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Effects of 4-Day School Weeks on Older Adolescents: Examining Impacts of the Schedule on Academic Achievement, Attendance, and Behavior in High School

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Four-day school weeks have proliferated across the United States in recent years, reaching over 650 public school districts in 24 states as of 2019, but little is known about their implementation and there is no consensus on their effects on students. This study uses district-level panel data from Oklahoma and a difference-in-differences research design to provide estimates of the causal effect of the 4-day school week on high school students' ACT scores, attendance, and disciplinary incidents during school. Results indicate that 4-day school weeks decrease per-pupil bullying incidents by approximately 39% and per-pupil fighting incidents by approximately 31%, but have no detectable effect on other incident types, ACT scores, or attendance.

Keywords: *achievement, adolescence, educational policy, educational reform, rural education, student behavior/attitude, econometric analysis, quasi-experimental analysis, policy analysis, secondary data analysis*

Four-day school weeks have proliferated across the United States in recent years, affecting over 650 public school districts in 24 states as of 2019, but little is known about their implementation and there is no consensus on their effects on students (Thompson et al., 2021a). Policies enabling 4-day school weeks are disputed by many state legislatures: Oklahoma, for example, is currently debating financial savings and achievement metrics that districts must meet to continue to use a 4-day school week beyond the 2020–2021 school year. Historically, districts adopting 4-day weeks have been motivated by potential financial savings and located primarily in poor, rural areas. However, a broader range of districts have recently turned to 4-day weeks in response to challenges related to COVID-19 (Altavena, 2020). Given the recent growth of 4-day school weeks, the relevant ongoing legislation, and their use in response to COVID-19, research on the implementation and effects of this policy is unprecedentedly salient and consequential.

A small body of literature on the effects of 4-day school weeks has developed over the past 6 years, but the scope of this work has been limited. Most of the existing research has focused on economic issues, such as school finance (Morton, 2021; Thompson, 2021a), parental labor supply (Ward, 2019), and housing prices (Nowak et al., 2019), or academic outcomes among younger students in Grades 3 to 8 (Anderson & Walker, 2015; Kilburn et al., 2021; Morton, 2021; Thompson, 2021b; Thompson & Ward, 2022). To date, there are few causal studies that consider outcomes of the 4-day school week for high-school-aged students. Thompson et al. (2021) use data from Oregon and find that the schedule negatively impacts nonrural high school students' 11th-grade math achievement and on-time graduation rates, and it increases rates of chronic absenteeism (i.e., missing more than 10% of school days) among students in nonrural schools. Fischer and Argyle (2018) find that adopting the 4-day week schedule increased a county's juvenile

crime rates using data from Colorado. Overall, the research examining impacts of the schedule for high school students is limited, as high-school-age students comprise nearly a third of all K–12 students, and the schedule may affect them differently than younger students. Furthermore, the existing research is limited in its ability to inform state-policy decisions outside of Oregon and Colorado, as the implementation of 4-day week schedules may vary by state, and state-level policymakers will be most inclined to make decisions based on data from their own state. This study seeks to address these gaps in our understanding of the effects of 4-day school weeks on high school students, with a particular focus on effects that have important implications for policy and have potential to vary based on students' age or developmental status.

As is discussed further in this article, sociological theory and evidence from cognitive developmental science suggest that the changes to a student's schedule elicited by a 4-day school week could have different effects on academic and behavioral outcomes for high-school-age adolescents and young children. In this article, I employ quasi-experimental research methods and district-level high school data from Oklahoma to provide the first estimates of the effect of the 4-day school week on high school adolescents' academic achievement, attendance, and school behaviors. More specifically, I examine yearly ACT scores, attendance, and behavioral incidents at school as outcomes.

Background on 4-Day School Weeks

Implementation

State policies that enable 4-day school weeks typically require districts to meet a minimum number of instructional hours without mandating a minimum number of instructional days. To implement a 4-day week, districts typically increase the length of the weekdays they are in school and have Fridays or Mondays off. A survey of a representative sample of 4-day week districts finds that on the off day or the "fifth day" nearly half are completely closed or offer no student services and less than one third offer any sort of activity to students with any frequency (Thompson et al., 2021a). Another survey of parents and students in 18 four-day week districts and 16 five-day week districts across Idaho, New Mexico, and Oklahoma found that students of all ages (>90% of Grades K–6 and >80% of Grades 7–12) reported home as one of or the only primary location(s) where students spent time on the fifth day (Kilburn et al., 2021). Middle and high school students occasionally had school athletics practice/games and/or worked a job on the fifth day, but other structured activities offered by the school or the community were rare. Whether other 4-day week students' experiences on the fifth day are similar in other districts within these states and other states is unknown.

Growth

Originating as early as the 1930s in South Dakota, the schedule is not an entirely new phenomenon, but it has seen unprecedented growth in its adoption over the past two decades, increasing from 257 schools across 108 districts in 1999 to 1,607 schools across 662 school districts in 24 states[1] in 2019 (Thompson et al., 2021a). Indeed, this estimate is conservative, and many more schools may operate on 4-day weeks than is currently thought to be true. COVID-19 has brought additional attention to the policy, as a broader range of districts have recently turned to 4-day weeks in response to the economic and logistical challenges of COVID-19 (Altavena, 2020; Haas, 2020). Four-day week districts have historically been located in rural areas and have relatively fewer students than other districts in the state, but there are a few districts that are exceptions to this pattern; for example, an urban district in Colorado that serves 18,000 students adopted a 4-day week at the start of the 2018–2019 school year and two urban districts in Arizona that each serve over 12,000 students will adopt a 4-day week for the 2020–2021 school year in response to COVID-19 (Altavena, 2020).

Rationale

A 2021 study of 342 four-day districts nationwide finds the most common rationale (selected by 65.1% of districts) for adopting a 4-day school week was financial savings in the areas of transportation, school operations, and support staff salaries and benefits (Thompson et al., 2021a).

Other reasons for adoption (selected by 25%–35% of districts) included attendance-related issues (e.g., low attendance rates, missing school for appointments or athletics) and issues related to being in a rural area (e.g., long bus rides, time to work on family farms and ranches, student/teacher retention). Prior research suggests that districts that adopt the schedule reduce their expenditures by only 1% to 2% on average as a result of the schedule change, but attendance is not significantly affected among students in Grades 3 to 8 (Anderson & Walker, 2015; Thompson, 2021b) and is not affected or negligibly affected among students in high school (Thompson et al., 2021b). Whether the other rationales and intended consequences of 4-day school weeks have been realized by the districts who have adopted them remains empirically unfounded.

Oklahoma Policy Context

Popular press articles indicate that the 4-day school week has been very controversial in Oklahoma (e.g., Ferguson, 2020). Despite extensive support for the schedule among school administrators, teachers, parents, and students who have 4-day weeks, the State Superintendent Joy Hofmeister argues against them, claiming that "forcing the academic year into fewer and longer days with extended weekly gaps in instruction does not create an optimal learning environment for our students" (Hofmeister, 2019). The controversy has spurred recent changes in Oklahoma state policy regarding school calendars.

Policy Changes

Four-day school weeks first became possible in Oklahoma with the passing of House Bill 1864 in the wake of the Great Recession in April 2009 (H.B. 1864, 2009). The policy changed the requirements for schools such that they no longer needed to operate for 180 days and 1,080 hours of classroom instruction per year; rather, they only needed to meet the 1,080 hours requirement. As a result, schools could operate for fewer than 180 days per year if they met the required 1,080 hours. Although the policy can be adopted at the school level, in practice, the policy has always been adopted at the district level in Oklahoma.

In response to the disapproval of 4-day school weeks from State Superintendent Joy Hofmeister and Republican concern that 4-day school weeks harm the state's reputation and students' education, the policy was recently changed by Senate Bill 441 in May 2019 (Forman, 2019; S.B. 441, 2019). The bill requires schools to operate for 165 instructional days as well as 1,080 hours per year beginning in the 2022–2023[2] school year. The average 4-day school week district operates for 148 days per year (Thompson et al., 2021a), and the 165-day requirement would essentially force them to switch back to 5-day weeks (Martinez-Keel, 2020). However, the bill includes a clause that allows schools to operate for fewer than 165 days if they can meet minimum requirements[3] for student performance and school district cost savings, in which case they must submit an application to the State Department of Education by June 30 each year to receive a 1-year waiver that must also be renewed every year.

There is additional controversy over the consequences of these minimum requirements. Four-day school week advocates claim that many 5-day week districts considered to be high-performing districts would not qualify under these requirements, and only 7% of the districts that had 4-day school weeks in the 2019–2020 school year would qualify for a waiver for all schools in their district (Ferguson, 2020). Hofmeister argues that 51% of all Oklahoma schools and 46% of all 4-day school week schools meet the requirements for a waiver, even if the full district would not qualify (Martinez-Keel, 2020). For many 4-day week districts, advocates caution that these minimum guidelines could mean completely closing the district because it would be impractical to operate the few schools in these rural districts on different schedules and the district will not be able to manage the financial burden of adding back a fifth school day (Martinez-Keel, 2020). Despite evidence that cost savings from adopting the 4-day school are limited (~2%; Morton, 2021; Thompson, 2021a), it is possible that switching back to a 5-day week could cost a district more than it ever saved (e.g., if students left the district for private school or another state with 4-day weeks). Most of this debate has occurred with little rigorous evidence of the effects of the 4-day week on students in Oklahoma, as the first

study of Oklahoma students was published only in 2021 (Morton, 2021).

Policy Implementation

Sixteen Oklahoma districts first recorded the complete schedule change, meaning every full school week on their calendar was planned to be 4 days long, in the fall of 2010, immediately following the policy change. The number of districts operating on the schedule increased steadily in the following years until the 2016–2017 school year and stayed relatively stable from then through the spring of 2019 (see Supplementary Figure A1 in the online version of the journal for the timing of 4-day school week adoption in Oklahoma). At the start of the 2018–2019 school year, 92 of Oklahoma's 513 (17.9%) public school districts had at least one school on a 4-day week schedule and about 7% of Oklahoma students were attending a 4-day week school (see Supplementary Figure A2 in the online version of the journal for the increase in the percentage of Oklahoma high school students attending a 4-day week school over time). The likely expansion of 4-day school weeks in 2019–2020 and 2020–2021 due to COVID-19 has not yet been publicized.

Effects of the 4-Day School Week on Students

Until recently, research on the 4-day school week was limited to anecdotal evidence from interviews and opinion surveys that generally touted various benefits of the schedule for students. In the last 6 years, several studies have employed panel data to make causal inferences about the effects of attending a 4-day week school as opposed to a 5-day week school for students. These studies provide important preliminary evidence regarding the effects of the schedule, but additional research is needed to build a comprehensive understanding of its consequences. For example, most of the quasi-experimental research considering effects on students to date has focused on estimating effects on achievement and attendance, despite the anecdotal claims that the schedule has broad effects on students' morale and engagement in school, behavior and disciplinary infractions, opportunities for extracurricular development, and health. Furthermore, the existing research has almost exclusively focused on students in Grades 3 to 8, despite the fact that districts across the county almost always implement the 4-day school week across all grades, K–12. This study helps to narrow these gaps by providing estimates of the effects of the 4-day school week on high school students' achievement, attendance, and school behaviors.

Academic Achievement

The existing research on the effects of the 4-day school week schedule on academic achievement has not reached a consensus. Perhaps most relevant to the present study, Thompson et al. (2021b) use high school data from Oregon and a difference-in-differences (DID) approach to examine effects of the schedule on 11th grade achievement on the Oregon Assessment of Knowledge and Skills. They find standardized math test scores decreased by 0.09 *SD* as an effect of the 4-day school week, with significant impacts driven only by the effect of the schedule on students in nonrural areas. They do not detect an effect of the schedule on reading achievement among students in rural or nonrural areas. Nevertheless, these results suggest the effect of the schedule may significantly vary based on the locale of a school.

All other existing research on the 4-day week's effects on academic achievement examines students in Grades 3 to 8 and also uses a DID research design. Although Anderson and Walker (2015) estimate positive effects of the schedule on the percentage of fourth and fifth grade students scoring above the proficiency threshold in math and English Language Arts (ELA) on the Colorado state test, the four other studies to date estimate negative average effects of the schedule on standardized math and ELA achievement, ranging from approximately −0.03 *SD* to −0.10 *SD* (Kilburn et al., 2021; Morton, 2021; Thompson, 2021b; Thompson & Ward, 2022). However, the statistical significance of the estimates varies depending on the sample included in the analysis.

More specifically, Morton (2021) leverages 2009–2016[4] district-level data from Oklahoma students in Grades 3 to 8 and estimates negative average effects on standardized math (−0.05 *SD*) and ELA (−0.03 *SD*) achievement, but the effects

are not statistically significant ($p < .05$). Using the same analytic approach with student-level data from 2005 to 2019, Thompson (2021b) finds a similar but statistically significant average effect of switching to a 4-day school week on standardized math (−0.06 *SD*) and reading (−0.04 *SD*) test scores of students in Grades 3 to 8 in Oregon. Kilburn et al. (2021) leverage district-level standardized test data from 2010 to 2018 from Idaho, Missouri, New Mexico, Oklahoma, and South Dakota and estimate negative but nonsignificant average effects of the schedule on math (−0.03 *SD*) and ELA (−0.04 *SD*) using the canonical DID approach.[5] Finally, Thompson and Ward (2022) use district-level data from 2009 to 2018 from 12 states[6] and estimate a statistically significant average negative effect of the 4-day week on math achievement (−0.03 *SD*) and a nonsignificant average effect on ELA achievement (−0.02 *SD*). Overall, the estimated effects on students in Grades 3 to 8 are relatively consistent across studies and states, but the variation in statistical significance of the estimates depending on the state(s) included in the sample suggests there may be some state-level variation in the implementation of the 4-day week or the composition of districts that implement the schedule.

Indeed, this body of work offers some investigation of heterogeneous effects of the schedule as well as the implementation features that may drive negative effects of the schedule. In his study of Grades 3 to 8 achievement in Oregon, Thompson (2021b) identifies heterogeneous effects of the schedule based on special education status, which predicts faring better on the schedule, and English Language Learner (ELL) status, which predicts faring worse. He finds no differences in the effect of the schedule based on students' race, gender, free-or-reduced price lunch eligibility, or gifted and talented designation. The older students in his sample, the seventh and eighth grade students, are also more negatively affected by the 4-day school week in terms of their academic achievement relative to the younger students in the sample. The eighth grade students experience the largest negative impact of the schedule, with their test scores decreasing by 0.09 *SD* in math and 0.06 *SD* in reading relative to their 5-day week counterparts. Finally, he also demonstrates that the observed negative average effects on math and ELA achievement in his study can be attributed, at least in part, to 4-day schools' average 3.5 fewer hours of time students spend at school per week compared to the 5-day schools in his sample. Similarly, Thompson and Ward (2022) find that significant, negative effects of the 4-day week on math and ELA achievement are borne only by 4-day week districts that were in the lowest tercile of "time in school," measured as weekly instructional hours.

Therefore, although the different average results across states could reflect real differences in the average effect of the policy by state, they more likely reflect the large amount of variation in the implementation of the policy (e.g., differences in changes in instructional time) and its effects on academics by district, resulting in statistical noisiness in the estimations at the state(s) level (Thompson et al., 2021a). For example, Thompson et al.'s (2021b) finding that the effect of the 4-day week on high school achievement depends on the rurality of a district suggests that differences in average estimates of the effect of the schedule across states may reflect differences in the composition of districts that have adopted the schedule in the state. One can also imagine that, in addition to instructional time, other factors with a well-established relationship to student achievement, such as student attendance, teacher quality and retention, and student fatigue, could vary greatly based on a district's specific implementation of the policy and drive differences in the effects of the schedule by district.

Attendance

Despite an abundance of anecdotal evidence that 4-day school weeks improve attendance, the three quasi-experimental studies existing to date that examine impacts on attendance find no effect or negligible effects on attendance rates. The anecdotal evidence, primarily based on interviews and opinion surveys, argues that attendance increases on a 4-day week because students can use the fifth day for activities and appointments for which they might otherwise miss school (Hale, 2007; Hanson, 2017; Hedtke, 2014; Kilburn et al., 2021; Kingsbury, 2008; Leiseth, 2008; Schank & York, 2009; Smith, 2009; Toppo, 2002; Turner, 2010). These situations are likely

to be particularly relevant in the remote, rural areas that have 4-day school weeks due to the lengthy travel that can be required to get to doctors' offices and athletics games at other schools. Indeed, Thompson et al.'s (2021a) national study of 4-day school week adoption and implementation provides support for the idea that districts believe attendance improves on the schedule. He found ~29% of districts cited "attendance issues related to things such as long commutes for school-sponsored athletic events or family appointments" as a primary motivation for their initial adoption of the 4-day week (Thompson et al., 2021a).

The empirical, quasi-experimental research on the effect of 4-day weeks, however, does not provide support for these claims. Within the aforementioned achievement study, Thompson et al. (2021b) find that 4-day weeks significantly reduced high school attendance rates by 1 to 2 percentage points only in 10th grade and 11th grade, and these decreases were again driven by students in nonrural schools. The percentage of students classified as chronically absent (i.e., missing more than 10% of school days) also increases significantly in only the 10th and 11th grades by 6 to 12 percentage points among students in nonrural schools. However, it is important to consider these estimates in the context of the 4-day week implementation, as one might expect absence rates and chronic absenteeism to increase mechanically as an effect of the 4-day week if students missed the same number of days in a year that they missed on a 5-day week schedule because there are fewer total days of school in the school year when operating on a 4-day week, about 18% fewer on average (Thompson et al., 2021a). Nevertheless, missing the same number of days in year on a 4-day and 5-day week schedule would cause a student to miss more hours of school on a 4-day week schedule because the school days are longer. Similarly, Anderson and Walker (2015), Kilburn et al. (2021), and Thompson (2021b) examine attendance rates as an effect of the 4-day school week among students in Grades 3 to 8. Using the same DID analysis strategy, all studies estimate a small (~0%–1%) and statistically insignificant effect of the 4-day week on attendance rates.

The discrepancies in the anecdotal and empirical evidence could be explained in several ways. For example, (a) the perceived improvements in attendance could merely be perceptions that are not borne out in reality, (b) the populations for whom attendance is improving could not be represented in the empirical samples, or (c) attendance could be improving in such a way that it is not captured by the traditional measurement of attendance, average daily attendance (ADA). The present study will address the second possibility by considering the effect of the 4-day school week on attendance among high school students in Oklahoma, a state whose 4-day week districts are almost exclusively located in rural areas. I discuss the first and third possibilities and their implications for the present study further in the "Discussion" section.

Behavior

Student behavior is not commonly indicated as a reason districts adopt a 4-day school week (Thompson et al., 2021a), but many anecdotal accounts report that the 4-day week improves students' morale and behavior (Dam, 2006; Donis-Keller & Silvernail, 2009; Hale, 2007; Hanson, 2017; Hedtke, 2014; Koki, 1992; Leiseth, 2008; Shoemaker, 2002). These accounts argue that the 4-day school week increases students' affinity for going to school and reduces disciplinary incidents at school. A cross-sectional study comparing students on 4-day and 5-day week schedules across 234 Colorado high schools in 2017 provides some descriptive support for these anecdotal claims (Israel et al., 2020). More specifically, the researchers use multiple logistic regression, controlling for school-level demographic characteristics, to compare self-report survey responses from the two groups of students. They find that 4-day week students are significantly less likely to report skipping school; using marijuana, cigarettes, or prescription drugs; or driving when under the influence of drugs or alcohol. However, they also find that 4-day week students are more likely to report being bullied. The researchers emphasize the need for longitudinal research to further investigate potential causal effects of the 4-day week underlying their mixed findings.

The existing quasi-experimental research on the effects of the 4-day school week on student behavior considers a limited set of outcomes.

Fischer and Argyle (2018) use a DID strategy to estimate the effect of the 4-day school week on juvenile crime. Using county-level panel data from Colorado, they find that the 4-day school week increases juvenile crime by nearly 20%, and these increases are concentrated in property crime during times that students are not in school. This finding is alarming and suggests that 4-day school weeks can have important, negative implications for adolescents' more severe behaviors outside of school that can be classified as public offenses. Nevertheless, it does not speak to the 4-day school week's influence on the more common and less severe negative student behaviors disciplined at the school level (e.g., alcohol or drug possession, vandalism, bullying, fighting, school bus incidents), which districts report are decreasing in the anecdotal studies.

Thompson's (2021b) Oregon achievement study provides some limited insight into the effect of the schedule on students' behaviors at school, but he considers only the fraction of days students miss for disciplinary infractions as an outcome. He finds no detectable effect of 4-day school weeks on the fraction of days students miss for disciplinary infractions (i.e., out-of-school suspensions) among students in Grades 3 to 8 in Oregon. This finding provides some evidence that opposes the anecdotal reports that disciplinary incidents decrease in schools, but, again, the generalizability of the finding to more common negative student behaviors that do not result in out-of-school suspensions is limited. Furthermore, Thompson's (2021b) study includes students only in Grades 3 to 8, whereas the effect of the schedule on discipline could be concentrated among high school students.

Once again, the discrepancies between the estimated causal effects and the anecdotal reports warrant investigation. This study will provide the first estimates of the causal effect of the 4-day school week on various student behaviors that warrant disciplinary action among high school students. Understanding the 4-day school week's effect on such behavioral incidents in school is important because inflicting or being a victim of such infractions can dramatically affect students' short- and long-term trajectories as well as the school climate for all students (Kupchik, 2016; Nickerson et al., 2014; Schoeler et al., 2018; Skiba et al., 2014). Moreover, estimating the effect of the schedule on various types of negative behaviors will enable policymakers and practitioners to understand the range of consequences of a 4-day school week for students and enable targeted policy reform if necessary.

Four-Day School Weeks and Adolescence

There are strong empirical and theoretical reasons to expect academic and behavioral consequences of 4-day school weeks for high school students to be different from those of the population that researchers have focused on to date, students in Grades 3 to 8. High school students typically range in age from 14 to 19 years and are developmentally considered to be "older adolescents" (Sawyer et al., 2018). Broadly, adolescence marks a time of significant physiological and cognitive development that corresponds with the onset of puberty, which typically begins when students are in middle school, or sixth to eighth grade (Sawyer et al., 2018). Except for Thompson et al.'s (2021b) study, research on the effects of 4-day school weeks on students to date has focused on the average effects on students in Grades 3 to 8 (Kilburn et al., 2021; Morton, 2021; Thompson, 2021b) or Grades 4 and 5 (Anderson & Walker, 2015). Only Thompson (2021b) additionally considers grade-based heterogeneity of the effect of 4-day weeks on achievement in his Grades 3 to 8 sample. Indeed, he provides the first evidence that early adolescents may be differentially affected by 4-day school weeks than elementary school-aged children: He finds that, in Oregon, the achievement of seventh- and eighth-grade students was more negatively affected by the 4-day school week than that of the younger students in his sample, with the most negative effects concentrated in eighth grade (i.e., 13–14 years old) for both math and reading. However, Thompson et al. (2021b) find negative effects on 11th-grade achievement only in math and among students in nonrural schools in Oregon.

Thus, the research on the effects of 4-day weeks to date suggests there may be important differences in the effect of the policy on students based on their age and development, and there is minimal evidence regarding the effects of the policy on older adolescents. Although there is individual variation in developmental timing such

that some early high school students may not yet be experiencing many of the developmental changes associated with older adolescence, this study operationalizes older adolescence as the ages during which students are in high school, as most high-school-aged students would be considered older adolescents (Sawyer et al., 2018). Nevertheless, because the existing literature has not articulated how aspects of younger or older adolescent development may be related to effects of the 4-day school week, this study details the potential, theoretical influence of aspects of general adolescence as well as specific aspects of older adolescence.

More specifically, some of the developmental changes that occur during adolescence are likely to make various features of a 4-day school week more or less harmful for students' achievement and behavior in high school. Although many features and consequences of 4-day school weeks may similarly affect students of all ages, developmental theory and other empirical findings regarding adolescence point to several features of 4-day school weeks whose effects are likely to vary for high school students relative to elementary students based on students' developmental status: (a) earlier start times, (b) longer school days and classes, and (c) increased free and/or unsupervised time.

Earlier Start Times

Both younger and older adolescents are particularly likely to be affected by earlier start times because of changes to circadian rhythms that occur at puberty (Dahl & Lewin, 2002). These circadian changes influence the release timing of the hormone melatonin such that adolescents are naturally predisposed to having later bedtimes and have a difficult time adjusting to earlier bedtimes. Therefore, earlier school start times are associated with students getting less sleep on school nights, as adolescents may struggle to adjust to an earlier bedtime despite having an earlier wake time (Edwards, 2012). Earlier start times and diminished sleep have been shown to have negative effects on adolescents' academic performance, attention, disciplinary infractions, and attendance (Adolescent Sleep Working Group et al., 2014; Heissel & Norris, 2018; Lufi et al., 2011; Owens et al., 2010; Thacher & Onyper, 2016; Wahistrom, 2002). It is important to note, though, that most of the empirical research considering the effect of start times estimates the effect of changing a start time by at least 30 minutes, whereas the national difference in start times between 4-day and 5-day school week schools is only 11 minutes (Thompson et al., 2021a). Thus, the earlier start times at 4-day week schools may be harmful to adolescents' achievement, attendance, and school behavior, but the extent of their likely impact is unknown.

Longer School Days and Classes

However, older adolescents may have a particular advantage over younger adolescents and elementary students in their ability to adjust to the longer school days and class periods associated with 4-day school weeks. The brain's prefrontal cortex undergoes significant development throughout adolescence and is, therefore, most developed in older adolescence. The prefrontal cortex, located in the frontal lobe of the brain, is the area of the brain responsible for the most complex cognitive functions, such as planning, sustained attention, working memory, and goal-directed behavior (Paus, 2005; Thillay et al., 2015; Yurgelun-Todd, 2007). In the case of the 4-day school week, these increased developmental capacities could improve a student's ability to succeed academically on the schedule by enabling them to focus over the course of a longer school day and to retain more information over the extended weekend than younger students. If the day is less cognitively taxing for high school students, there may be a range of related positive consequences, such as reduced stress, improved morale, increased attendance, and fewer disciplinary incidents.

Increased Out-of-School Time

Although there remains much unknown about how the 4-day week alters students' time use, Kilburn et al.'s (2021) cross-sectional survey study of students' experiences on 4-day and 5-day school weeks provides suggestive evidence that students' total "free" time, or out-of-school time, increases on a 4-day week schedule by about 3.5 hours per week for students in Grades 7 to 12. Approximately 79% of the 1,364 four-day week students in Grades 7 to 12 surveyed in Oklahoma reported "home" as the

location they spent the most time on the fifth day, and 15% of these students reported that they were regularly home without adult supervision during that time. Similarly, in interviews, students reported they primarily spent the fifth day at home and occasionally attended school athletics events and/or worked a job on the fifth day, but other structured activities at the school or the community on the fifth day were rare. Therefore, although the precise change in the amount of unsupervised out-of-school time caused by the 4-day week is unknown, the existing evidence strongly suggests that 4-day weeks increase students' total amount of out-of-school time per week and, at least for some students, their amount of unsupervised out-of-school time.

Increased out-of-school time is also likely to have affect older adolescents differently than their younger counterparts. It is well established that increased unsupervised out-of-school time is associated with various negative outcomes for older adolescents (Posner & Vandell, 1999), including reduced academic achievement (Mahoney et al., 2003), increased antisocial behavior, and greater frequency of risky behavior such as delinquency and substance use (Gage et al., 2005; Jacob & Lefgren, 2003; Mahoney, 2000). Indeed, Fischer and Argyle (2018) found that 4-day school weeks led to almost a 20% increase in juvenile crime among high school students in Colorado, concentrated during times the students were not at school. Unsurprisingly, juvenile justice involvement and generally engaging in antisocial and risky behaviors outside of school have been shown to be positively associated with exhibiting such behaviors in school as well (Andershed et al., 2001; Fabelo et al., 2011). Therefore, the increase in out-of-school time on a 4-day school week may particularly put high school students at risk of increases in negative behaviors and disciplinary infractions at schools.

Overall, it is unlikely that the 4-day school week only advantages or disadvantages high school students relative to younger students, but there is good reason to suspect that 4-day school weeks could have different consequences for these older adolescents than their elementary and/or middle school counterparts. Given that the policy is currently being debated in many state legislatures, gathering additional evidence on the effects of the schedule on high school students' achievement, attendance, and behavior could have important implications for policy and practice.

Research Questions

Despite tremendous national growth in 4-day school weeks and controversial legislative debates regarding the policy, research on its effects is limited. Indeed, the effects of the schedule on high school achievement and attendance have been examined using data only from one state. Another frequently purported benefit of the policy, improved school behavior, has puzzlingly little empirical support to date but has not been examined among high school students. This study notably contributes estimates of the causal effect of the 4-day school week on high school students' achievement, attendance, and disciplinary incidents. Estimating these effects using data from Oklahoma has the unique potential to inform future Oklahoma policy on school calendars. The study specifically seeks to answer the three following questions: What is the effect of the 4-day school week on high school students' (a) math and English ACT scores, (b) attendance rates, and (c) disciplinary incident rates?

Method

Data

This study employs 12 years (2007–2008 to 2018–2019) of demographic and ACT data, 9 years of attendance data (2010–2011 to 2018–2019), and 9 years of data (2009–2010 to 2017–2018) from annual behavioral incident reports from all 417 traditional public school districts in Oklahoma serving high school students. Because the 4-day school week has never been adopted in a district in a "city" location as designated by the National Center for Education Statistics (NCES), the analytic sample excludes city districts (n = 6). The complete panels include district-year observations from these 411 school districts in Oklahoma and were constructed using school-level calendar data (available through 2018–2019) from the Oklahoma State Department of Education (OSDE), district-level demographic data from the NCES Common Core of Data (CCD), district-level ACT data from OSDE,

district-grade level attendance data from OSDE, and district-level behavioral incident reports from OSDE.

The district-level calendar data are constructed from high-school-level calendar data. None of the 4-day week districts in the sample have multiple high schools serving the same district; thus, the treatment is effectively adopted at the district level. The CCD demographic data include each district's yearly number of students enrolled in Grades 9 to 12, racial composition (available from only 2008–2009 to 2018–2019), percentage of students eligible for free or reduced-price lunch (FRPL), percentage of ELLs, percentage of special education students, and pupil–teacher ratio. The ACT data from OSDE include yearly estimates of each district's average math and English score for all students who took the test. Each section of the ACT is scored on a scale of 1 to 36. Attendance data include yearly district-grade-level average daily membership (ADM), the average number of students enrolled per day over the course of a school year, and ADA, the average number of students recorded as present at school per day over the course of a school year. Oklahoma measures ADA such that students who are in attendance for two out of three periods before or after lunch are counted as attending for one half day. Students who miss class for school activities (e.g., sports, Future Farmers of America [FFA] competitions) are not marked as absent for those periods.[7] The data of behavioral incident reports include annual district-level counts of the following incidents[8] among students in Grades 9 to 12: (a) possession, use, or sale of alcohol, illicit drugs, or tobacco; (b) vandalism; (c) bullying; (d) fighting or assault; (e) possession of or incidents with weapons (e.g., BB guns, knives) other than firearms; (f) school bus incidents; and (g) truancy.

Sample

The analytic sample is restricted to the Oklahoma districts that served high school students in a noncity location. City districts that serve high school students ($n = 6$) are excluded because no 4-day school weeks have ever been adopted in city-located districts in Oklahoma, and there are large qualitative differences between city districts and the primarily rural districts in which 4-day school weeks are common. Thus, city districts are not likely to be a useful counterfactual for districts that adopt 4-day school weeks.

Descriptive statistics presented in Table 1 indicate many significant differences ($p < .05$) between districts that always have 5-day weeks (Column 1) and those that ever adopt 4-day school weeks (Columns 2 and 3), as well as between districts that adopt 4-day school weeks before adoption (Column 2) and after adoption (Column 3). Some particularly notable average differences between districts that always have 5-day weeks and districts that ever adopt 4-day school weeks include 4-day week districts' higher percentages of FRPL-eligible students, higher percentages of Native American students, smaller district memberships, lower ACT scores, and higher incident rates of truancy and alcohol, drugs, or tobacco. In addition, as expected, districts that ever adopt 4-day school weeks are located almost exclusively (94%) in rural areas, whereas the 5-day week districts in the sample are located more evenly across rural (72%), town (22%), and suburban (5%) areas.

When comparing 4-day week districts before and after adoption, the differences are generally smaller in magnitude, but many are still statistically significant. More specifically, relative to their preadoption period when they are operating on 5-day weeks, the 4-day week districts have higher percentages of FRPL-eligible students, smaller district memberships, lower ACT scores, and lower incident rates of bullying. Attendance rates and rates of all other incident types were similar across the two groups.

These descriptive differences are useful for considering average differences in the composition of the control and treatment samples, but it would be invalid to interpret these differences as *effects* of the 4-day school week. These groups vary on other factors, such as the years during which they are observed, that could be driving the observed differences, as opposed to whether districts adopted a 4-day school week. To address this issue, I use a quasi-experimental research design to estimate causal effects of the 4-day school week.

Empirical Strategy

This study employs panel data and a quasi-experimental DID approach to estimate causal effects of 4-day school weeks by comparing the

TABLE 1

Descriptive Statistics

	Analytic sample					
	All noncity 5-day districts (n = 321)		Four-day districts before adoption (n = 90)[a]		Four-day districts after adoption (n = 90)[a]	
District-level variables	Mean	*SD*	Mean	*SD*	Mean	*SD*
District characteristics						
% FRPL-eligible	54.87	17.67	61.16	14.42	65.09	14.30
% ELL	3.38	5.91	1.35	4.19	1.63	2.00
% Special ed.	17.01	4.64	18.68	4.18	20.05	4.36
% White	61.42	16.66	58.41	17.54	56.40	16.75
% Native American	21.70	17.18	32.16	18.84	28.61	19.04
% Asian	0.83	1.48	0.50	0.61	0.50	0.76
% Hispanic	8.67	10.43	3.64	3.06	5.46	4.69
% Black	3.19	6.97	2.45	4.38	2.03	4.13
% Other	4.09	6.51	2.81	4.43	6.99	8.82
District HS enrollment	379.70	694.35	164.72	151.23	156.10	151.42
Pupil–teacher ratio	13.66	5.64	12.87	3.49	13.02	2.94
Location						
% Rural	72.31	44.75	94.17	20.78	94.57	22.55
% Town	22.36	41.67	4.10	17.38	3.21	17.41
% Suburb	5.34	22.48	1.73	12.00	2.22	14.82
% City	0.00	0.00	0.00	0.00	0.00	0.00
ACT participation and scores						
Participation (n)	69.17	138.23	30.45	37.02	33.05	29.65
English	18.45	1.78	18.14	1.70	16.77	1.06
Math	19.07	2.26	18.92	1.83	16.75	1.49
Attendance rates[b] (%)						
Grade 9	94.84	1.88	94.68	1.65	94.94	1.45
Grade 10	94.59	1.95	94.43	1.66	94.65	1.71
Grade 11	94.60	2.14	94.64	1.68	94.75	1.96
Grade 12	94.46	2.53	94.73	1.80	94.77	2.17
Incidents per 100 students[c]						
Alcohol, drugs, or tobacco	2.21	2.52	2.83	2.29	2.09	2.40
Vandalism	0.22	0.77	0.37	0.60	0.25	0.50
Bullying	1.11	2.23	1.67	2.04	0.65	0.84
Fighting or assault	1.86	2.38	2.53	2.04	1.78	2.19
Weapons	0.26	0.59	0.26	0.33	0.17	0.34
School bus	0.31	0.88	0.48	0.68	0.26	0.58
Truancy	2.76	5.33	2.64	3.42	1.75	2.51

Note. The panel data in this table include the 411 non-city districts serving high school students in Oklahoma observed annually for 12 years (except as otherwise noted) from SY 2007-2008 to SY 2018-2019 (N=4,932). HS = high school. FRPL = Free or Reduced-Price Lunch. ELL = English language learners.

[a]Observations are weighted such that each pre- and postadoption district is equally represented in their respective category, regardless of the year they adopted the 4-day school week.

[b]Attendance rates are calculated by dividing districts' reported Grades 9 to 12 Average Daily Attendance by Grades 9 to 12 Average Daily Membership, and the data include district observations for 9 years, from spring 2011 to 2019.

[c]Incident data include district observations for 10 years, from spring 2010 to 2019.

contemporaneous changes in outcomes of districts with 4-day school weeks to those of districts that never or had not yet adopted 4-day weeks. I estimate variations of the following DID specification:

$$Y_{dt} = \lambda_d + \theta_t + \beta \text{Four-day}_{dt} + X'_{dt}\gamma + \epsilon_{dt}, \quad (1)$$

where Y_{dt} is the dependent variable of interest, that is, ACT math and English scores,[9] attendance rates (ADA/ADM*100) for each grade, or incident counts per 100 students for each incident type; λ_d are district fixed effects; θ_t are year fixed effects; β represents the effect of the 4-day week; Four-day_{dt} is an indicator variable that takes on a value of 1 each year a district has a 4-day week schedule; and ϵ_{dt} is an error term that accommodates for clustering at the district level (Bertrand et al., 2004). X_{dt} is a vector of covariates that controls for potential shocks that vary within districts over time and are historically linked to academic outcomes, ADA, and behavioral incident counts. These covariates include, for each district-year observation, the percentage of FRPL-eligible students, the percentage of students designated as ELLs, and the percentage of special education students.

The interpretation of the estimates produced in Equation 1 relies on several important assumptions. One assumption is that the effect of 4-day school weeks (i.e., the "treatment") is the same over time, or "static." However, the effect of a 4-day week schedule could potentially vary depending on the length of time that students have been exposed to the schedule. For example, districts' ACT scores could decline significantly in the first year they switch to a 4-day week as teachers adjust their curriculums, but then stabilize to their preswitch levels in the following years. Alternatively, the schedule could increasingly improve or harm districts' ACT scores each year of exposure to the schedule, resulting in a growing effect (positive or negative) of the 4-day week over time. These considerations are also important in relation to attendance and discipline outcomes, as these outcomes could decrease or increase over time as districts adjust to and, ideally, learn how to optimize the schedule to promote attendance and reduce negative behaviors. To account for such potential time-varying treatment effects, I specify semi-dynamic fixed-effects DID models that allow the schedule to have distinct effects the first year, the second year, and after three or more years of having a 4-day week:

$$Y_{dt} = \lambda_d + \theta_t + \sum_{\tau=0}^{2} \beta_{+\tau} \text{Four-day}_{d,t+\tau} + X'_{dt}\gamma + \epsilon_{dt}, \quad (2)$$

where τ is the number of years after a school has adopted the 4-day schedule (the first year of adoption, $\tau = 0$) and $\beta_{+\tau}$ represents the effect of 4-day weeks τ years after a district adopts the schedule. Joint *F*-tests are additionally employed to test the null hypothesis of a constant treatment effect, $H_0 : \beta_0 = \beta_1 = \beta_2$.

The "parallel trends" assumption is another critical assumption for DID analyses. This assumption requires that changes in outcomes over time in "control" districts (i.e., districts that never or had not yet adopted the 4-day schedule) are comparable to the changes that would have occurred in districts after they adopted 4-day weeks if they had remained on 5-day weeks. A violation of the parallel trends assumption would preclude the interpretation of the Equation 1 estimates as causal effects because the control group would not be a valid counterfactual for the treatment group over time. Because it is impossible to observe districts that do adopt 4-day school weeks as 5-day school weeks in the post-treatment period, the best way to test this assumption is to test for parallel trends in the pretreatment period. Parallel trends would be assumed to be violated, for example, if districts that eventually adopted 4-day weeks had decreasing ACT scores before they switched to the 4-day week relative to districts that never switched. In that case, it would not be possible to attribute any changes in ACT scores post-treatment to the schedule change as opposed to the different trends existing between the treatment and control districts before treatment; in other words, such a finding would suggest that the untreated districts are unlikely to be a valid counterfactual for the treated districts in the post-treatment period. To empirically examine the parallel trends assumption, I use the Granger causality test ("event study") as a falsification check (Angrist & Pischke, 2009) that estimates the effect of the 4-day week on the outcome variables for the years before and after the change:

$$Y_{dt} = \lambda_d + \theta_t + \sum_{\tau=2}^{4} \beta_{-\tau} \text{Four-day}_{d,t-\tau} + \sum_{\tau=0}^{2} \beta_{+\tau} \text{Four-day}_{d,t+\tau} + X'_{dt}\gamma + \epsilon_{dt}, \quad (3)$$

where $\beta_{-\tau}$ represents the "effect" of being τ years prior to adoption relative to never adopting 4-day weeks or being 1 year before adoption. To uphold the parallel trends assumption, the estimated "effect" of eventual 4-day week adoption should be constant and equal to zero in the years preceding adoption. Joint *F*-tests are employed to test the null hypothesis of a constant pretreatment "effect" equal to zero, $H_0 : \beta_{-4} = \beta_{-3} = \beta_{-2} = 0$.

Another critical assumption embedded in the DID specification is related to selection bias. At the district level, selection concerns are warranted because 4-day weeks are not randomly assigned to districts and, rather, districts voluntarily choose whether to adopt 4-day weeks. The inclusion of district fixed effects in all specifications helps to address this concern, as the fixed-effects control for unobservable heterogeneity between districts averaged over time, such as the percentage of students in a district who qualify for FRPL. Rather, the chief threat with regard to selection is that treatment and control districts could be trending differently on district characteristics preadoption, and these differences could lead to adopting the four-day school week. For example, evidence that district membership decreases significantly more over time during the pretreatment period in treatment districts than control districts would raise the concern that districts chose to adopt 4-day weeks because they were losing students at a faster rate than other districts. In that case, it would be impossible to attribute any observed effect of the 4-day school week in the post-treatment period to the schedule change as opposed to the decreasing membership in treatment districts during the pretreatment period.

Selection concerns would also be warranted if students and families were systematically choosing to enter or exit 4-day week districts (pre- or postadoption) over time. This systematic entry and/or exit would have the potential to change the total enrollment in the district as well as the composition of the students in the district. Indeed, if students were systematically exiting a district after it adopted a 4-day week because they disliked the 4-day week (and not being replaced by new students), enrollment would decrease in the year(s) following adoption, and the composition of the students would necessarily change such that a greater percentage of students and/or families would be in favor of the 4-day week. In such a situation, any observed effects of the 4-day week could alternatively be attributed to the changes in the population of students at the district. However, substantial entry and/or exit into these districts is unlikely due to the rural location of most 4-day week districts. Given that it is impossible to directly examine effects of the 4-day week on student-level entry and exit without student-level data, I estimate the effects of the schedule on reasonable proxies: district-level enrollment and characteristics representative of the composition of the district (e.g., the percentage of FRPL-eligible students).

Therefore, I employ the following specifications to examine assumptions about selection into and out of treatment:

$$X_{dt} = \lambda_d + \theta_t + \beta \text{Four-day}_{dt} + \epsilon_{dt} \quad (4)$$

$$X_{dt} = \lambda_d + \theta_t + \sum_{\tau=2}^{4} \beta_{-\tau} \text{Four-day}_{d,t-\tau} + \sum_{\tau=0}^{2} \beta_{+\tau} \text{Four-day}_{d,t+\tau} + \epsilon_{dt}, \quad (5)$$

where X_{dt} represents time-variant district enrollments and characteristics (i.e., the natural log of Grades 9–12 enrollment, the natural log of Grades 9–12 ADM, the percentage of White students, the percentage of Native American students, the percentage of FRPL-eligible students, the percentage of students in special education, and the pupil–teacher ratio). The event study in Equation 5 provides a further interrogation of the DID estimates from Equation 4. Of note, these specifications are limited to testing for selection bias based on observed district characteristics. Although these robustness checks can provide strong suggestive evidence that selection is not a major concern, it is still possible that differential trends between treated and control districts on unobserved district characteristics (e.g., families' interest in 4-day school weeks, parents' job schedules) could be related to student outcomes and to selecting into or out of treatment, biasing the estimates herein.

The specifications that examine ACT scores as outcomes require additional robustness checks related to selection and missingness. Current Oklahoma policy requires all Grade 11 students to take either the ACT or SAT, but prior to the 2017–2018 school year, the ACT was offered to high school students on an opt-in basis. Thus, the percentage of students taking the ACT varies across districts and years. There are also some years in which districts have no students who take the ACT. Lacking outcome data, these districts are excluded from the analytic sample for each "missing" district-year observation. Evidence of a pretreatment or posttreatment "effect" of 4-day school weeks on (a) the percentage of students taking the ACT or (b) district-level missingness from the ACT sample would be problematic for the interpretation of DID specifications examining ACT outcomes because it would suggest that the 4-day school week affected who was represented in the ACT sample. It could be, for example, that adopting a 4-day school week makes students or an entire district less likely to participate in the ACT because there is less time at school to prepare for, take, or administer the test at school over the course of the school year. In that case, it would be impossible to attribute any observed effect on ACT scores to the 4-day school week as opposed to concurrent changes at 4-day week districts in (a) the population of students who take the ACT or (b) district-level participation in the ACT. To test for these "effects," I specify equations that replicate the static DID and event study specifications, respectively, presented in Equations 1 and 3 but use ACT participation rates and missingness as outcomes:

$$H_{dt} = \lambda_d + \theta_t + \beta \text{Four-day}_{dt} + X'_{dt}\gamma + \epsilon_{dt} \tag{6}$$

$$H_{dt} = \lambda_d + \theta_t + \sum_{\tau=2}^{4} \beta_{-\tau} \text{Four-day}_{d,t-\tau} + \sum_{\tau=0}^{2} \beta_{+\tau} \text{Four-day}_{d,t+\tau} + X'_{dt}\gamma + \epsilon_{dt}, \tag{7}$$

where H_{dt} represents (a) the percentage of students who took the ACT and (b) ACT district-level missingness (yes/no).

As an additional robustness check regarding the sensitivity of the baseline estimates to the specified control group, I conduct the Equation 1 DID analyses with two additional, more restrictive control groups. Descriptive statistics for these control groups are presented in Supplementary Table A1 in the online version of the journal. The first alternative control group limits the control group to 5-day week districts in rural locations ($n = 262$). This control group is a valuable comparison group because treated districts are almost exclusively rural (94%) and 4-day school weeks are known to be a rural phenomenon; therefore, rural 5-day week districts may provide a better counterfactual for 4-day week districts than all noncity 5-day week districts. The second alternative control group is created using one-to-one (i.e., k:1) nearest neighbor propensity score matching without replacement or caliper restrictions (Rubin, 1973). This method generates propensity scores predicting all districts' likelihood of receiving treatment and identifies, for each treated district ($n = 90$), the untreated district ($n = 90$) that is most similar based on a vector of observable district characteristics (see all district characteristics listed in Table 1). Propensity scores for the districts that adopt a 4-day school week within the study period ($M = 0.333$, $SD = 0.128$) were reasonably similar to and not statistically significantly different from those of the matched comparison group ($M = 0.326$, $SD = 0.137$).

A final robustness check is required to address an assumption embedded in two-way fixed effects (TWFE) DID specifications with variation in treatment timing, such as the specification used in this study. When there is variation in treatment timing and the effects of treatment vary over time, the TWFE DID estimator represents a weighted average of all two-group[10] by two-period (i.e., year) DID estimators (Goodman-Bacon, 2021). The weights on each 2 × 2 comparison are determined by the proportion of districts in the treatment versus control group and the variance of the treatment dummy in each pair. Whereas the proportion of treated districts will be highest in comparisons made toward the end of the study period, the variance of treatment status will be largest in comparisons made in the middle of the study period. Therefore, when a district adopts the 4-day week in the study period, it could cause the estimated effect in a district to be underrepresented or overrepresented in the overall TWFE

DID estimator. A developing body of literature shows that these weighted average fixed-effects estimators can poorly represent the average treatment effect (ATE), and they are more likely to poorly represent the ATE if there are heterogeneous treatment effects by treatment time (Callaway & Sant'Anna, 2021; de Chaisemartin & D'Haultfoeuille, 2020; Goodman-Bacon, 2021; Sun & Abraham, 2021). To address this issue, I compare my original static DID point estimates with reweighted estimates calculated using Goodman-Bacon's (2021) *bacondecomp* Stata package.

When interpreting the statistical significance of all DID estimates presented in this study, I leverage Benjamini and Hochberg's (1995) procedure to address concerns that the multiple sets of comparisons conducted herein increase the likelihood of making one or more false discoveries, or family-wise error rate (FWER), when using the standard alpha level of .05. For all point estimates that are significant at $p < .05$, I further interrogate whether the estimate is statistically significant from zero using the Benjamini–Hochberg method with a conservative false discovery rate (FDR) of 0.05.

Results

Difference-in-Differences

DID and semi-dynamic DID analyses, as specified in Equations 1 and 2, were conducted examining the effect of the 4-day school week on the following outcomes: math and English ACT scores, the natural log of 9th- to 12th-grade ADA, and the natural log of counts of seven types of disciplinary infractions in Grades 9 to 12.

ACT Scores. The DID and semi-dynamic DID point estimates of the effect of 4-day weeks on districts' math and English test scores are presented in Table 2. Although the majority of the point estimates are positive, all point estimates in both the static DID and semi-dynamic DID models are statistically insignificant from zero and meaningfully small (i.e., less than or equal to 0.40 points on the ACT), indicating there is no detectable effect of the 4-day week on math ACT scores (static DID $\beta = 0.14, 95\%\,\text{CI}: [-0.19, 0.46]$) or English ACT scores (static DID $\beta = 0.03, 95\%\,\text{CI}: [-0.31, 0.39]$. The joint *F*-tests conducted for each semi-dynamic DID specification also fail to reject a constant treatment effect over time on math and English ACT scores.

Attendance. The DID and semi-dynamic DID point estimates of the effect of 4-day weeks on the high school attendance rates (attendance rate = ADA/ADM × 100) in total and in each grade are presented in Table 3. These point estimates can be interpreted as average percentage point change in districts' attendance rates due to the 4-day school week. The static estimates of the effect for each grade (ninth grade $\beta = -0.06$, $95\%\,\text{CI}: [-0.42, 0.29]$; 10th grade $\beta = 0.01$, $95\%\,\text{CI}: [-0.39, 0.42]$; 11th grade $\beta = -0.16$, $95\%\,\text{CI}: [-0.61, 0.28]$; 12th grade $\beta = -0.18$, $95\%\,\text{CI}: [-0.68, 0.32]$) as well as all high school grades ($\beta = -0.12$, $95\%\,\text{CI}: [-0.47, 0.24]$) are statistically insignificant and small, indicating there is no detectable effect of the 4-day school week on attendance rates. The corresponding joint *F*-tests also fail to reject constant treatment effects over time on the total high school attendance rates and attendance rates in each high school grade.

School Disciplinary Incidents. The DID and semi-dynamic DID point estimates of the effect of 4-day weeks on the rate of school disciplinary incidents per 100 students by incident type are presented in Table 4. These point estimates can be interpreted as the average change in districts' frequency of incidents per 100 students for each incident type due to the 4-day school week. The results suggest that 4-day weeks significantly decreased the frequency of bullying incidents by 0.65 incidents per 100 students ($95\%\,\text{CI}: [-1.14, -0.16], p = .009$), which is approximately a 39% decrease in the incident rate 4-day week districts had before adopting the 4-day week, and fighting and assault incidents by 0.79 incidents per 100 students ($95\%\,\text{CI}: [-1.31, -0.28], p = .003$), a 31% decrease. The point estimates on the bullying incident rate and the fighting and assault incident rate both remain statistically significant when tested using the Benjamini–Hochberg multiple comparisons procedure with a conservative FDR of 0.05. School bus

TABLE 2

Effects of the 4-Day School Week on ACT Scores

	Dependent variables: ACT scores			
	Math ACT		English ACT	
Independent variable	(1)	(2)	(3)	(4)
Four-day	0.18		0.03	
	(0.17)		(0.18)	
Adoption year		−0.01		−0.23
		(0.14)		(0.16)
1-year lag		0.40		0.28
		(0.25)		(0.26)
2-year lag		0.36		0.23
		(0.25)		(0.26)
Adj. R^2	.5641	.5647	.6164	.6168
p value: $(H_0 : \beta_0 = \beta_1 = \beta_2)$	—	.2935	—	.1981

Note. Standard errors, clustered at the district level, are in parentheses. All models include district FE, year FE, and the following district-level covariates: the percentage of students eligible to receive free or reduced-price lunch, the percentage of English learners, and the percentage of special education students (coefficients suppressed). The panel data in this table include the 411 noncity districts serving high school students in Oklahoma that adopted a 4-day school week between 2011 and 2019 or never had a 4-day week schedule. The districts are observed annually from 2008 to 2019, but 342 district-year cells (134 unique districts) did not test students on the ACT or have missing ACT data. Not testing students or having missing ACT data in a given year was not related to adopting a 4-day school week (see Supplementary Table A6 in the online version of the journal). Observations of 4-day week districts are included only for a treatment window of up to 4 years before adoption and 3 years following adoption. *N*=4,147. Schedule data and ACT data are from the Oklahoma State Department of Education, and demographic data are from the National Center for Education Statistics Common Core of Data (CCD) FE = fixed effects.

*$p < .05$. **$p < .01$. ***$p < .001$.

incidents decrease by 0.19 incidents per 100 students ($95\%\,\mathrm{CI}: [-0.36, -0.16], p = .036$), a 40% decrease; however, this point estimate is not statistically significant when accounting for multiple comparisons. The 4-day week did not have a significant static effect on the rates of all remaining incident types, including alcohol/drugs/tobacco ($\beta = -0.42$, $95\%\,\mathrm{CI}: [-1.04, 0.20]$), vandalism ($\beta = 0.00$, $95\%\,\mathrm{CI}: [-0.18, 0.19]$), weapons ($\beta = -0.07$, $95\%\,\mathrm{CI}: [-0.19, 0.05]$), and truancy incidents ($\beta = -0.35$; $95\%\,\mathrm{CI}$: $95\%\,\mathrm{CI}: [-1.17, 0.47]$). The joint *F*-tests for all semi-dynamic DID specifications with disciplinary incidents per 100 students as outcomes fail to reject constant treatment effects over time.

Robustness Checks

Results of the event study specifications, as detailed in Equation 3, that were employed to test the robustness of the parallel trends assumptions embedded in the static and semi-dynamic DID specifications presented in Tables 2 to 4 are, respectively, presented in Supplementary Tables A2 to A4 in the online version of the journal. The event studies provide suggestive evidence regarding whether, conditional on district and year fixed effects, outcomes of districts that would adopt a 4-day school week but had not yet adopted it ("2-year lead," "3-year lead," etc.) were trending differently relative to the outcomes of districts in the year preceding adoption of the 4-day week and districts that would not adopt a 4-day week. Although there is some suggestive evidence of downward trends in bullying incidents, fighting incidents, and truancy incidents, the results presented in Supplementary Tables A2 to A4 in the online version of the journal, respectively, depicted in Supplementary Figures A3 to A5 in the online version of the journal, fail to reject the null hypothesis that there are no significant differences between the treatment and control districts before treatment for any of the examined outcomes. The joint *F*-tests examining

TABLE 3

Effects of the Four-Day School Week on Attendance Rates

	Dependent variables: Attendance rates[a]									
	9th grade		10th grade		11th grade		12th grade		Total 9th–12th grade	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Four-day	−0.062		0.013		−0.164		−0.184		−0.116	
	(0.180)		(0.207)		(0.225)		(0.254)		(0.180)	
Adoption year		0.023		−0.004		−0.313		−0.134		−0.144
		(0.227)		(0.235)		(0.252)		(0.276)		(0.193)
1-year lag		0.191		0.085		0.006		−0.409		−0.034
		(0.213)		(0.250)		(0.291)		(0.354)		(0.229)
2-year lag		−0.553		0.113		−0.458		−0.400		−0.309
		(0.320)		(0.346)		(0.343)		(0.334)		(0.257)
Adj. R^2	.5510	.5521	.5150	.5147	.5285	.5288	.5550	.5551	.6693	.6693
p value: $(H_0 : \beta_0 = \beta_1 = \beta_2)$	—	.0772	—	.8764	—	.2679	—	.5460	—	.5021

Note. Standard errors, clustered at the district level, are in parentheses. All models include district FE, year FE, and the following district-level covariates: the percentage of students eligible to receive free or reduced-price lunch, the percentage of English learners, and the percentage of special education students (coefficients suppressed). The panel data in this table include the 411 noncity districts serving high school students in Oklahoma that adopted a 4-day school week between 2011 and 2019 or never had a 4-day week schedule. The districts are observed annually from 2011 to 2019, but observations of 4-day week districts are included only for a treatment window of up to 4 years before adoption and 3 years following adoption. N = 3,046. Schedule data and attendance data are from the Oklahoma State Department of Education, and demographic data are from the National Center for Education Statistics Common Core of Data (CCD). FE = fixed effects.

[a]Attendance rates are calculated using the following equation: Attendance rate = (Average Daily Attendance / Average Daily Membership) × 100. Point estimates can be interpreted as the percentage point change in attendance rate.

*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 4

Effects of the 4-Day School Week on School Disciplinary Incidents

	Dependent variables: Incidents per 100 students[a]													
	Alcohol, drugs, or tobacco		Vandalism		Bullying		Fighting or assault		Weapons		School bus		Truancy	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Four-day	−0.42		0.00		−0.65**		−0.79**		−0.07		−0.19*		−0.35	
	(0.32)		(0.09)		(0.25)		(0.26)		(0.06)		(0.09)		(0.42)	
Adoption year		−0.37		0.01		−0.77*		−0.52		−0.09		−0.27*		−0.15
		(0.36)		(0.09)		(0.31)		(0.42)		(0.07)		(0.13)		(0.45)
1-year lag		−0.54		0.01		−0.44		−0.82*		−0.04		−0.09		−0.35
		(0.36)		(0.15)		(0.29)		(0.38)		(0.08)		(0.11)		(0.47)
2-year lag		0.10		−0.07		−0.82		−0.87		−0.14*		−0.31*		−0.76
		(0.55)		(0.11)		(0.42)		(0.56)		(0.07)		(0.14)		(0.65)
Adj. R^2	.2940	.2939	.0640	.0634	.2015	.2012	.2438	.2427	.1210	.1207	.1183	.1186	.3400	.3396
p value: $(H_0 : \beta_0 = \beta_1 = \beta_2)$	—	.3343	—	.7006	—	.4313	—	.8816	—	.3603	—	.3287	—	.5524

Note. Standard errors, clustered at the district level, are in parentheses. All models include district FE, year FE, and the following district-level covariates: the percentage of students eligible to receive free or reduced-price lunch, the percentage of English learners, and the percentage of special education students (coefficients suppressed). The panel data in this table include the 411 noncity districts serving high school students in Oklahoma that adopted a 4-day school week between 2011 and 2019 or never had a 4-day week schedule. The districts are observed annually from 2010 to 2018, but observations of 4-day week districts are included only for a treatment window of up to 4 years before adoption and 3 years following adoption. $N = 3{,}046$. Schedule data and attendance data are from the Oklahoma State Department of Education, and demographic data are from the National Center for Education Statistics Common Core of Data (CCD). FE = fixed effects.

[a]Incidents per 100 students are calculated using the following equation: Incidents per pupil = Incident count / Grades 9–12 enrollment × 100.

*$p < .05$. **$p < .01$. ***$p < .001$.

"effects" of 4-day weeks on all outcomes during the preadoption period also fail to reject the null hypothesis that the effects of being a district in the years preceding adoption of the 4-day week were constant and equal to zero, providing further support for the parallel trends assumption.

A second set of robustness checks test for selection into and out of treatment by examining the association between district characteristics (e.g., enrollment, racial composition) and adopting a 4-day school week over time. I test for such potential selection bias related to 4-day week adoption by regressing time-variant district characteristics on the 4-day week conditional on time and district fixed effects, as specified in Equations 4 and 5. The examined time-variant district characteristics include (a) district enrollment in Grades 9 to 12 (Table 5): yearly enrollment in Grades 9 to 12 and total ADM for Grades 9 to 12, and (b) other district characteristics (see Supplementary Table A5 in the online version of the journal): the percentage of White students, the percentage of Native American students, the percentage of students who are FRPL-eligible, the percentage of special education students, and the student–teacher ratio. All of the point estimates in Table 5 and Supplementary Table A5 in the online version of the journal are substantively small and statistically insignificant, indicating that I fail to reject the null hypotheses that (a) districts are not selecting into treatment due to changes in district characteristics during the pretreatment period and (b) districts are not changing with respect to those same characteristics during the post-treatment period. Therefore, I find no strong evidence for selection into or out of treatment based on observables using this method.

The analyses estimating effects of the 4-day week on ACT scores require additional robustness checks related to selection. As previously described, analyses using ACT scores are potentially subject to selection bias based on the variation in the percentage of students who choose to take the ACT between and within districts over time as well as the missingness of ACT scores for several districts. Using the specifications in Equations 6 and 7, I test for "effects" of the 4-day week on the percentage of students taking the ACT in a district and on whether a district reported any ACT scores. As displayed in Supplementary Table A6 in the online version of the journal, all point estimates are statistically insignificant, indicating that I fail to reject the null hypothesis that there are no selection effects related to (a) the percentage of students taking the ACT in a district or (b) district-level participation in the ACT.

I additionally test the sensitivity of the baseline results by repeating the analyses with two alternative, more restrictive control groups. More specifically, I conduct the same static DID and semi-dynamic DID specifications (Equations 1 and 2) with the previously defined alternative control groups: (a) a matched comparison group of control districts and (b) rural-only control districts. Descriptive statistics for the two alternative control groups are presented alongside descriptive statistics of the treatment group before and after adoption in Supplementary Table A1 in the online version of the journal. The static DID and semi-dynamic DID analyses conducted using each alternative control group are presented for the ACT score outcomes in Supplementary Table A7 in the online version of the journal, for the attendance outcomes in Supplementary Table A8 in the online version of the journal, and for the disciplinary incident outcomes in Supplementary Table A9 in the online version of the journal. The reported point estimates in these tables are similar in both magnitude and statistical significance to those of the original analyses presented in Tables 2 to 4. Thus, these results provide additional evidence that the baseline results are robust to the use of alternative control groups.

Finally, I account for possible bias in the point estimates related to variation in treatment timing in TWFE DID by producing reweighted estimates, as presented in Supplementary Table A10 the online version of the journal, using Goodman-Bacon's (2021) procedure. The reweighted estimates are generally consistent with the original static DID estimates, suggesting that variation in treatment timing is not strongly biasing the original estimates. The Goodman-Bacon (2021) decomposition of the weights on each two-group by two-period (2×2) pair also shows that the share of the overall weighting placed on comparisons between "timing groups" (districts who ever adopted a 4-day school week) and "never-treated groups" was greater than 97% for all subsamples, further indicating that the issues related

TABLE 5

Effects of the Four-Day School Week on District Enrollment (Event Study)

	Dependent variables: District enrollment			
	ln(Grades 9–12 enrollment[a])		ln(Grades 9–12 ADM[b])	
Independent variable	(1)	(2)	(3)	(4)
Four-day	−0.04		−0.01	
	(0.02)		(0.02)	
4-year lead		−0.01		−0.00
		(0.03)		(0.03)
3-year lead		−0.01		−0.00
		(0.03)		(0.03)
2-year lead		−0.02		−0.01
		(0.02)		(0.01)
Adoption year		−0.04		−0.01
		(0.03)		(0.03)
1-year lag		−0.06		−0.01
		(0.04)		(0.03)
2-year lag		−0.06		−0.05
		(0.04)		(0.04)
N	4,437	4,437	3,046	3,046
Adj. R^2	.9751	.9751	.9855	.9854
p value: $(H_0 : \beta_{-2} = \beta_{-3} = \beta_{-4} = 0)$	—	0.7126	—	0.9668
p value: $(H_0 : \beta_0 = \beta_1 = \beta_2)$	—	0.7265	—	0.2134

Note. Standard errors, clustered at the district level, are in parentheses. All models include district FE and year FE. The panel data in this table include the 411 noncity districts serving high school students in Oklahoma that adopted a 4-day school week between 2011 and 2019 or never had a 4-day week schedule. Observations of 4-day week districts are included only for a treatment window of up to 4 years before adoption and 3 years following adoption.

[a]Grades 9 to 12 enrollment data are from the CCD and represent districts' enrollments measured at a cross-sectional point in time each school year. These data are available from 2008 to 2019.

[b]Average Daily Membership (ADM) data are from the Oklahoma State Department of Education and represent districts' average daily enrollment over the course of a school year. Although ADM provides a more precise measure of enrollment than the CCD measure, these data are available only from 2011 to 2019.

*$p < .05$. **$p < .01$. ***$p < .001$.

to variation in treatment timing for TWFE DID estimators are not likely to affect the original estimates herein. This result was similar to that of Thompson and Ward (2022), who used the same procedure and found that the weighting placed on the same comparisons was between 95% and 99% for all of their analyses. A graphical example of this decomposition exercise for the math ACT analysis in this study is presented in Supplementary Figure A6 in the online version of the journal.

Discussion

State-level policy decisions on 4-day school weeks across the country are being made without any evidence regarding the schedule's effects on high school students. This study used panel data from Oklahoma public high school districts and a DID research design to provide a rigorous, quasi-experimental analysis of the effects of the 4-day school week on high school students' achievement, attendance, and behavior.

ACT Scores

I find no detectable effect of the schedule on districts' average ACT scores in math or English. Given that the 4-day week districts in Oklahoma during this study period were almost exclusively rural (~95%), the findings herein are consistent with Thompson et al.'s (2021b) null effects on

11th-grade math and achievement for students in rural schools. The null effect reported in this study also aligns with Morton's (2021) and Kilburn et al.'s (2021) null finding on students' state test scores in Grades 3 to 8. However, it contradicts Anderson and Walker's (2015) study, which finds positive effects of the schedule on student achievement in Grades 4 and 5 in Colorado, and Thompson and Ward's (2022) and Thompson's (2021b) studies, which find negative effects of the schedule on student achievement in Grades 3 to 8, with the most negative effects concentrated in Grades 7 and 8 (only Thompson, 2021b). The lack of a detectable effect in the current study is surprising in contrast to the concentration of the negative academic effects among the older, middle-school-age students in Thompson's (2021b) study; nevertheless, it is difficult to compare these results simultaneously across developmental age groups and states, as there could also be significant state-based differences in the implementation and consequences of the policy (and state-based differences could also vary by developmental age group). There was a theoretical basis to expect that 4-day school weeks could affect high school students differently from younger students, but it is possible that the various mechanisms through which the 4-day week positively and negatively affects high school students' achievement relative to younger students' achievement essentially cancel out such that all students were similarly affected by the schedule.

This study's null result regarding effects of the schedule on high school achievement in conjunction with Thompson et al.'s (2021b) findings suggests that the age and development of students in addition to district characteristics (e.g., rural vs. non-rural) and implementation features (e.g., instructional hours) may be key factors in determining the effect of the schedule on academic achievement. Investigating the relationships between rurality, the implementation of the 4-day school week, and the effects of the policy on academic achievement is a promising direction for future research. Many questions remain regarding the mechanisms underlying observed academic effects of 4-day school weeks, but the null results on ACT scores presented in this study provide the most rigorous and relevant estimate of the effect of 4-day school weeks on high school students to date for the policymakers and practitioners debating 4-day school weeks in Oklahoma.

Attendance

With regard to attendance, I also find no detectable effect of the 4-day school week on attendance rates in any high school grade. This finding aligns with Thompson and Ward's (2022) estimated null effects on attendance among rural high school students as well as Anderson and Walker's (2015), Kilburn et al.'s (2021), and Thompson's (2021b) estimated null effects on attendance among students in Grades 3 to 8, but it contrasts the strong and frequent anecdotal claims that attendance is improving due to the 4-day week. Indeed, 29% of 4-day week districts from a national sample of 4-day week districts cited attendance issues as one of their primary reasons for adopting the 4-day school week. Anecdotal evidence based on surveys and interviews of 4-day week district members indicates that they think attendance increases on a 4-day school week because students can use the fifth day for activities and appointments (e.g., sports games/tournaments, FFA competitions, doctor's appointments) that they would otherwise have to miss regular school hours to attend (Hale, 2007; Hanson, 2017; Hedtke, 2014; Kilburn et al., 2021; Kingsbury, 2008; Leiseth, 2008; Schank & York, 2009; Smith, 2009; Toppo, 2002; Turner, 2010). It is possible, of course, that 4-day school week district members simply misperceive the schedule as improving student attendance when there is no effect. In that case, I would recommend discouraging the adoption of 4-day school weeks with the sole purpose of improving attendance.

However, if attendance increases at 4-day week districts precisely because students are missing less class time for school activities like sports, it is possible that the attendance measure used in this study and in the other quasi-experimental studies would not capture these changes. More specifically, the ADA measure used in Oklahoma, as well as that of Colorado and Oregon, does not record class time that students miss for school activities as an absence. It is conceivable that students who are old enough to participate in school activities at these districts would

frequently have to miss class when on a 5-day week schedule to make the long trip to compete at other districts because of their rural location. Missing school for an appointment, however, would be recorded as an official absence (even if excused) that would appear in the ADA measure. Therefore, if students were previously missing significant amounts of class time for school activities, it is possible that these districts were increasing their attendance rates in terms of the percentage of time students were in class, but these increases would not appear in analyses that use the most common measure of attendance, ADA. Because of this potential for systematic measurement error to be biasing the results, future research should investigate the role of school activity–related absences in reported increases in attendance at 4-day school week districts.

School Disciplinary Incidents

Finally, this study finds that 4-day school weeks significantly decrease rates of high school students' disciplinary incidents related to bullying and fighting at school, but they have no detectable effect on rates of incidents related to alcohol/drugs/tobacco, vandalism, weapons, school bus rides, and truancy. Bullying incidents reduced by 0.65 incidents per 100 students (95% CI: [−1.14, −0.16]), a 39% decrease, and fighting incidents reduced by 0.79 incidents per students (95% CI: [−1.31, −0.28]), a 31% decrease. In sum, these effects amount to an average of 97 fewer bullying incidents and 117 fewer fighting incidents per year across all 4-day week districts in Oklahoma. At first, the decreases in and null effects on disciplinary incidents are surprising given high school students' increased free time and likely reduced supervision on the 4-day school week. However, these specific changes are concentrated during time spent outside of school, and it is possible that any changes in behavior outside of school are not translating to the behaviors in school measured in this study. The decreases in and null effects on in-school disciplinary incident rates could also be attributed to students' spending less time at school and having less time to commit these infractions when they switch to a 4-day school week. According to Thompson et al.'s (2021a) study of the implementation of 4-day school weeks, students at 4-day week districts spend 7% less time at school and have 18% fewer school days on average than 5-day week students over the course of a year.

It would be reasonable to expect that changes in the frequency of incidents that can occur at any point in the day, such as bullying and fighting, would be more related to changes to the total time students are at school than changes to the number of school days. However, this claim relies on the assumption that these incidents are equally distributed throughout the day and not concentrated during discrete periods of the day, such as lunch and recess. Unfortunately, to the best of my knowledge, no peer-reviewed research has documented the distribution of these various incidents throughout the day, week, and/or year, so this assumption is untested. If these incidents occurred only during lunch (and the length of lunch periods was not impacted by the 4-day week schedule), for example, one would expect their frequency to be more closely connected to the number of days students are at school. Therefore, if the 4-day school week had no effect on student behavior other than reducing the time or days students are at school, one might expect incidents that can occur throughout the day (e.g., bullying and fighting) to reduce by ~7%, or up to ~18% at most. However, this study finds that bullying and fighting incident rates, respectively, decrease by an average 39% (95% CI: −68%, −10%) and 31% (95% CI: −52%, −11%), suggesting that the 4-day school week could be having a positive effect on these student behaviors over and above simply reducing the time (or days) students spend at school. Although an 18% decrease is within the 95% CI of each estimate, it is worth noting that the estimated average decreases are greater than the estimated average 20% to 23% decreases in bullying attributed to school-based anti-bullying programs based on Ttofi and Farrington's (2011) meta-analysis of 44 programs.

Alternatively, for incidents that can only occur once per day (e.g., truancy) or during discrete periods of the day whose duration is unchanged by the 4-day school week (e.g., school bus rides), it would be reasonable to assume that their frequency would be connected to the total days of school as opposed to total time at school. Thus, if 4-day weeks had no effect on the frequency of these incidents outside of reducing total days of

school, the frequency rates of these incidents should decrease by ~18%. This study estimates that school bus incident rates reduce by 40% (95% CI: [−75%, −33%]) and truancy rates reduce by 13% (95% CI: [−44%, +18%]) on average, but neither effect is statistically significant from zero when accounting for the multiple comparisons in this study, so I cannot reject the possibility that the 4-day school week has no effect on these incident rates or is reducing them proportionately to the reduction in days of school. For the remaining examined types of incidents—alcohol/drugs/tobacco, vandalism, and weapons—it is less immediately clear whether their frequency would be better predicted by time at school or days of school. Nevertheless, all estimated effects of the four-day school week on the rates of these incidents were also not statistically significant from zero or a decrease of up to 18%, so I cannot reject the possibility that the 4-day school week has no effect on these incident rates or is reducing them proportionately to the reduction in time at school or days of school.

Implications

A comprehensive understanding of the 4-day school week's impact on student behavior will require future research that examines effects on students' behavior both inside and outside of school. Nevertheless, the 4-day school week's effective reduction of in-school bullying and fighting incident rates, both in absolute terms and relative to the decreases in time at school, have important implications for policy and practice. School-based disciplinary incidents, such as bullying and fighting, can have substantial long-term negative consequences for both the victims and perpetrators of the incidents (Kupchik, 2016; Nickerson et al., 2014; Schoeler et al., 2018; Skiba et al., 2014); minimizing these incidents is often a priority for schools (Ttofi & Farrington, 2011), and the 4-day school week may be an effective way to do so in rural districts like those in the present study. Nevertheless, it is worthwhile to recognize that these positive effects on high school students' behavior are most likely an unexpected positive consequence of the policy rather than the intent of the policy; indeed, districts do not report adopting the schedule for the purpose of reducing disciplinary incidents (Thompson et al., 2021). The unexpected nature of the effect raises questions about the underlying mechanism(s) driving the effect and other potential unintended consequences: perhaps 4-day school weeks reduce bullying and fighting incident rates by reducing the time that students are at school and by improving students' morale, reducing students' stress, increasing students' weekly sleep, or generally improving school climate. These questions warrant additional research, as the range of effects of the 4-day school week is only minimally understood despite the policy's continued growth across the country and controversial political nature.

The generalizability of the results presented in this study to other districts located outside of Oklahoma depends on the consistency of the implementation of the 4-day school week schedule, the differences between the districts and students experiencing the schedule, and the differences in students' opportunities and experiences on the "fifth day" across states. Whether true state-based differences exist in the nuanced implementation and resulting consequences of the 4-day school week largely remains to be seen. Thompson et al.'s (2021a) implementation and adoption study provides the first high-level evidence of state-based variation in schools' rationales for adopting the schedule and the opportunities they offer students on the fifth day, but the study does not link any differences in implementation to effects of the schedule. Further describing the implementation of the schedule, related effects, and individual differences in its effects in future research will have important implications for policymakers considering placing restrictions on the implementation of the schedule and for practitioners considering adopting, abandoning, or adjusting the implementation of the schedule in their own district.

In Oklahoma, most districts will no longer be able to operate on a 4-day school week as of the 2022–2023 school year because they will not meet the requirements for achievement and cost savings established by the State Department of Education. This February 2020 decision was made without any peer-reviewed empirical evidence regarding the policy in Oklahoma, as the first study of the state's 4-day week, which found null effects of the schedule on achievement in Grades 3 to 8, was published online in August 2020 (Morton, 2021). Many 4-day week superintendents are hoping that

they will have the evidence they need to persuade the legislature to let them continue to operate on 4-day school weeks beyond the 2021–2022 school year. It is my hope that the null findings on high school students' achievement and attendance as well as the promising effects on bullying and fighting presented in this study will help to inform these ongoing policy debates and any resulting revisions of requirements for schools to be eligible to operate on a 4-day school week in Oklahoma.

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Supplemental Material

Supplemental material for this article is available online.

Notes

1. States with at least one school operating on a 4-day school week schedule during the 2018–2019 school year were Alaska, Arizona, California, Colorado, Georgia, Idaho, Iowa, Kansas, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Texas, Washington, and Wyoming.

2. Senate Bill 441 originally required districts to uphold the 165 days and 1,080 hours requirements for the 2021–2022 school year, but all districts were granted a waiver for 2021–2022 due to COVID-19.

3. The eligibility guidelines were proposed by the Oklahoma State Department of Education and State Superintendent Joy Hofmeister, and they were signed into law by the Governor through an executive order in February 2020. The guidelines require elementary and middles schools to (a) have received a letter grade of "C" or higher on their student growth indicator on their most recent Oklahoma School Report Card and (b) not be currently identified for Comprehensive Support and Improvement (CSI), Target Support and Improvement (TSI), or Additional Targeted Support and Improvement (ATSI). High schools must (a) have a 4-year cohort graduation rate equal to or greater than the most recent state average, (b) have received a letter grade of "C" or higher on their academic achievement indicator on their most recent Oklahoma School Report Card, (c) have received a letter grade of "C" or higher on their postsecondary opportunities indicator on their most recent Oklahoma School Report Card, and (d) not be currently identified for CSI, TSI, or ATSI. In addition, any district applying for a waiver must submit a budget and narrative describing their cost savings to the County Excise Board.

4. Reported years refer to the spring of the school year being referenced.

5. Kilburn et al. (2021) also implement two alternative Callaway and Sant'Anna (2021) estimation procedures, an inverse probability weighted model and an outcome regression model, that reweight their estimates to account for potential bias due to variation in treatment timing. The inverse probability weighted model estimates a nonsignificant average effect on math achievement (−0.05 *SD*) and a significant, negative average effect on English Language Arts (ELA) achievement (−0.06 *SD*). The outcome regression model finds a significant negative effect on math achievement (−0.10 *SD*) and on ELA achievement (−0.09 *SD*).

6. Thompson and Ward's (2022) study includes data from the following 12 states Arizona, Georgia, Idaho, Kansas, Minnesota, Missouri, Montana, New Mexico, Nevada, Oklahoma, Oregon, and South Dakota.

7. Students can have up to 10 total absences (or 20 half-day absences) for school activities per year. Beyond these 10 allotted absences, students would have to be recorded as officially absent if they were to miss additional school for school activities.

8. Note that the behavioral incident count is inclusive of all related suspensions, but the total incident count is a more sensitive measure for capturing student behavior than suspension counts, as not all disciplinary incidents result in a suspension.

9. Models were also run using standardized ACT math and English scores. The results of the static and semi-dynamic difference-in-differences (DID) specifications were not statistically or substantively different from the results of the specification that used the scale scores.

10. The analytic subsamples in this study include up to 11 "groups": never-treated districts, always-treated districts (only for the attendance analyses sample), and the nine cohorts of districts that adopted 4-day weeks each year from 2011 to 2019.

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