32]	Cross-sectional *comparison of school night sleep of adolescents from Australia and the United States*	Australia: N=385 USA: N=302	Australia:13-18yrs USA:13-19 yrs	Australia: 8:32±0.28 USA: 7:45±0.37 Mean (SD)	TST	School Sleep Habits Survey, Smith Morningness/ Eveningness Questionnaire, 8-day Sleep Diary,	After controlling for age and sex, Australian adolescents obtained an average of 47 minutes more sleep per school night than those in the U.S. Australian adolescents were more likely to have a parent-set bedtime (17.5% vs 6.8%), have a later school start time (8:32AM vs 7:45AM) and spend less time per day on extra-curricular commitments (1h 37m vs 2h 41m) than their U.S. peers. The mediating factors of parent-set bedtimes, later school start times, and less time spent on extra-curricular activities were significantly associated with more total sleep.
Thacher et al. (2016)[34]	Prospective cohort *examination of range of variables affecting sleep health, both before and after a 45-min delay in start time.*	Wave 0: N=597 Wave 1: N=410 Wave 2: N=372	Wave 0 16.07 ± 0.05 Wave 1 16.41± 0.05 Wave 2 16.89± 0.05 Mean (±SE)	Time 1: 7:45 AM Time 2: 8:30 AM	TST, bedtimes, and wake times, sleep onset latency, Daytime Sleepiness., attendance and tardiness record, disciplinary violations and academic performance.	Student Questionnaires (Owl-Lark Scale, Pittsburgh Sleep Quality Index (PSQI, Depression, Anxiety and Stress Scale-DASS-21)	Students delayed but did not extend their sleep period; we found lasting improvements in tardiness and disciplinary violations after the start-time delay, but no changes to other variables. At the first follow-up, students reported 20 minutes longer sleep, driven by later rise times and stable bed times. At the second follow-up, students maintained later rise times but delayed bedtimes, returning total sleep to baseline levels. A delay in rise time, paralleling the delay in the start time that occurred, resulted in less tardiness and decreased disciplinary incidents, but larger improvements to sleep patterns may be necessary to affect health, attendance, sleepiness, and academic performance.

Study Author(s) (Year)	Study Design (Study duration)	Sample size	Age/School year Range	School Start times	Key outcomes	Survey Instrument	Key Findings
Vedaa et al. (2012)[35]	Prospective cohort *a quasi-experimental design*	N=106 (From 2 schools	10th graders	Intervention gp: Time 1-8:30AM Time 2-9:30AM Control gp: T- 8:30 AM	TST, Sleep onset latency, Daytime sleepiness (KSS), positive and negative affect	The Karolinska Sleepiness Scale, Reaction time test (RT), Positive and Negative Affect Schedule (PANAS), Retrospective sleep diary	Later school start times may both lengthen nocturnal sleep and increase students' alertness in early morning classes. When comparing the change in total sleep time (TST) between Saturday night and Sunday night, the intervention group's delta values (ΔM=77.36; SD=157.8) were significantly different from that of the control group (ΔM =152.47;SD=143.07),t(71) -22.11, p= .04.)
Vorona et al. (2011)[19]	Cross-sectional	Virginia Beach: 2007-N=13,018 2008-N=12,916 Chesapeake: 2007-N=8,315 2008-N=8,459	16-18 yrs	Virginia Beach schools: 07:25 AM Chesapeake schools: 08:45AM	Teen Crash rates/1000 drivers	DMV for crash rates, Hampton Roads Transportation Planning Organization (HRTPO) for traffic congestion.	In 2008, there were 12,916 and 8,459 Virginia Beach (VB) and Chesapeake 16- to 18-year-old drivers, respectively. For VB and Chesapeake, teen drivers' crash rates in 2008 were 65.8/1000 and 46.6/1000 (p < 0.001), respectively, and in 2007 were 71.2/1000 and 55.6/1000. Teen drivers' crash peaks in the morning occurred one hour earlier in VB than Chesapeake, consistent with school commute time. Congestion data for VB and Chesapeake did not explain the different crash rates.
Vorona et al. (2014)[18]	Cross-sectional	Chesterfield County: 2009-N=10,434 2010-N=11,059 2011-N=10,275 Henrico County: 2009-N=8,560, 2010-N=8,805 2011-N=8,357	16-18 yrs	Chesterfield Co. schools: 07:20 AM Henrico Co. schools: 08:45 AM	Teen Crash rates/1000 drivers	The Urban Transportation-MPO Division of the Richmond Regional Planning District Commission report, Virginia Department of Motor Vehicles Police Crash Report.	Chesterfield teens manifested a statistically higher crash rate of 48.8/1,000 licensed drivers versus Henrico's 37.9/1,000 (p = 0.04) for 2009-2010. For 2010-2011, CC 16-17 year old teens demonstrated a statistically significant higher crash rate (53.2/1,000 versus 42.0/1,000), while for 16-18 teens a similar trend was found, albeit non-significant (p = 0.09). Crash peaks occurred 1 hour earlier in the morning and 2 hours earlier in the afternoon in Chesterfield, consistent with commute times. Post hoc analyses found significantly more run-off road crashes to the right (potentially sleep-related) in Chesterfield teens.

Study Author(s) (Year)	Study Design (Study duration)	Sample size	Age/School year Range	School Start times	Key outcomes	Survey Instrument	Key Findings
Winsler et al. (2015)[23]	Cross-sectional	N=27,939 (From multiple schools)	8th, 10th and 12th graders	Unspecified	Self-reported weekday sleep duration, mental health outcome variables (depression /hopelessness, suicidal ideation, and attempted suicide)	2009 Fairfax County (Virginia) Youth Survey	High-school students reported an average 6.5 h of sleep per school night, with 20 % obtaining ≤ 5 h, and only 3 % reporting the recommended 9 h/night. Just 1 h less of weekday sleep was associated with significantly greater odds of feeling hopeless, seriously considering suicide, suicide attempts, and substance use.
Wolfson et al. (2007)[24]	Cross-sectional	N=205 (From 2 schools)	7th-8th graders	School E: 7:15 AM School L: 8:37AM	TST, bedtime, wake-time, daytime sleepiness weekend delay, weekend oversleep, as well as the qualitative sleep variables (sleepiness, sleep–wake behavior problems, sleep hygiene)	Sleep Habits Questionnaire, Sleep–Wake Behavior Problems scale, ASHS to assess sleep hygiene	Students at the late-starting school reported waking up over 1 hr. later on school mornings and obtaining 50 min more sleep each night, less sleepiness, and fewer tardies than students at the early school. All students reported similar school-night bedtimes, sleep hygiene practices, and weekend sleep schedules.