Impact of High School Graduation Requirements on Health of High School Students.

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Abstract

In this study, I evaluate the relationship between high school students' rigorous coursework and their health behaviors, such as body mass index (BMI), smoking cigarettes, alcohol consumption, and TV viewing. I consider the state increase in high school students' math graduation requirements as a measure of their rigorous coursework. I use the state survey data from Youth Risk Behavioral Surveillance System from 1993 to 2019 and employ the difference in difference method in this study. The results suggest that states with higher math requirements for graduation are likely to have a lower BMI and obesity prevalence. The BMI decreases by 0.12 units at a 5% significance value, and the probability of being obese decreases by 1.3 percentage points at a 1% significance value. The results by race suggest that BMI and obesity level decreases for white students with a significant value, while no significant change was observed for minority students (black and Hispanic). Additionally, white high school students are less likely to smoke a cigarette and watch TV, while no such impact was observed for minority students. Furthermore, there is an increase in current drinking behavior among white high school students. Overall, the results suggest that rigorous math coursework does positively impact the health of high school students.

Introduction:

Healthy People 2030 goal is to reduce the prevalence of obesity among adults, children, and adolescents. The prevalence of obesity for the year 2017-18 among children and adolescents aged 2-19 years old is 19.3%, and among adults aged 20 and above, the obesity prevalence is 42.4% (Ogden et al., 2020). Further, the prevalence of obesity among the American population is predicted to increase by 49% by the year 2030 (Ward et al., 2019). There is an estimated association between obesity and higher health costs, which equate to about $2,505 more per person than healthy-weight people (Cawley et al., 2021). Recent events of the COVID-19 pandemic has made us aware of the health risk of being obese (Cai et al., 2021). Additionally, it is found that being obese leads to other life-threatening diseases such as type 2 diabetes and heart disease (CDC, 2022c).

The above facts suggest obesity is a severe issue, so policy intervention is crucial to tackle this problem. It is essential to introduce a policy to target the population at a younger age that will help reduce the prevalence of obesity in adulthood (Arria et al., 2008; Hawkins et al., 1999; Simmonds et al., 2016). In 2017, 90% of Americans aged 25 years and older has completed at least a high school education (Bureau, 2017). I, therefore, direct my research towards education and its effects on health, as this is an area to which most young people are exposed. Studies in both economics and medical journals has suggested that there are positive benefits to health from schooling (Cutler and Lleras-Muney, 2008; Davies et al., 2018; Grossman, 2015). Previous studies has used compulsory schooling law as an instrument to find a causal relationship between health and schooling (Fonseca et al., 2020; Grabner, 2009; Lleras-Muney, 2005). The results from previous literature suggest that an increase in years of schooling is associated with a decrease in BMI and obesity levels (Brunello et al., 2013; Cutler and Lleras-Muney, 2010; Grabner, 2009).

However, most of the previous research has studied the impact of schooling on an individual's health later in life (Galama et al., 2017; Grossman, 2015). Additionally, the quality of schooling, such as time investment and development of skills, is not considered in these studies, which will impact the health of individuals (Cunha and Heckman, 2007; Cutler and Lleras-Muney, 2010; Galama et al., 2017; Grossman, 2015). Few literatures has addressed some of these concerns by considering school quality and its impact on health (Frisvold and Golberstein, 2011; Hao and Cowan, 2019).[1]

Recent literature suggests a causal relationship between education and health, as well as education and the labor market, when a change is observed in high school graduation course requirements in STEM subjects (Goodman, 2019; Hao and Cowan, 2019).[2] (Hao and Cowan, 2019) suggest that increasing high school students' STEM coursework is a factor through which education impacts health behavior indicators, such as a decrease in alcohol consumption. The exogenous change in high school graduation requirements is triggered by the report "A Nation at Risk," published in April 1983 by the National Commission on Excellence in Education. The report recommended increasing high school students' STEM coursework (Gardner, 1983). This report was published due to the lack of overall progress of the United States in the fields such as commerce industry, science, and technological innovation compared to other specific countries in Europe and Asia. Many states reacted to the report and made changes in the curriculum for high school students.

1. (Frisvold and Golberstein, 2011) use pupil-teacher ratio, average teachers' wage, and length of the school year as proxies to measure school quality. Their results suggest that school quality increases the effects of years of schooling on health outcomes later in life.
2. (Goodman, 2019) shows that state changes in minimum high school math requirements substantially increase black students' completed math coursework and their later earnings.

In this research, I study the impact of an exogenous change in high school graduation requirements for math on high school students' body weight. I focus on the high school graduation requirements for math due to its association with the future labor market and health outcomes, consistent with the previous literature (Goodman, 2019; Hao and Cowan, 2019). To evaluate this relationship, I use the state survey data from Youth Risk Behavioral Surveillance System (YRBSS) from 1999 to 2019. The difference in timing of each state's policy implementation allows me to employ the difference-in-difference method in this study. I analyze the results according to the sample of white and minorities race (black and Hispanic), as previous research suggests health factors such as obesity differ according to race (Kirby et al., 2012b; Nonnemaker and Farrelly, 2011; Zhang and Wang, 2004). The results from this study suggest that students in states with a higher requirement for math observe a decrease in BMI and obesity prevalence. The BMI decreases by 0.12 units at a 5% significance value, and the probability of being obese decreases by 1.3 percentage points at a 1% significance value. The results by race suggest that BMI and obesity level decreases for white students with a significant value, while no significant change was observed for minority students (black and Hispanic). The results are robust with additional controls. Event study analysis also suggests a decrease in BMI and obesity prevalence for high school students in the states with higher math requirements for graduation.

The report "A Nation at Risk" mentioned suggestions to improve American high school education. An increase in specific course requirements, rigorous coursework, and an increase in time investment for students studying are some of the few suggestions mentioned in the report (Gardner, 1983). (Hao and Cowan, 2019) study suggests that increasing high school graduation requirements in STEM courses might lead to changes in how much time high school students spend on schoolwork or their attitude toward positive future expectations, which could in turn

affect their health risk behavior. Similarly, in this study, I suggest an increase in time investment in school related work, higher expectations for the future, and skills developed in school are some channels through which high school students' body weight will be impacted.

First, an increase in the high school graduation requirement for math increased the number of math courses taken (Federman, 2007; Goodman, 2019; Schiller and Muller, 2003). This, in turn, suggests that students are investing more time in school work overall due to the increased graduation requirements. Additionally, the optimistic future value might affect current students' behavior by making them more likely to invest in their schooling (Cutler and Lleras-Muney, 2008). Thus an increase in schoolwork will impact high school students' time investment in leisure activities, eventually affecting their body weight. Besides the change in time investment, previous research suggests that skills acquired in school affect an individual's health (Cutler and Lleras-Muney, 2008; Galama et al., 2017). (Cutler and Lleras-Muney, 2008) study also suggests that the quality of schooling, such as school curriculum, should be considered to explain the impact of education on health outcomes. Previous research has indirectly suggested that individuals with higher math requirements for graduation are more likely to have higher skill levels (Federman, 2007; Goodman, 2019; Schiller and Muller, 2003). Hence, an increase in high school graduation requirements suggests an increase in skill level for high school students, which will positively impact their health indicators, such as obesity.

The findings of this study contribute to the existing body of research in the fields of education and health. First, as obesity becomes more prevalent, this research provides insight into how taking rigorous math courses in high school can decrease obesity levels among high school students. The positive outcome from the increase in high school graduation requirements can also reduce the future obesity prevalence among the adult population. Second, the results provide an

understanding of one channel through which education impacts individuals' body weight. Third, the results suggest that increasing the high school graduation requirement for math decreases the body weight of white students but has no impact on minority students. The disparity in the white and minority adult population in terms of obesity levels is reflected in the results of this study. Policymakers need to take this into account when formulating obesity prevention strategies. Overall, the increase in high school graduation requirements does have a positive benefit on the adolescent body weight and will help curb the future obesity prevalence.

In addition to my previous analysis, I also investigate the high school students' time investment in daily life activities, such as TV viewing, consumption of alcohol, and cigarette smoking. These factors will affect the body weight of high school students. The results suggest that white high school students are less likely to view TV in states with higher math requirements. Additionally, the number of days that white students smoked cigarettes decreased significantly. There is a significant increase in current drinking among white students, while there is no significant impact on the number of days of alcohol consumption. The results do not see any change in time investment for daily activities for the high school students in the minority group; hence, there is also no evidence for the change in their body weight. This study provides evidence that body weight is related to high school students' change in time investment due to the increase in high school graduation requirements for math.

The paper is structured as follows: The next section is a data description explaining about high school graduation requirements policy and data variables used in this study. Next is the empirical section used in this study and the robustness check. Results and the conclusion follow it.

Data:

In this research, I use multiple sources to collect the data, as no data identifies the high school graduation requirements of high school students with their health indicators. To collect the data on high school students' health behavior, I use the Youth Risk Behavior Surveillance System (YRBSS) state-based school survey for this research from the period 1999-2019 (CDC, 2022b). To collect the data on high school graduation requirements, I use the Digest of Education Statistics (DES) published by the National Center for Education Statistics (NCES) (NCES, 2022). Additionally, I contact each state's education department and collect data on high school graduation requirements.

A: High school graduation requirements:

High school students in the United States must complete the minimum number of courses in different subjects to earn a high school diploma. The graduation requirement for high school is set by each state, with some states leaving it to the local school district. I use the Digest of Education Statistics to collect data on graduation requirements for high school (NCES, 2022). The National Center for Education Statistics publishes the Digest of Education Statistics, which provides statistical information for American education from pre-kindergarten through graduate school. National Center for Education Statistics collects and analyzes education related data in the U.S.. The data regarding high school graduation requirements are reported in terms of the number of Carnegie units required for graduation in each state. One Carnegie unit is equivalent to a full course that is completed within the span of one year. The data reports the minimum number of Carnegie units required for graduation in math (NCES, 2022). The change in high school graduation requirements is imposed on the new incoming class during the Fall semester. I collect the data on each state's high school graduation requirements from 1999 to 2019. Data for all the

years is not available from the Digest of Education Statistics, so I contacted each state's education department to collect the missing data. I also referred to the data collected in the previous study (Hao and Cowan, 2019). I drop 8 states (MI, IA, NE, MA, CO, ND, PA, and MN) for which high school graduation requirements are unavailable or states that doesn't have a high school graduation requirement. Additionally, I drop the states (WA, IN, OH, and OR) for which data is unavailable in the YRBSS. The total state in the analysis is limited to 37 states in the United States.

A1: Reform to the High School Graduation Requirements:

The report "A Nation at Risk," published in 1983, initiated the states to change the minimum high school graduation requirement for high school students. The report is published by National Commission on Excellence in Education which was created by President Ronald Reagan's education secretary T.H. Bell. The report suggested that American high school education should be reformed to compete against the other growing nations in the fields of commerce, industry, science, and technological innovation. The report mentioned suggestions to improve high school education. One of the recommendations from the report was to increase the high school graduation requirement, this includes: "(a) 4 years of English; (b) 3 years of mathematics; (c) 3 years of science; (d) 3 years of social studies; and (e) one-half year of computer science" during the 4 years of high school education. Other recommendations include high school students should be exposed to rigorous coursework, increased time invested in studying, high standards for graduation, tests to measure achievement, and an improved teaching environment. Many states have increased the minimum high school graduation requirements in recent decades, as the report recommends. I use this exogenous change in high school graduation requirements in this study, and it has been explored in previous research studies (Goodman, 2019; Hao and Cowan, 2019).

Course requirements for math vary from 2 to 4 years for different states in the time period from 1999-2019, which can be observed in figure 1 and figure 2. In Figure 1, high school graduation requirements for math is represented for the class of 1999. The data shows that, for the most part, states require two years of math courses for graduation, with only a few states requiring three years. Figure 2 represents the high graduation requirements for math for the class of 2019. It can be inferred from Figures 1 and 2 that many states have increased their high school graduation requirement for math by one or two years during this time period (1999-2019). The "A Nation at Risk" report recommended that students complete three years of math during their four years of high school. Further, the report mentions that a high school is science-oriented if the high school focuses on four years of math and science. Previous research has suggested that states that increase high school graduation requirements are exposed to more math courses and rigorous coursework. (Federman, 2007; Goodman, 2019). Hence, I recognize three years of high school graduation requirements for math as the baseline in this study. I consider high school students in the states that require four years of math for graduation to be exposed to more rigorous coursework. Thus, I consider these states to be the treatment group (T=1). The control group, on the other hand, are those states that require three years or less of math for high school graduation. I consider these states to provide less rigorous coursework to high school students compared to the states in the treatment group. Figure 3 shows the states in the treatment and control groups. It shows the state changes in high school graduation requirement to four years in a particular time frame. There are seventeen states in the treatment group and twenty states in the control group.

Figure 1: High School Graduation Requirements for Math (Class of 1999)

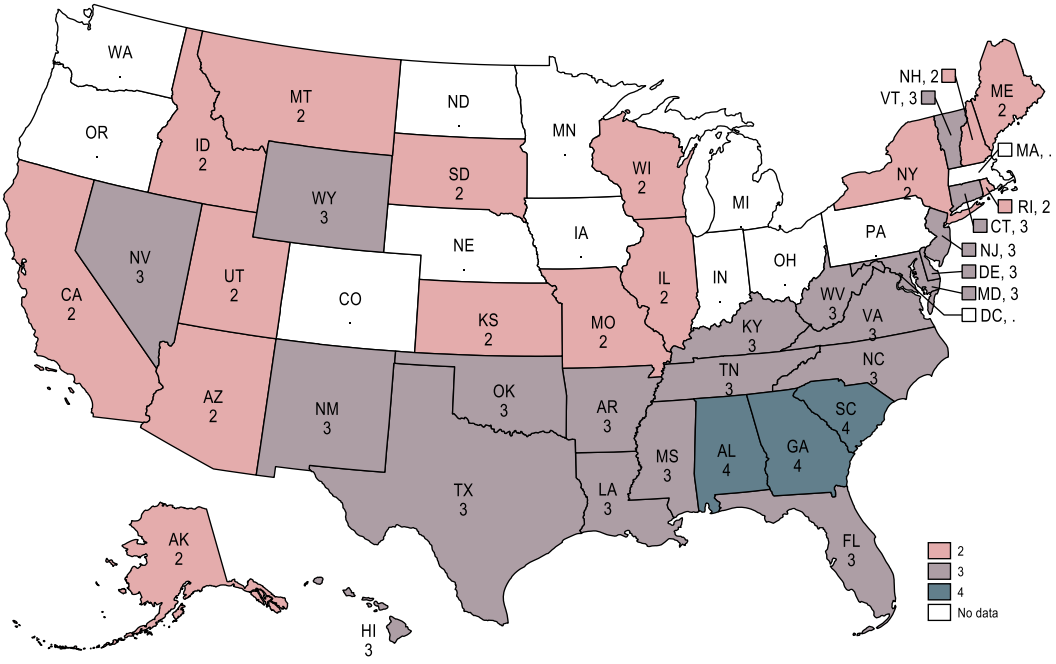
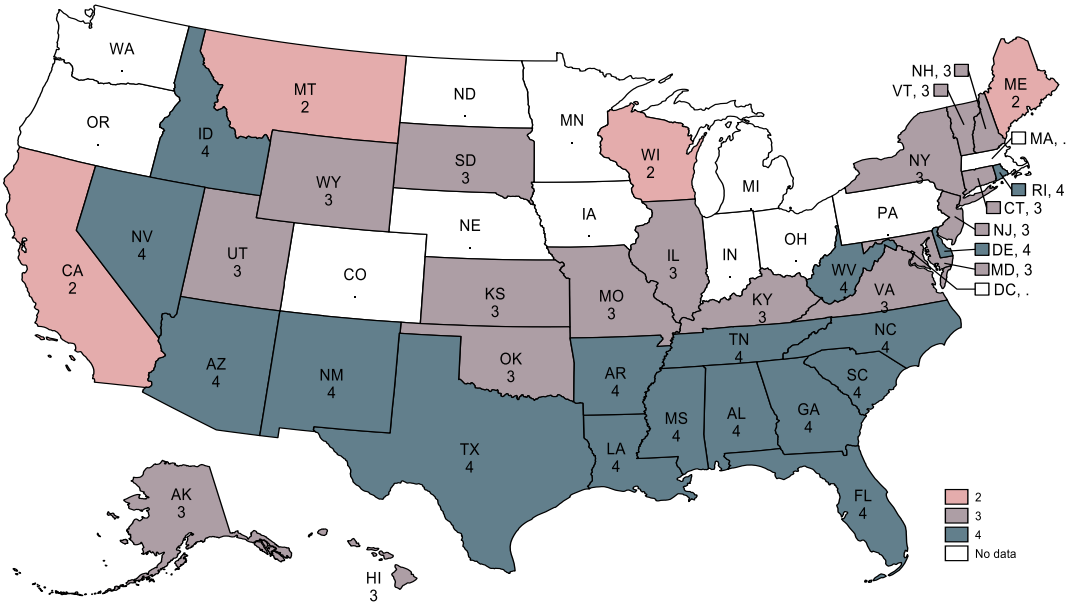
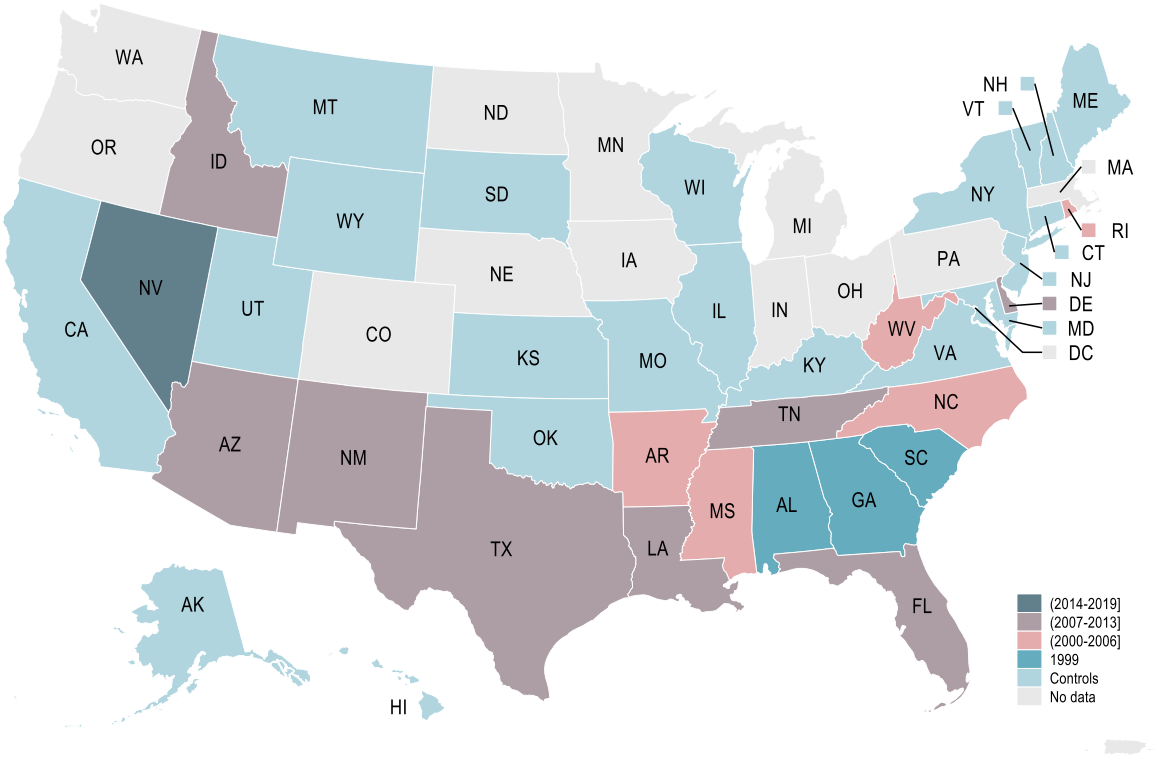


Figure 2: High School Graduation Requirements for Math (Class of 2019)



Notes: The figure above shows the minimum number of math courses required by each state to graduate from high school in the respective class years.

Figure 3: The adoption of math reforms by states



Notes: The figure above shows the time at which states changed the high school graduation requirements for math to four years.

B: YRBSS

The health data of high school students is collected from the Youth Risk Behavior Surveillance System (YRBSS), which is a state-level survey (CDC, 2022b). The YRBSS was established in 1991 by the Centers for Disease Control and Prevention (CDC). The YRBSS is a national public health surveillance system that collects data on health risk behaviors that can lead to death, disability, and social problems among youth and young adults in the United States. The survey is organized every two years and is usually conducted during the spring semester. It surveys public and private schools in the United States, with a sample of 9th to 12th grade students. For this study, I am assuming that each student enters high school during the fall semester and will graduate in

four years. With this assumption, I am matching each student's high school graduation requirements with the YRBSS data according to their graduation year. The new high school graduation requirement will first be implemented for 9th grade, while the other grades will still have the old requirement. I collapse the data at the grade-state level and assign the treatment at the grade level. The data has information on students' sex, age, grade, and race. I use this information to analyze the results according to the sub-sample of race.

C: State level controls

I use state-level controls in the analysis. In order to take into account the different school characteristics, I control for the pupil-teacher ratio and school spending, which are continuous variables. The data for the school characteristics are obtained from the NCES (NCES, 2022). High school students in some states are required to take a high school exit exam as a part of graduation. I collect the data on exit exams from the NCES and each state's education department (CDC, 2022b). I construct a variable equal to 1 if the state has any exit exam requirements for graduation and 0 if vice versa. The YRBSS does not have information related to parents' characteristics, so I collect data from the U.S. Bureau of Labor Statistics to control for economic characteristics (BLS, 2022). I use the state's median income and unemployment level, which are continuous variables.

D: Summary Statistics

Table 1 presents the descriptive statistics for states in the treated and control groups for the full sample and by race. The treatment group refers to high school students in states where the graduation requirements for math are equal to four years. The control group refers to high school students in states where the graduation requirements for math are equal to three years or less. The

means presented are weighted by sampling weights, so the sample is representative at the state level. The YRBSS asks high school students about their height and weight in the survey, which is used to calculate BMI and the obesity indicator. If an observation has missing a value for height or weight, or if there are outliers in the data, those observations are dropped from the analysis. The full sample includes all high school students in the data, while the white sample includes only high school students who identify as white. The minority sample includes high school students who identify as black or Hispanic. The number of observations in the treatment group is lower than the control group for all the samples as fewer states are in the treatment group.

BMI is a continuous variable and obese is an indicator variable equal to one if the BMI is greater than 30 units. According to the CDC, a BMI of over 30 is considered obese (CDC, 2022a). High school students in treated states are likely to have higher BMI and obesity rates compared to the control states for the full sample and sample by race. The body weight of high school students in the minority population is higher than that of the white population in both the treated and control groups. Previous studies have established a difference in body weight according to race, with minorities generally having a higher body weight than the white population (Ruth et al., 2019). Male is an indicator variable equal to one if the high school student is male and zero for female. Both genders are in equal proportion in all the samples. The race equals 1 for white high school students and 0 for minority students. On average, the high school students age is 16 years. This suggest that there are equal proportion of high school students from each grade. Treated states are likely to have lower state school spending and median income compared to the control group. Further, treated states are likely to have higher unemployment rates and pupil-teacher ratios. The exit exam requirement for graduation is higher in the treated states compared to the control states.

Table 1: Data Description

Variables	Full Sample		White		Minority	
	Treatment	Control	Treatment	Control	Treatment	Control
Obese	0.140	0.124	0.118	0.106	0.166	0.159
BMI	23.518	23.202	22.970	22.823	24.144	23.970
Male	0.507	0.507	0.511	0.508	0.503	0.504
Age	16.093	16.005	16.076	16.031	16.113	15.952
Race	0.532	0.670	1	1	0	0
Grade	10.391	10.442	10.393	10.44	10.389	10.433
Pupil-Teacher ratio	15.777	15.488	15.777	15.066	15.786	16.345
Spending	9584.835	14128.735	9551.802	13701.110	9622.433	14994.130
Income	47262.890	57423.020	46318.250	55494.020	48338.050	61331.560
Unemployment	6.030	5.613	6.063	5.594	5.993	5.644
Exit exam	0.740	0.376	0.720	0.340	0.759	0.448
N	319,119	598,027	416,904	172,581	146,538	181,123

Notes: Observations are weighted to be representative at the state level. Weights are used from the YRBSS. Sample size N represents total number of high school students in the sample. Missing values have been deleted from the observations.

Empirical Strategy

I examine how changes to high school graduation requirements for math at the state level impact high school students' health. Previous research has used this exogenous variation in their study (Goodman, 2019; Hao and Cowan, 2019). When a state enacts a new policy for high school graduation requirements, it is first applied to 9th graders, while the other grades are still subject to the old policy. However, I consider all grades to be treated when the state changes the policy. First of all, students in higher grades, such as 10th grade or higher, are more likely to have a higher BMI. Using state-grade level data to define treatment will produce biased results, as the

comparison group is expected to have a higher BMI than the treatment group at the start of the policy. Second, the same treatment timing will take into account the spillover among the different grades, as previous research suggests peer effects on adolescents' body weight and health risk behavior (Lundborg, 2006; Trogdon et al., 2008). I also present the results only for the 9th graders to validate the results of the treatment setup in this study. I use the two-way fixed effect model in this study to estimate the effect of higher high school graduation requirements for math on high school students health. This model relies on the exogenous variation in the timing of the change in high school graduation requirements of math across states.

$$Health_{igst} = \alpha MathRequirement_{igst} + X_{igst}\beta_1 + Z_{st}\beta_2 + \gamma_s + \delta_t + \gamma_s * t + \epsilon_{igst}$$

Here, $Health_{igst}$ represents individual i's BMI level or obese indicator in grade g in state s at year t. $MathRequirement_{igst}$ is a binary indicator variable, it is equal to 1 when individual i in grade g in state s at year t is exposed to the higher level of math requirements for high school graduation (treatment). X_{igst} represents individual level controls for individual i in grade g in state s at year t. These controls include, race indicator (white and minority (blacks and Hispanics)), sex indicator (male and female), and age. Z_{st} includes state level controls such as median income and unemployment as economic variables, public teacher ratio, and spending as school level characteristics. γ_s represents the state fixed effects to control for time invariant heterogeneity across the state. δ_t represents the time fixed effects to control for the nationwide trend that may affect the health indicators. Further, $\gamma_s * t$ represents state specific linear time trends that control for unobserved factors varying within each state over time. With the given controls, α represents the causal impact of the policy change. The standard error are clustered at the state level (Bertrand et al., 2004).

For the robustness check, I present the results only for the high school students in the 9th grade that are less than 16 years old. This analysis will identify the policy's impact on high school students in the short term and validate the treatment adopted in this study. Another issue that can arise from using the full sample is that sample selection bias may be present in the results. This can happen when the dropout rate increases because of increased high school graduation requirements. If the sample is limited to 16 years old or younger, this will take into account the minimum age for schooling in the U.S. and resolve the issue of sample selection bias. The concern that high school students will drop out because of increased high school graduation requirements for STEM courses has been studied in previous research. This research found that increasing high school graduation requirements for STEM courses is not related to high school students' dropout rate (Hao and Cowan, 2019). I also present the results for the 9th and 10th grade students combined as they are likely to be younger than 16 years old.

Moreover, I use exit exam requirements for high school graduation as a robustness check. Further, the robustness check includes adding a binary indicator for changes in the high school graduation requirements for other courses during the math reform. This indicator takes the value of 1 when the state has a change in high school graduation requirements in other courses. I also present the event study analysis for robustness check.

Results:

A) BMI

Table 2 presents the difference-in-differences estimate for the impact of high school graduation requirements for math on high school students' BMI and obesity. The results are presented for the overall sample and sample by race. The result from table 2 suggests a decrease

in high school students' BMI and obesity levels in the treated states compared to the control states. BMI decreases on average by 0.12 units with a 5% significant value. The prevalence of obesity decreases by 1.3 percentage points with a 1% significant value. The findings are consistent with prior research in the fields of education and health, which utilize compulsory schooling laws as an instrumental variable. The finding from the previous research suggests that an increase in years of schooling reduces obesity or BMI in the United States and other countries (Brunello et al., 2013; Fletcher, 2015; Grabner, 2009; Kim, 2016). However, the estimate from the previous research is higher in magnitude than the results presented in this study (Brunello et al., 2013; Grabner, 2009). The results from this study add to the literature on education and health, suggesting a decrease in adolescent body weight when high school students are exposed to higher graduation requirements for math.

Table 2 presents results by race. The results for white high school students suggest a decrease in BMI of 0.17 units with a 5% significant value. Additionally, the prevalence of obesity decreases by 1.5 percentage points with a 1% significant value. The results suggest that white high school students are likely to have lower body weight in the states with higher math requirements for high school graduation. However, there is no significant change in BMI and obesity prevalence for high school students in the minority group. According to previous research, BMI or obesity prevalence varies by race. The white population is less likely to be obese, while the minority population is more likely to be obese (Anderson et al., 2019; Kirby et al., 2012a; Kirby et al., 2012b; Oddo et al., 2016). Past research on the impact of schooling on BMI and obesity also suggests a positive health benefit for white adults compared to black adults (Grabner, 2009). The results from this study also suggest that there are disparities in how education affects health,

depending on race. Policymakers can use this information to develop policies addressing each racial group's unique needs.

Table 2: The effect of high school graduation requirements on high school students' BMI and obesity prevalence.

	Sample for all age
A: BMI	
Total Sample	-0.120**
	(0.057)
Sample by race	
White only	-0.174**
	(0.080)
Minority only	-0.063
	(0.113)
B: Obese	
Total Sample	-0.013***
	(0.003)
Sample by race	
White only	-0.015***
	(0.005)
Minority only	-0.010
	(0.006)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.

Table 3 presents results for robustness check using an alternative specification. In this table, I control for the exit exam requirements and provide results for the younger subsample. Column 1 shows the results for high school students of all ages and grades. Column 1 suggests that results are similar to the baseline specification with similar estimates, suggesting the results to be robust.

The results indicate that the change in high school graduation requirements for math has a negative impact on their body weight, except for minority students. The results from column 2 presents

Table 3: The effect of high school graduation requirements on high school students' BMI and obesity prevalence.

	Sample for all age	9th Grade only	Sample for less then 16 years old
A: BMI			
Total Sample	-0.120**	-0.083	-0.055
	(0.057)	(0.071)	(0.060)
Sample by race			
White	-0.177**	-0.095	-0.126
	(0.072)	(0.107)	(0.092)
Minority	-0.063	-0.031	-0.008
	(0.113)	(0.108)	(0.140)
B: Obese			
Total Sample	-0.013***	-0.010**	-0.010**
	(0.003)	(0.004)	(0.004)
Sample by race			
White	-0.015***	-0.013*	-0.016**
	(0.005)	(0.008)	(0.007)
Minority	-0.010	-0.008	-0.005
	(0.006)	(0.008)	(0.010)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio, exit exam.

who are younger than 16. This study's results will consider the sample selection issue and validate the treatment setup. The results suggest that the probability of being obese decreases for high school students and for white students, while there is no impact on the BMI of high school students. Column 3 presents the results for the sample of high school students less than 16 years old and in 9th and 10th grade. The results also suggest a significant impact on obesity prevalence. The results

from columns 2 and 3 suggest that sample selection is not an issue in this study. There is a decrease in obesity levels for high school students after the implementation of the policy. However, there is no significant change in BMI level for the younger subsample, but the direction of the estimate is still negative. The findings suggest that the high school graduation requirements for math have a greater impact on early graders who are in the higher weight group.

In table 4, I control for the change in high school graduation requirements for other courses (English, science, social science, other) during the same time period as the change in high school graduation requirements for math. This analysis will verify that the change in high school students' body weight is attributable to an increase in math or other coursework graduation rates. The result is similar to the baseline specification, suggesting that the change in high school graduation requirement for math has a causal impact on their body weight.

Table 4: The effect of high school graduation requirements on high school students' BMI and obesity prevalence.

	Sample for all age
A: BMI	
Total Sample	-0.129** (0.058)
Sample by race	
White	-0.172**

	(0.079)
Minority	-0.080 (0.077)
B: Obese	
Total Sample	-0.013*** (0.003)
Sample by race	
White	-0.014*** (0.005)
Minority	-0.008 (0.008)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. Additional control includes exit-exam dummies and change in other graduation course requirements. State-level controls include median income, unemployment rate, education spending, pupil-teacher ratio.

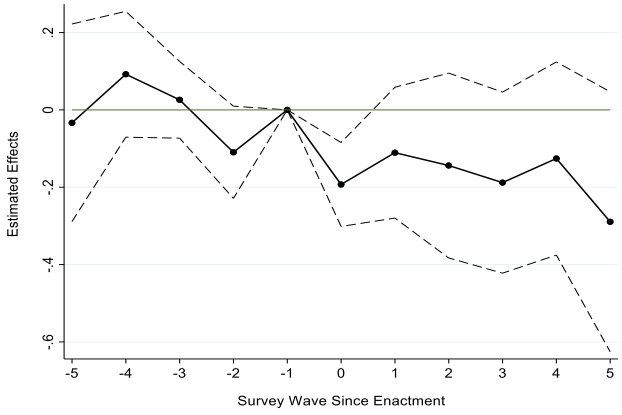
Figure 2 presents the results of the event study analysis. The event-study analysis evaluates if the impact of the change in high school graduation requirements for math on high school students' BMI and obesity prevalence is persistent over the years of implementation. The YRBSS is conducted every two years, and the high school students are interviewed during the spring semester. However, the policy change is implemented for the class of high school students starting in the fall semester. Hence high school students in the dataset are observed a year, or more years after the policy was implemented. In this case, creating one-year lead and lags of treatment is complex. I use equation 1 and replace the policy indicator for change in high school graduation requirements for math with a series of event time indicators representing time relative to the survey data observed in the study. In the event study figures, the survey wave since enactment represents the YRBSS surveys before/after implementation of the new high school graduation requirements for

math. Reference period -1 consists of respondents who are interviewed one or more years before the time of implementation of the new high school graduation requirement policy.

Part A presents the event study analysis for BMI among high school students. The event study analysis in part A found no evidence of a differential trend in BMI level before the policy implementation, which supports the parallel trend assumption. Figures A1 and A2 clearly suggest a decrease in BMI for high school students after the change in their graduation requirements for math. Additionally, the impact of the high school student's graduation requirements for math on their BMI in persistent over the years, especially for white students. Figure A3 suggests no change in BMI for minority high school students, similar to the previous results. Part B presents the event study analysis for obesity prevalence among high school students. Figures B1 and B2 clearly indicate a decrease in obesity levels for high school students after the change in graduation requirements for math. The impact was prevalent over the years after the change in high school graduation requirements for math. Figure B3 suggests no change in the obesity rate for black and Hispanic minority students. The event study results suggest that change in high school students graduation requirements for math has a causal impact on their body weight.

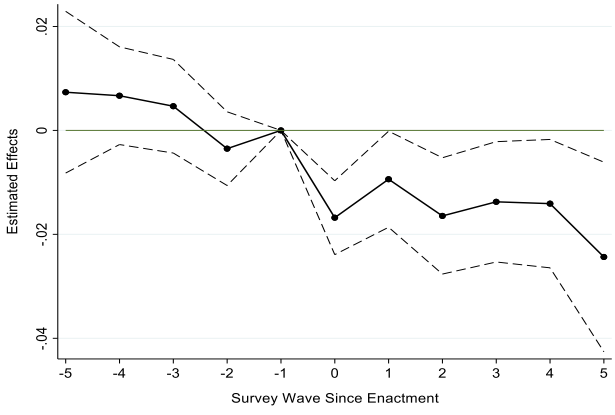
A) BMI

A1) Full Sample



B) Obese

B1) Full Sample



A2) White only

B2) White only

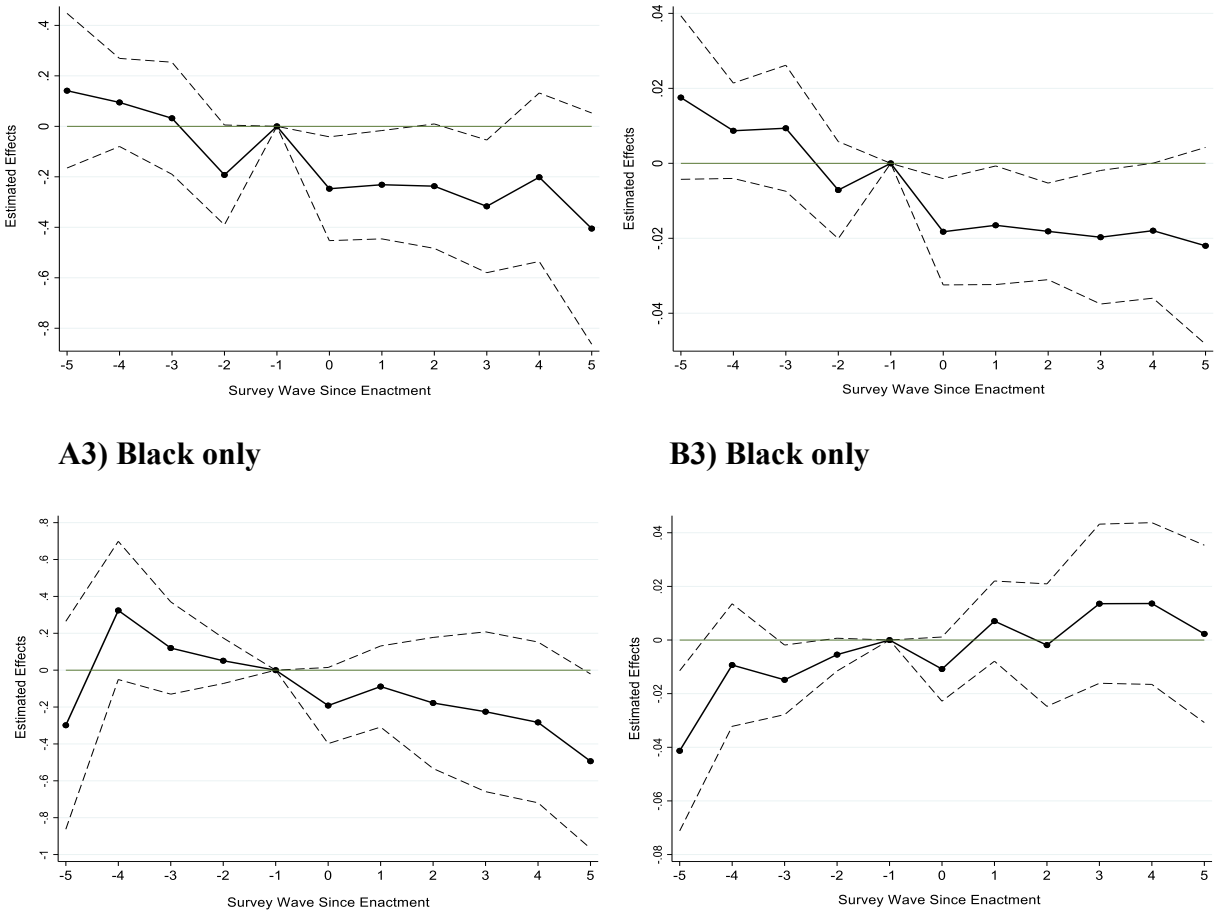


Figure: Event study analysis of High school graduation requirement for math on high school students' BMI and obesity. The figure depicts the estimated effects of GDL on teenage body weight using an event study design described in equation (2). The dashed lines represent the 95% confidence interval of these estimated effects.

B) Impact of high school graduation requirements on other outcomes

I extend the analysis for the high school students' time investment in watching TV and risky health behavior. The change in these activities will impact the body weight of high school students. Studies have found that increased TV viewing leads to higher BMI in children and adolescents (Danner, 2008; Nieto and Suhrcke, 2021; Tahir et al., 2019). The results from table 4 suggest that the increase in high school graduation requirements for math decreases TV viewing for white high school students. On an average school day, watching TV decreases by 0.037 hours,

with a significant value for white high school students. There is no significant change in TV viewing for high school students belonging to minority races. The results suggest that a decrease in leisure time, such as viewing TV, might have contributed to the decrease in BMI and obesity among high school students after the change in high school graduation requirements.

Next, I estimate the impact of high school graduation requirements for math on high school students' cigarette smoking and alcohol consumption. The study's results showed a significant increase in the number of high school students who reported drinking alcohol in the past 30 days by 1.4 percentage points. Results by race suggest that current drinking behavior for white high school students increases by 1.5 percentage points. Additionally, white high school students were less likely to smoke cigarettes, with a significant decrease of 0.23 days in the number of days smoked in the past 30 days. The results suggest no significant impact on minority students' risky health behavior. The previous study suggests that heavy drinking is associated with a positive increase in body weight, while a moderate amount of drinking does not have such an impact (Sayon-Orea et al., 2011; Wang, 2010). The results of this study suggest that while there has been an increase in current drinking behavior, there has not been an increase in the number of drinking days in the past 30 days. Therefore, it is unlikely that the increase in current drinking behavior has positively impacted high school students' body weight. For smoking, the previous study suggests a mixed response to the reduction of smoking and its relation to obesity (Courtemanche et al., 2018; Gruber and Frakes, 2006).

Table 4: The effect of high school graduation requirements on high school students' risky health behaviors

	(1)	(2)	(3)
	All Sample	White	Black
Current smoker	0.003	-0.007	0.012
	(0.005)	(0.006)	(0.008)
	(N=948,487)	(N=604,559)	(N=343,928)

Current drinker	0.014**	0.015**	-0.001
	(0.006)	(0.007)	(0.010)
	(N=911,972)	(N=588,063)	(N=323,909)
Number of cigarettes smoked in the past 30 days	-0.059	-0.151	0.017
	(0.043)	(0.062)	(0.078)
	(N=738,439)	(N=483,668)	(N=254,771)
Number of days cigarette smoked in the past 30 days	-0.058	-0.230*	0.164
	(0.084)	(0.126)	(0.177)
	(N=948,487)	(N=604,559)	(N=343,928)
Number of days alcohol consumed in the past 30 days	0.020	-0.010	-0.052
	(0.076)	(0.134)	(0.123)
	(N=911,972)	(N=588,063)	(N=323,909)
TV	0.005	-0.037**	0.010
	(0.024)	(0.018)	(0.039)
	(N=842,566)	(N=517,484)	(N=325,080)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. Further, individual controls includes cigarette and alcohol consumption. Additional control includes exit-exam dummies and change in other graduation course requirements dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.

Conclusion:

I study the impact of high school graduation requirements for math on high school students' BMI and obesity prevalence. I use the YRBSS survey to collect data on high school students health indicators and match them with their high school graduation requirements. The research suggests that states with a higher high school graduation requirement for math observe a decrease in BMI and obesity prevalence. In addition, the results by race indicate that states with a higher high school graduation requirements for math decrease white students' body weight. However, the estimated effect was not significant for minority high school students. An additional robustness check indicates that BMI and obesity prevalence decreases for high school students as the graduation requirements for math increase. The results for the younger subsample suggest that sample selection is not a problem in this study and that the estimated effect is more prevalent among high

school students in higher weight groups. The event study analysis provides evidence that the change in high school graduation requirements for math decreases BMI and obesity prevalence. This decrease is persistent over the years, suggesting that the change in requirements is positively affecting the health of high school students. Additionally, the study estimates the impact of high school graduation requirements for math on high school students' TV viewing and risky health behavior. The change in behavior in these factors for high school students is one channel through which change in their body weight can be observed. The results suggest that white high school students who have to take more math classes watch less TV and smoke fewer cigarettes. It also made them more likely to drink alcohol but didn't make them drink more often. There was no significant change in TV viewing or health risk behavior for minority students.

There are some limitations to this study. First, the YRBSS survey data used in this study is based on self-reported height and weight, which may be subject to measurement error and lead to biased results. However, previous studies have used this YRBSS data for their research (Qiu and Sung, 2021; Sabia et al., 2017). Second, the YRBSS does not track high school students after graduation, so its hard to analyze whether the math requirements had any long-term benefits. This is something that should be looked into further, as there is evidence to suggest that schooling has long-term benefits. (Brunello et al., 2013; Grabner, 2009; Kemptner et al., 2011). Third, the YRBSS data does not include families' socio-economic characteristics, such as education and income. These characteristics impact the high school student's body weight, which can lead to biased results in the analysis, even after controlling for state-level school and economic aspects. However, previous research has used this data in the analysis using similar controls (Hao and Cowan, 2019).

This research contributes to the literature on education and health, precisely chronic conditions such as obesity. The increase in high school graduation requirements impact the students lifestyle and also their skill which in turn impact their body weight. In this research, I show that the decrease in smoking days and TV viewing are some of the time investment factors that are associated with lower body weight of the white high school students. Further, increase in high school students might have reduced the high school student's participation in physical activities. There was not enough information in the data to conduct this research on physical activities in their daily life except for the physical activity in the school. Previous research has suggested that high school students increase in physical activity in school does not have an impact on the high school students BMI (Sabia et al., 2017). Introducing policy which increases the high school graduation requirements for the high school students is effective in reducing the high school students body weight, however the minority population has no impact on such policy. Previous research suggest decrease in alcohol consumption for the minority population and no impact on the white high school students. This can be due to extended data in this study and also the definition of the treatment. A higher high school graduation for math for the high school students might not be effective This research uses the inc Additionally, individual response to stress can be associated with smoking in smoking days for white students suggesting that high school students are not I was not able to However, the increase in high school graduation increase the Previous studies use compulsory schooling law to establish a causal relationship between education and health. However, previous research does not explain what educational factors can impact an individual's health. Additionally, previous studies tend to focus on education and its impact on an individual in adulthood. In this study, l explore the exogenous variation in high school graduation requirements specifically for math and its impact on high school student's body weight. The results

provide causal evidence of increased high school students' math graduation requirements on decreasing body weight. Thus, the results provide a channel through which schooling impacts the body weight of high school students. The results from this study further provide evidence of change in leisure timing of viewing TV and health risk behavior of the high school students.

Finally, the change in the high school graduation requirement was motivated by a desire to improve the quality of American high school education in order to increase the country's competitiveness in the global economy. The change in high school graduation requirement does has benefit on the future college enrollment in the field of STEM as well as increasing in earning (Goodman, 2019). Apart from the economic improvement the change has a positive benefit on health.

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Robustness Check:

Table A3: The effect of high school graduation requirements on high school students' BMI and obesity prevalence.

	Sample for all age	Sample for less than 16 years old	9th Grade
A: BMI			
Total Sample	-0.130**	-0.055	-0.082
	(0.063)	(0.061)	(0.077)
Sample by race			
White	-0.138**	-0.121	-0.081
	(0.074)	(0.108)	(0.127)
Minority	-0.020	-0.011	-0.027
	(0.139)	(0.141)	(0.109)
B: Obese			
Total Sample	-0.013***	-0.010**	-0.010**
	(0.003)	(0.004)	(0.004)
Sample by race			
White	-0.013**	-0.016*	-0.012
	(0.006)	(0.008)	(0.009)
Minority	-0.008	-0.004	-0.008
	(0.008)	(0.010)	(0.008)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. Further, individual controls includes cigarette and alcohol consumption. Additional control includes exit-exam dummies and change in other graduation course requirements dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.

Regression results

Table 4: The effect of high school graduation requirements on high school students' risky health behaviors

	(1) All Sample	(2) White	(3) Black
Current smoker	0.012*	0.007	0.016*
	(0.006)	(0.008)	(0.009)
Current drinker	0.016***	0.020***	0.007
	(0.005)	(0.007)	(0.010)

Number of cigarettes smoked in the past 30 days	0.015 (0.044)	-0.009 (0.055)	0.046 (0.050)
Number of days cigarette smoked in the past 30 days	0.098 (0.116)	0.055 (0.176)	0.203 (0.133)
Number of days alcohol consumed in the past 30 days	-0.002 (0.059)	-0.025 (0.097)	-0.005 (0.106)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. Further, individual controls includes cigarette and alcohol consumption. Additional control includes exit-exam dummies and change in other graduation course requirements dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.

Robustness Check:

Table 4A: The effect of high school graduation requirements on high school students' risky health behaviors

	(1) All Sample	(2) White	Black
Current smoker	0.010* (0.006)	0.006 (0.008)	0.015 (0.009)
Current drinker	0.015*** (0.005)	0.018*** (0.007)	0.010 (0.005)
Number of cigarettes smoked in the past 30 days	0.009 (0.044)	-0.019 (0.071)	0.056 (0.047)
Number of days cigarette smoked in the past 30 days	0.088 (0.111)	0.030 (0.172)	0.222* (0.126)
Number of days alcohol consumed in the past 30 days	-0.003 (0.061)	-0.034 (0.106)	0.022 (0.092)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. Additional control includes exit-exam dummies and change in other graduation course requirements dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.

Table 4B: The effect of high school graduation requirements on high school students' risky health behaviors. Analysis is based on sample for students less than 16 years old and in grade 9th and 10th.

	(1) Total sample	(2) White	(3) Black
Current smoker	0.014***	0.010	0.017*
	(0.005)	(0.008)	(0.009)
Current drinker	0.027***	0.038***	0.008
	(0.006)	(0.010)	(0.014)
Number of cigarettes smoked in the past 30 days	0.011	-0.020	0.061
	(0.037)	(0.053)	(0.051)
Number of days cigarette smoked in the past 30 days	0.057	-0.026	0.229
	(0.106)	(0.154)	(0.149)
Number of days alcohol consumed in the past 30 days	0.060	0.042	0.052
	(0.057)	(0.080)	(0.138)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include age, gender, and race dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.

Table 4C: The effect of high school graduation requirements on high school students' risky health behaviors. Analysis is based on sample for students less than 16 years old and in grade 9th.

9th Grade	(1) Total sample	(1) White	(2) Black
Current smoker	0.019**	0.016	0.028**
	(0.009)	(0.013)	(0.012)
Current drinker	0.016*	0.032*	0.001
	(0.009)	(0.017)	(0.015)
Number of cigarette smoked in the past 30 days	0.051	0.040	0.085
	(0.039)	(0.056)	(0.053)
Number of days cigarette smoked in the past 30 days	0.066	-0.047	0.293
	(0.169)	(0.227)	(0.190)
Number of days alcohol consumed in the past 30 days	-0.084**	-0.092	-0.054
	(0.034)	(0.104)	(0.139)

Notes: Estimates are obtained using weighted regression, using individual and state level controls, state and year fixed effects, and state specific linear time trend with standard errors are clustered by state and in parentheses (* p<.10 ** p<.05 *** p<.01). Weights are obtained from the YRBSS. Individual controls include

age, gender, and race dummies. State-level controls include median income, unemployment rate, per pupil education spending, pupil-teacher ratio.