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BROADBAND INTERNET ACCESS AND ADOLESCENT MENTAL HEALTH IN THE U.S.

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ABSTRACT

Broadband internet has become a critical component of U.S. infrastructure, but policymakers are increasingly concerned that the widespread adoption of this technology has adversely affected adolescent mental health. To test this hypothesis, we use 2009–2019 National and State Youth Risk Behavior Survey data and leverage the nationwide rollout of broadband internet. First, we show that adolescents in states with greater broadband internet access reported spending more time online. Next, we find that a one-standard-deviation increase in broadband internet access was associated with a 9.3–16.5-percent increase in adolescent suicide ideation. While we document increases in suicide ideation for both girls and boys, the results are most pronounced for adolescent girls. Exploring potential mechanisms, we show that greater broadband internet access was associated with increases in cyberbullying and body dissatisfaction among adolescent girls and a reduction in the likelihood that adolescent boys reported getting an adequate amount of sleep.

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1. Introduction

There has been a dramatic deterioration of adolescent mental health over the last two decades. Over one third of young adults are living with mental illness, and the share of adolescents and young adults suffering from anxiety or experiencing major depressive episodes has doubled (Goodwin et al. 2020; Daly 2022). These mental health struggles place adolescents at elevated risk for suicide (Hasin et al. 2005; Chang et al. 2013). While the determinants of mental health are multifaceted, clinicians, advocacy groups, and policymakers have noted that the adolescent mental health crisis has occurred alongside a dramatic increase in the amount of time that adolescents spend online (American Academy of Pediatrics 2016; Marchant et al. 2017; Twenge et al. 2017; White House 2022). Indeed, adolescents who reported spending more time online also reported higher levels of suicide ideation (see Figure 1). This association, in part, has led a bipartisan group of senators to propose legislation to induce online platforms to take efforts to reduce adolescent suicidal behaviors, online bullying, and disordered eating behaviors (119th U.S. Congress 2025). Despite the descriptive evidence strongly suggesting a relationship between internet use and adolescent mental health, self-selection on the part of internet users and the targeted nature of social media algorithms has made it difficult to draw a strong causal link. As a result, the U.S. Surgeon General has called for "more research…on the relationship between technology and mental health" (U.S. Surgeon General 2021).

There are several pathways through which internet use might influence adolescent mental health. For one, a growing literature links internet access to improvements in economic growth and local labor market conditions (Kolko 2012; Atasoy 2013; Kuhn and Mansour 2014; Bhuller et al. 2023). Although most adolescents are not working, they may indirectly benefit through the improved economic position of their parents and other household members. Indeed,

researchers have connected internet-induced labor market improvements to improvements in adult mental health (Gawai 2023; Johnson and Persico 2024), and parental mental health is a strong predictor of adolescent mental health (Mühlenweg et al. 2016; Blanchflower et al. 2024).

Internet use may also influence adolescent mental health by changing the frequency and manner of peer interactions, though the direction of this relationship is theoretically unclear. If internet use results in more frequent positive interactions, it may improve mental health. For example, Bauernschuster et al. (2014) found that households in areas whose pre-existing telecommunication technology was more conducive to the rollout of high-speed broadband internet experienced increases in social capital. However, this benefit may be offset by online interactions crowding out positive in-person interactions (Golin et al. 2022; Pugno 2024). For example, Fumarco and Baert (2019) found that students who were more likely to digitally communicate with their peers reported having fewer friends and fewer face-to-face interactions. Additionally, internet use may also facilitate cyberbullying which has been shown to harm mental health (Nikolaou 2017; Bacher-Hicks et al. 2022; Blanchflower and Bryson 2025), though prior quasi-experimental evidence from Spain did not detect a relationship between high-speed internet access and cyberbullying (Arenas-Arroyo et al. 2025).

Is it also possible that internet use may expose adolescents to idealized lifestyles and imagery that foster unfavorable social comparisons (U.S. Surgeon General 2021; Colombo et al. 2025).[1] Comparing changes in outcomes around the

[1] There are large literatures in public health, psychology, and sociology documenting relationships between beauty standards and mental distress, particularly for adolescent girls and young women (for reviews, see Ryding and Kuss 2020; Merino et al. 2024). While this topic has received relatively less focus from economists, researchers have found that women with thinner peers are more likely to engage in disordered eating behaviors (Costa-Font and Jofre-Benet 2013; Adruini et al. 2019), relatively heavier children experience elevated rates of behavioral problems (Huang et al. 2022), and thin-ideal media exposure increases body dissatisfaction and risky weight-loss behaviors (Carpenter and Churchill 2026).

time that campuses gained access to the social media site Facebook, Braghieri et al. (2022) showed that students were subsequently more likely to overestimate their peers' social lives and reported worse mental health.[2] Leveraging variation in internet speed over time, McDool et al. (2020) found that adolescents – particularly adolescent girls – who gained access to faster broadband reported feeling less comfortable with their appearance.

Finally, it is possible that internet access may affect adolescents' mental health by changing their underlying physical health. Internet access may disrupt regular sleep schedules (Billari et al. 2018; Lindquist and Sadoff 2023), which has been linked to reductions in physical (Jin and Ziebarth 2020) and mental health (Giuntella et al. 2024; Argys et al. forthcoming). Additionally, there is evidence linking increased internet access to excess body weight in adults (DiNardi et al. 2019; Lin et al. 2024; Ma and Sheng 2024; Cheng and Xu 2025), and excess body weight is associated with poorer mental health (Sabia and Rees 2015; Willage 2018; Iwatate et al. 2023).[3]

In this paper, we use 2009–2019 National and Youth Risk Behavior Survey data to examine the relationship between internet access and adolescent mental health. By leveraging the rollout of broadband internet using data from the Federal Communications Commission, we show that a one-standard-deviation increase in the share of the state with broadband internet access was associated with a 4.1-percentage-point (11.6-percent) increase in the likelihood that adolescents reported spending at least three hours online per day. Having established a relationship between internet access and internet use, we then show that a one-standard-

[2] There is also experimental evidence (Allcott et al. 2020; Mosquera et al. 2020) that deactivating Facebook improves mental health. However, the rollout of Facebook was also associated with improvements in labor market outcomes (Armona 2025).

[3] In related work, Nieto and Suhrcke (2021) found that the transition to digital television in the United Kingdom was associated with an increase in adolescents' BMI and a reduction in their mental health.

deviation increase in broadband internet access was associated with a 1.2–1.9-percentage-point (9.3–16.5-percent) increase in the likelihood that adolescents reported considering, planning, and attempting suicide.[4] While these increases are sizable relative to the baseline means, they are in line with prior estimates on the effects of school bullying (Rees et al. 2022; Hansen et al. 2024), poor performance on high-stakes testing (Wang 2016), and economic downturns (Gassman-Pines et al. 2014) on adolescent suicide ideation. In contrast to prior work which has focused predominantly on how internet access affects adolescent girls' mental health, we show statistically significant increases in suicide ideation for both adolescent girls and adolescent boys.

Next, we explore the potential channels through which internet access may harm adolescent mental health. In contrast to prior work that failed to document a relationship between broadband internet access and cyberbullying (Arenas-Arroyo et al. 2025), we find that a one-standard-deviation increase in broadband internet access was associated with a 1.8-percentage-point (9.0-percent) increase in the likelihood that adolescent girls reported being cyberbullied. We also find that adolescent girls were 2.7 percentage points (8.0 percent) more likely to describe themselves as being "overweight." However, we do not detect any evidence that broadband internet access was related to actual changes in adolescent BMI, regardless of sex. Finally, we show that although broadband internet access was not associated with changes in cyberbullying or body image among adolescent boys, that they were 2.8 percentage points (9.9 percent) less likely to report getting an adequate amount of sleep each night. Overall, these patterns suggest that broadband internet access may adversely affect adolescent mental health through a variety of pathways that depend, at least in part, on sex.

[4] We focus on the reduced-form relationship, rather than attempting to use internet access as an instrument for internet use, because of the coarse level with which the internet use variable is measured.

Our results add to an emerging economics literature studying the relationship between internet access, social media, and adolescent mental health. Using data on mental disorders diagnosed in Italian hospitals from 2001–2013, Donati et al. (2025) found that broadband availability was associated with increases in self-harm and compulsory hospitalizations, particularly for younger cohorts. In contrast, Colombo et al. (2025) found that internet access in Uruguay was associated with both a reduction in the likelihood that adolescents reported feeling lonely and an increase in the likelihood that they reported feeling worried. Additionally, in a working paper, Guo (2023) compared changes in mental health outcomes for adolescents in Canadian neighborhoods that had no internet, low-speed internet, and high-speed internet around the introduction of the visual social media platform Instagram in October 2010. Following the introduction of visual social media, she found an increase in the likelihood that schools designated adolescent girls as having severe mental health special needs. Most recently, Arenas-Arroyo et al. (2025) showed that high-speed internet access in Spain increased (i) adolescents' internet use and (ii) mental distress among adolescent girls.

We make several key contributions. First, we provide the first evidence that increases in broadband internet access led to meaningful changes in internet utilization in the United States, validating a critical, but previously untested, assumption of prior work (Guldi and Herbst 2017; DiNardi et al. 2019; Gawai 2023; Johnson and Persico 2024). Second, in contrast to prior research that primarily focused on adolescent girls, we provide important evidence that greater broadband access increased suicide ideation among both adolescent girls and adolescent boys. These results add to a growing awareness that adolescent boys are also experiencing a mental health crisis (Blanchflower et al. 2024). Third, our data allow us to comprehensively explore the pathways through which internet access may affect adolescent mental health (e.g., bullying, social comparisons, sleep deprivation,

etc.). Given the large share of adolescents that regularly use the internet, and the perceived difficulty of reducing this figure, identifying the specific channels through which internet access harms adolescent mental health is important for policymakers interested in developing targeted interventions to mitigate these psychological harms.

The rest of the paper proceeds as follows: Section 2 discusses the State and National Youth Risk Behavior Surveys that we use to study changes in adolescent mental health and our identification strategy leveraging location-specific changes in internet access over time. Section 3 presents our results examining changes in internet use, suicide ideation, bullying victimization, body image, body mass index, and sleep, overall and for specific subgroups. Finally, Section 4 discusses the policy implications and limitations of our results.

2. Data and Methods

2.1 Data: Youth Risk Behavior Surveys

The Youth Risk Behavioral Surveillance System (YRBSS) is administered by the Centers for Disease Control and Prevention to monitor the prevalence of risky behaviors among U.S. adolescents. The YRBSS is a collection of school-based surveys that are usually administered in the spring of odd-numbered years. We use both the National Youth Risk Behavior Surveys (NYRBS) and the State Youth Risk Behavior Surveys (SYRBS). The NYRBS data are collected by the CDC and contain information on approximately 14,000 students each year. While they are designed to be nationally representative, they are commonly used to evaluate state-level policies (see, for example, Tauras et al. 2007; Carpenter and Cook 2008; Anderson et al. 2013; Coleman et al. 2013; Atkins and Bradford 2015). In contrast, the SYRBS are designed to be representative of high school students within each state. These surveys are owned and controlled by state health and education

agencies, and the questions included in the surveys vary across states. However, nearly every state has granted the CDC permission to harmonize their surveys into the combined SYRBS. Following prior work (e.g., Anderson and Elsea 2015; Sabia and Anderson 2016; Sabia et al. 2019; Abouk et al. 2023; Cotti et al. 2024), we combine these two datasets to maximize the number of state-year observations within our 2009–2019 sample and weight observations to be representative at the state level (i.e., we weight observations by the number of adolescents of the same age, sex, and race/ethnicity in the state during the survey year).[5]

During our sample period, adolescents were asked the number of hours that they used a computer for something that was not school related. They were told to count the time they spent playing video games, watching videos, texting, or using social media on their smartphones, computers, game consoles, and tablets. Their options included zero hours, less than one hour, one hour, two hours, three hours, four hours, and five or more hours. Based on the CDC recommendation from the YRBS codebooks, we create an indicator variable for whether the adolescent reported spending more than three hours online, though we also examine changes in the amount of time that they reported spending online.[6]

Our primary mental health outcomes of interest are three indicators denoting whether adolescents reported that they had seriously considered: (a) attempting suicide during the past 12 months (*CONSIDERED SUICIDE*), (b) making a suicide plan during the past 12 months (*PLANNED SUICIDE*), or (c) attempting suicide during the past 12 months (*ATTEMPTED SUICIDE*). As previously mentioned, Figure 1 shows that adolescents who reported spending

[5] We obtain these population figures from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program.

[6] While the American Academy of Pediatrics (AAP) previously recommended that children have at most two hours of screen time per day, in 2016 AAP dropped the numeric guideline in favor of a recommendation to be mindful of the quality and quantity of media consumption (American Academy of Pediatrics 2025).

more time online also reported higher levels of suicide ideation. Compared to adolescents who reported spending at most one hour online each day, adolescents who reported spending five or more hours online were 68 percent more likely to have considered suicide, 72 percent more likely to have made a suicide plan, and 64 more likely to have attempted suicide.

Table 1 reports summary statistics for our outcome variables, overall and separately by sex. In addition to questions on internet use and suicide ideation, the YRBSS also allows us to explore the possible pathways through which broadband access may have affected suicide ideation, such as through changes in body image, bullying, and physical health. While adolescent boys were more likely to report spending at least three hours per day online (36.7 percent vs. 33.8 percent), adolescent girls reported far higher rates of suicide ideation (19.2 percent vs. 12.4 percent), were more likely to report having been cyberbullied (19.9 percent vs. 10.6 percent), and were more likely to describe themselves as being overweight (33.8 percent vs. 25.9 percent).

2.2 Data: FCC Form 477

We obtain data on broadband internet access from the Federal Communications Commission's Form 477, which provides information on county-level internet connectivity at six-month intervals starting in 2009. We merge information on county-level broadband access with county-level population data obtained from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program to calculate the population-weighted share of the state with access to broadband internet.

Figure 2 shows the share of each state that had access to broadband for four years of our sample period, though we utilize annual variation in state-level broadband access throughout our analysis. Although nearly 70 percent of the country had broadband access at the start of our sample period, there was

meaningful coverage heterogeneity among states, ranging from less than 50 percent (Mississippi) to nearly 90 percent (Massachusetts). By the end of our sample period, over 90 percent of the country had broadband access and only three states had less than 80 percent coverage (Arkansas, Mississippi, and Nebraska). Meanwhile, Figure 3 presents descriptive evidence that adolescents in states with greater broadband internet access were more likely to be moderate to heavy internet users. Compared to adolescents in states where at most 50 percent of the population had access to broadband internet, those residing in states with near-universal broadband access were approximately 67 percent more likely to report spending three or more hours online (0.24 vs. 0.40).

2.3 Methods

To examine the relationship between changes in internet access and mental health, we leverage variation in the share of the state with broadband internet access (Guldi and Herbst 2017; DiNardi et al. 2019; Arenas-Arroyo et al. 2025) using the following specification:

$$Y_{isdt} = \alpha + \beta \cdot BROADBAND\ COVERAGE_{st} + \mathbf{B}'_{st}\lambda + \mathbf{X}'_{isdt}\gamma + \theta_s + \tau_{dt} + \varepsilon_{isdt} \quad (1)$$

where the dependent variable, Y_{isdt}, is the outcome of interest (e.g., the number of hours spent online, whether the adolescent reported considering suicide, etc.) for individual *i*, in state *s*, in Census division *d*, in year *t*. Our independent variable of interest, $BROADBAND\ COVERAGE_{st}$, is the share of the state population with broadband internet access. Our coefficient of interest, β, measures the relationship between our outcomes of interest and the share of the state with access to broadband internet.

We include a vector of state-level time-varying economic conditions and policies that may be correlated with both broadband internet access and adolescent mental health. Specifically, the vector $\mathbf{B}_{st}$ includes the state-level unemployment

rate, the real value of personal income per capita, the average amount of per capita funds received from public assistance programs, the natural log of the real effective minimum wage, the share of the state with a college degree, the share of the state comprised of non-Hispanic Black individuals, and the share of the state comprised of Hispanic individuals (Ruhm 2000, 2015; Cotti and Tefft 2013; Clark et al. 2020).

Given prior evidence on how school bullying affects adolescent mental health, the vector $\mathbf{B}_{st}$ also includes indicators for whether the state had adopted a strong or weak anti-bullying law (Sabia and Bass 2017; Rees et al. 2022). Similarly, because internet access may affect adolescent mental health by altering body image, we account for a variety of state-level policies affecting appearance-related behaviors, including whether the adolescent was required to undergo a school-based body mass index assessment (Churchill 2024), whether the state limited fast-food companies' liability for weight-related harms (Carpenter and Tello-Trillo 2015), whether the adolescent was bound by youth indoor tanning laws (Darlow et al. 2016; Carpenter et al. 2023), the natural log of the real value of cigarette taxes (Cawley et al. 2004; Rees and Sabia 2010; Choudhury and Conway 2020), and whether the state had nutritional standards for school meals exceeding the U.S. Department of Agriculture requirements (Wojcicki and Heyman 2006; Cullen et al. 2008; Capogrossi and You 2017).

The vector $\mathbf{X}_{isdt}$ includes individual-level characteristics that are potentially correlated with mental health, including indicators for age, sex, race/ethnicity, and whether the adolescent was part of the NYRBS or the SYRBS. The vector of state fixed effects, θ_s, accounts for time-invariant state-specific characteristics. To account for the fact that certain regions of the country (e.g., northeastern and western states) consistently had greater broadband access throughout our sample period, we include a full set of Census division-by-year fixed effects, τ_{dt}. Standard errors are clustered at the state level (Bertrand et al. 2004).

In the presence of our covariates and fixed effects, the standard identifying assumption in a difference-in-differences setting is that the outcomes would have evolved identically in treated and non-treated states in absence of treatment. However, our setting is slightly more complicated because our independent variable of interest is a continuous measure that never takes on the value of zero during our sample period (Haxhiu and Helgerman 2024). One potential solution is to recode our independent variable of interest to an indicator variable that takes on the value of one after a state reaches a certain level of broadband internet access. However, the appropriate threshold of internet coverage is not immediately evident, and any estimates from this specification would be identified by comparing changes in outcomes for adolescents in states newly above the threshold (not all of whom have internet access) to the changes in outcomes for adolescents in states not above the threshold (many of whom might have internet access). Instead, we retain our continuous independent variable of interest but adopt a "strong parallel trends" assumption that the outcomes for all groups receiving the treatment at the same time, regardless of the dose, would have evolved similarly at every dosage level (Callaway et al. 2024).

Variants of our specification have been used to estimate the relationship between internet access and a variety of economically meaningful outcomes (see, for example, Bhuller et al. 2013; Falck et al. 2014; Akerman et al. 2015; Guldi and Herbst 2017; DiNardi et al. 2019; and Arenas-Arroyo et al. 2025). However, we undertake two primary tests to increase confidence in our results. First, we adopt a randomization inference procedure that randomly matches states to the broadband internet rollout in other states (Fisher 1935; Buchmueller et al. 2014; Cunningham and Shah 2018). Comparing our actual estimates to the distribution of 100 placebo estimates allows us to assess whether we were likely to have estimated the relationship by chance. Second, we test the sensitivity of our results to iteratively dropping a random 10 percent of the sample (Broderick et al. 2020). By plotting

the distribution of estimates from 100 iterations of this procedure, we are able to examine whether our results are likely being driven by a particular (potentially improper) subset of comparisons.

3. Results

3.1 Changes in Screen Time

We begin by examining the relationship between changes in broadband internet access and the likelihood that adolescents reported spending at least three hours online per day for non-school-related reasons in Table 2. In column 1, we show that a one-standard-deviation increase in broadband internet access was associated with a 4.1-percentage-point increase in the likelihood that adolescents reported spending at least hours online per day – an 11.6 percent increase relative to the sample mean. In the next two columns, we explore whether the relationship varied by gender. Column 2 shows that a one-standard-deviation increase in broadband internet access was associated with a 4.9-percentage-point (14.5-percent) increase in the likelihood that adolescent girls reported spending at least three hours online per day, while column 2 shows a smaller – but still sizable – 3.3-percentage-point (9.0-percent) increase among adolescent boys.[7]

To increase confidence that we are detecting a meaningful relationship between broadband internet access and adolescent internet use, we (i) matched each state to the broadband internet rollout that occurred in a random state and estimated equation (1) using this placebo broadband access variable. Figure 4 plots the distribution of the placebo coefficients obtained from 100 iterations of this randomization inference procedure (Fisher 1935; Buchmueller et al. 2011;

[7] Appendix Table 2 presents results where the outcome of interest is a continuous measure of the number of hours that adolescents reported spending online. These results likewise show a stronger relationship between broadband internet access and internet use for adolescent girls than for adolescent boys.

Cunningham and Shah 2018) compared to the corresponding estimate obtained from the actual data (Panel A). Only three of the placebo coefficients were larger in absolute magnitude than the actual coefficient, indicating that the estimated relationship between broadband internet access and adolescent internet use was unlikely to have occurred by chance.[8] Meanwhile, Appendix Figure 2 plots the estimates obtained from 100 iterations where we randomly dropped 10 percent of the sample (Broderick et al. 2020) and re-estimated equation (1). These results show that the relationship is unlikely to be driven by a particular set of comparisons. Finally, Appendix Figure 3 shows that the relationship is not being driven by any single state.

3.2 Changes in Suicide Ideation

Given that changes in broadband internet access were related to changes in adolescent internet use, in Table 3 we now examine whether the rollout of broadband internet access was also predictive of changes to adolescent mental health. We find that a one-standard-deviation increase in broadband access was associated with a 1.9-percentage-point (12.0-percent) increase in the likelihood that adolescents reported that they had seriously considered suicide (Panel A, column 1). Consistent with our results examining changes in internet utilization, we detect larger changes in suicide ideation for adolescent girls compared to adolescent boys. While a one-standard-deviation increase in broadband internet access was associated with a statistically significant 3.1-percentge-point (16.1-percent) increase in the likelihood that adolescent girls reported seriously

[8] MacKinnon and Webb (2020) showed that randomization inference with coefficients may over-reject the null hypothesis and proposed a lower-power option where the actual cluster-robust *t*-statistic is compared to the placebo cluster-robust *t*-statistics. Appendix Figure 1 adopts this more conservative approach and continues to suggest that the underlying relationship was unlikely to have occurred by change.

considering suicide (Panel A, column 2), the estimate for adolescent boys is over 80-percent smaller in magnitude and statistically insignificant (Panel A, column 3).

Next, we find that a one-standard deviation increase in broadband internet access was associated with a 1.8-percentage-point (11.8-percent) increase in the likelihood that adolescent girls reported making a suicide plan (Panel B, column 2) and a 1.6-percentage-point (17.2-percent) increase in the likelihood that adolescent girls reported attempting suicide (Panel C, column 2). The fact that we detect increasingly smaller percentage point changes based on the severity of the outcome suggests that greater broadband internet access was associated with a downward shift of adolescent girls' mental health distribution. In contrast, while we do not detect a statistically significant relationship between broadband internet access and the likelihoods that adolescent boys reported that they had seriously considered suicide (Panel A, column 3) or made a suicide plan (Panel B, column 3), we find that a one-standard-deviation increase in broadband access was associated with a 0.9-percentage-point (13.8-percent) increase in the likelihood that adolescent boys reported that they had attempted suicide (Panel C, column 3). This pattern of results suggests that adolescent boys who were already at an elevated risk of attempting suicide were those who were most adversely affected by greater broadband internet access.[9]

Again, we have undertaken a number of tests to demonstrate the robustness of these results. In Figure 5, we report results from randomization inference exercises for each of our suicide outcomes. We find strong evidence that the relationship between broadband internet access and adolescent suicide ideation was unlikely to have occurred by chance.[10] Likewise, Appendix Figure 2 shows that the

[9] Appendix Table 3 shows that greater broadband internet access was associated with similar increases in suicide ideation for both white and non-white adolescents.

[10] We reach a similar conclusion when we perform randomization inference based on the cluster-robust *t*-statistics (MacKinnon and Webb 2020). The corresponding empirical p-value for each of outcomes is 0.03, 0.12, and 0.02.

patterns are robust to dropping a random 10 percent of the sample, alleviating concerns that the results are being driven by a set of (potentially improper) comparisons (Broderick et al. 2020). In Appendix Table 4, we show that the patterns are robust using raw data without the population weights that make the surveys representative at the state level. Meanwhile, in Appendix Table 5, we show that the results are robust to using a specification that accounts for spatial heterogeneity with state-specific linear time trends rather than the Census Division-by-year fixed effects. Finally, we show in Appendix Figure 3 that the estimated relationships are not being driven by any one state.

3.3 Changes in Bullying and Self-Image

In this section, we begin exploring the potential pathways through which greater broadband internet access may have adversely affected adolescent mental health. Researchers, policymakers and advocacy groups have all expressed concern that broadband internet access may increase the frequency and duration of bullying (Slonje et al. 2013; Nixon 2014; National Children's Alliance 2025; U.S. Department of Health and Human Services 2025). The hypothesis is that, prior to the rollout of broadband internet, bullying was largely confined to school property during school hours. However, by increasing the ease with which adolescents can interact with each other, broadband internet access may have made it so that adolescents may be the victims of bullying anywhere throughout the entire day. Yet prior quasi-experimental work leveraging variation in fiber optic deployment in Spain found no evidence that high-speed internet access affected the likelihood that adolescents were cyberbullied (Arenas-Arroyo et al. 2025).

In Table 4, we explore the relationship between broadband internet access and the likelihood that adolescents reported being victims of cyberbullying. In column 1, we do not find evidence of a statistically significant relationship when using the full sample of adolescents. However, this aggregate analysis appears to

mask important sex-specific heterogeneity that becomes apparent when we separately examine adolescent girls and boys. Column 2 shows that a one-standard-deviation increase in broadband internet access was associated with a statistically significant 1.8-percentage-point (9.0-percent) increase in the likelihood that adolescent girls reported being cyberbullied, while column 3 shows that the point estimate for adolescent boys is 67 percent smaller in magnitude, opposite signed, and statistically insignificant.[11] In Appendix Table 7, we find suggestive evidence that greater broadband internet access was also associated with an increase in the likelihood that adolescent girls reported being bullied at school, which is consistent with prior evidence that in-person bullying and cyberbullying are complements and not substitutes (Manzella 2018; Dasgupta 2019; Nikolaou 2022; Churchill et al. 2025).[12]

Another common concern is that internet use may expose adolescents to unrealistic body imagery that distorts their self-image (Tiggemann and Slater 2013; NPR 2021; Sanzari et al. 2023), particularly as the higher bandwidth speeds associated with broadband internet have shifted adolescent internet use away from text-based websites and towards visual social media (e.g., Instagram, YouTube, TikTok, etc.). We test this possibility in Table 5 where our dependent variables are

[11] In Appendix Table 6, we show that a one-standard-deviation increase in broadband internet access was associated with a 3.0-percentage-point (13.1-percent) increase in the likelihood that white adolescent girls reported being cyberbullied (Panel A, column 2). We do not detect a statistically significant relationship for non-white adolescent girls (Panel B, column 2) or adolescent boys of any race/ethnicity (column 3).

[12] The estimates are in line with prior evidence on the relationship between bullying and suicide ideation. For example, Hansen and Lang (2011) found that suicide attempts among teen girls fell 22 percent during the summer months, which they attributed to a reduction in "negative social interactions." Leveraging variation in in-person schooling due to the COVID-19 pandemic, Bacher-Hicks et al. (2022) found that the transition to online schooling reduced bullying-related internet searches by 30-35 percent, while Hansen et al. (forthcoming) found that the move back to in-person schooling was associated with an increase in bullying-related Google searches and a 12-18-percent increase in adolescent suicides. Likewise, Rees et al. (2022) found that state anti-bullying laws reduced the likelihood that adolescent girls reported being bullied by 10.7 percent and the likelihood that they reported that they had seriously considered suicide by 8.7 percent.

constructed from a question asking adolescents how they would describe their bodies. We do not find any evidence that broadband internet access was associated with a change in the likelihood that adolescents described themselves as being "underweight" (Panel A). However, we find that a one-standard deviation increase in broadband internet access was associated with a 1.9-percentage-point (3.5-percent) reduction in the likelihood that adolescents described themselves as "normal weight" (Panel B, column 1) and a corresponding 1.9-percentage-point (6.4-percent) increase in the likelihood that they described themselves as "overweight (Panel C, column 1). Consistent with prior work demonstrating that bodyweight-related social comparisons have more adverse effects on the mental health of adolescent girls and young women (Hargreaves and Tiggemann 2004; Myers and Crowther 2009; Bibiloni et al. 2013; Valois et al. 2019; Carpenter and Churchill 2026), we find that this relationship was driven by adolescent girls who were 2.9 percentage points (5.3 percent) less likely to describe themselves as "normal weight" (Panel B, column 2) a 2.7 percentage points (8.0 percent) more likely to describe themselves as "overweight" (Panel C, column 2).[13]

3.4 Changes in Physical Health

In this section, we test whether broadband internet access may have adversely affected adolescents' mental health by harming their physical health. For example, increased broadband internet access may have resulted in adolescents staying up late to remain online. Because there is strong evidence linking sleep quality and mental health (Giuntella et al. 2024; Argys et al. forthcoming), particularly for adolescents (Tarokh et al. 2016; Zhang et al. 2017), broadband-induced disruptions in sleep may help explain the estimated increase in suicide ideation. In our data,

[13] Appendix Figure 4 shows that a one-standard-deviation increase in broadband internet access was associated with a reduction in the likelihood that both white and non-white adolescents described themselves as "normal weight" and an increase in the likelihood that they described themselves as "overweight."

respondents were asked the number of hours of sleep that they get on an average school night. The American Academy of Sleep Medicine recommends that adolescents aged 6–12 should regularly sleep 9–12 hours and that those aged 13–18 should sleep 8–10 hours (Paruthi et al. 2016). Based on this recommendation, our dependent variable in Table 6 is an indicator for whether adolescents reported getting the appropriate amount of sleep on an average school night. While we do not detect any change in sleep for the full sample or adolescent girls, we show in column 3 that a one-standard-deviation increase in broadband internet access was associated with a 2.8-percentage-point (9.9-percent) reduction in the likelihood that adolescent boys reported getting at least eight hours of sleep each night. We show in Appendix Table 8 that this relationship was stronger in terms of magnitude and statistical significance for white adolescent boys who were 5.0 percentage points (17.2 percent) less likely to report getting an adequate amount of sleep.[14]

Finally, prior work has shown that broadband access increases sedentary behaviors and, consequently, body mass index (BMI).[15] Because excess bodyweight has been linked to worse mental health (Sabia and Rees 2015; Willage 2018; Nieto and Suhrcke 2021; Iwatate et al. 2023), in Table 7 we examine whether broadband internet access was associated with a change in adolescent BMI. We do not find any evidence that greater broadband internet access was associated with a

[14] The fact that we detect a reduction in the likelihood that adolescent boys reported getting an adequate amount of sleep contrasts with Arenas-Arroyo et al. (2025). They found that a one-standard-deviation increase in fiber-optic deployment in Spain was associated with a 4.2-percent reduction in sleep time for adolescent girls without any change for adolescent boys (Table 1, Panel A, column 2). However, when they examined broadband internet more broadly, rather than specifically analyzing the rollout of fiber-optics, the relationship for adolescent girls fell in magnitude and became statistically insignificant (Table 1, Panel B, column 2).

[15] This evidence largely points to a positive relationship between internet access and bodyweight. DiNardi et al. (2019) found that broadband internet increased white women's bodyweight in the United States, while Lin et al. (2024) found that high-speed internet access increased obesity in Australia. However, Chen and Liu (2022) found that increased internet access reduced bodyweight in China. Yet other researchers have also linked the rollout of broadband internet in China to increases in adolescent BMI in China (Ma and Sheng 2024; Cheng and Xu 2025).

statistically significant change in BMI. Indeed, our estimates are incredibly precise, allowing us to rule out a reduction exceeding 0.61 percent and an increase exceeding 1.0 percent with 95 percent confidence. Likewise, we show in Appendix Table 9 that greater broadband internet access was unrelated to changes in the likelihoods that adolescents were classified as underweight (Panel A), healthy weight (Panel B), or overweight (Panel C). Nor do we find evidence in Appendix Table 10 that broadband internet access was differentially related to adolescent BMI based on race/ethnicity. Overall, our results suggest that increasing bodyweight is unlikely to be the pathway through which greater broadband internet access has adversely affected adolescent mental health.

4. Conclusion

Over the last several decades, broadband internet has become a critical component of U.S. infrastructure (Czernich et al. 2011; Choi et al. 2015). Because the widespread adoption of this technology has occurred alongside a deterioration in adolescent mental health (Goodwin et al. 2020; Daly 2022), policymakers and advocacy groups are increasingly interested in understanding the degree to which internet use may be contributing to this mental health crisis (American Academy of Pediatrics 2016; U.S. Surgeon General 2021; White House 2022). Leveraging the rollout of broadband internet with 2009–2019 National and Youth Risk Behavior Survey data, we show that greater broadband interest access was associated with an increase in (i) the amount of time that adolescents reported spending online and (ii) the likelihood that they reported considering, planning, and attempting suicide. These results are robust to a variety of alternative specifications and methods for conducting statistical inference, and we show that the patterns are not being driven by a particular subset of comparisons. Examining potential mechanisms, we show that greater broadband internet access was associated with increases in cyberbullying and body dissatisfaction among adolescent girls, as well as a

reduction in the likelihood that adolescent boys reported getting an adequate amount of sleep. Given the perceived difficulty of reducing the amount of time that adolescents spend online, these latter findings are likely to be of particular interest to policymakers looking for possible ways to soften the negative relationship between broadband internet access and adolescent mental health.

This study is subject to some limitations. First, although our results show that greater broadband internet access has been associated with a deterioration in adolescent mental health, they cannot speak to whether the relationship varied across different types of content. Yet policymakers are increasingly turning to content-specific regulations based on a belief that some content types, such as social media (National Conference of State Legislatures 2024; 119th U.S. Congress 2025) and pornography (Newsweek 2024), are the most detrimental to adolescent mental health. Testing whether these recent efforts have improved outcomes will be a promising area for future work. Second, because our broadband internet data are only available beginning in 2009 and our YRBSS data are measured at the state level, we do not have a purely untreated comparison group. As a result, we must make a stronger parallel trends assumption than in a difference-in-differences setting with a discrete treatment variable. While these complications are common in research studying how internet access has influenced a variety of economically meaningful outcomes (see, for example, Bhuller et al. 2013; Falck et al. 2014; Akerman et al. 2015; Guldi and Herbst 2017; DiNardi et al. 2019; and Arenas-Arroyo et al. 2025), and we have taken several steps to show that are not being driven by a particular subset of comparisons, identifying alternative sources of variation that permit weaker identification assumptions remains an important area for further research. Despite these limitations, our results provide important, comprehensive evidence on the relationship between broadband internet access and the mental health of U.S. adolescents.

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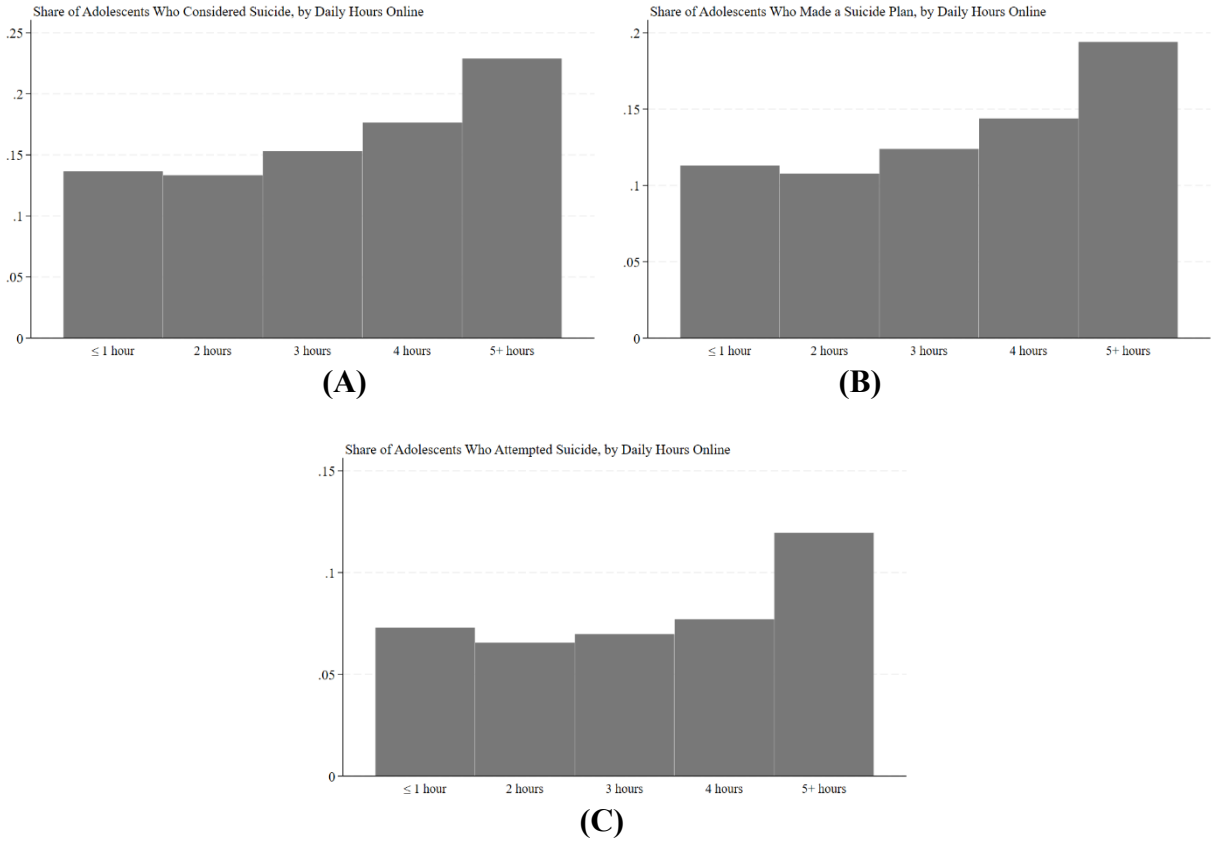
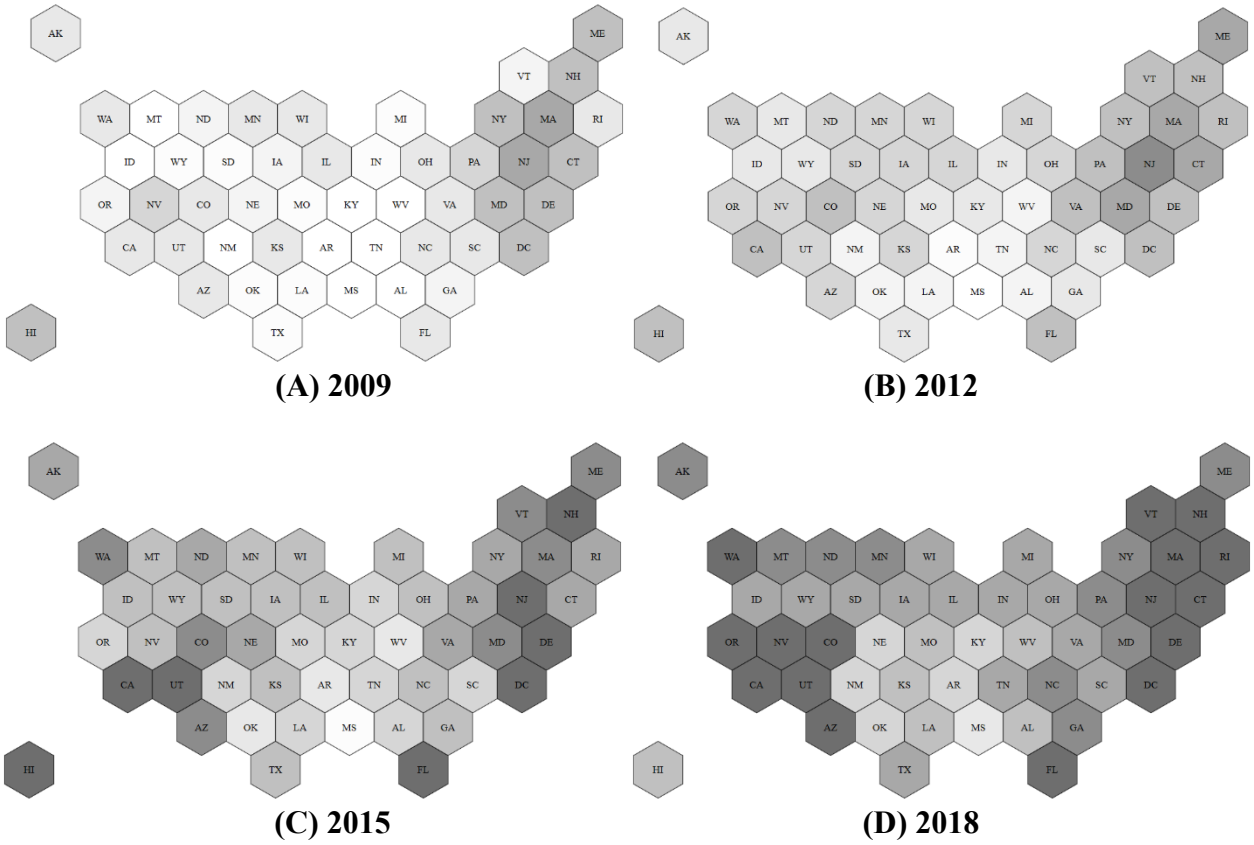
6. Figures

Figure 1: Adolescents Who Reported Spending More Time Online Also Reported Higher Rates of Suicide Ideation



Source: National and State Youth Risk Behavior Surveys, 2009–2019
Note: The figure plots the share of adolescents who reported that they had seriously considered suicide (Panel A), made a suicide plan (Panel B), and attempted suicide (Panel C) by the number of hours that they reported spending online. The summary statistics utilize population weights.

Figure 2: State-Level Changes in Broadband Access Over the Sample Period



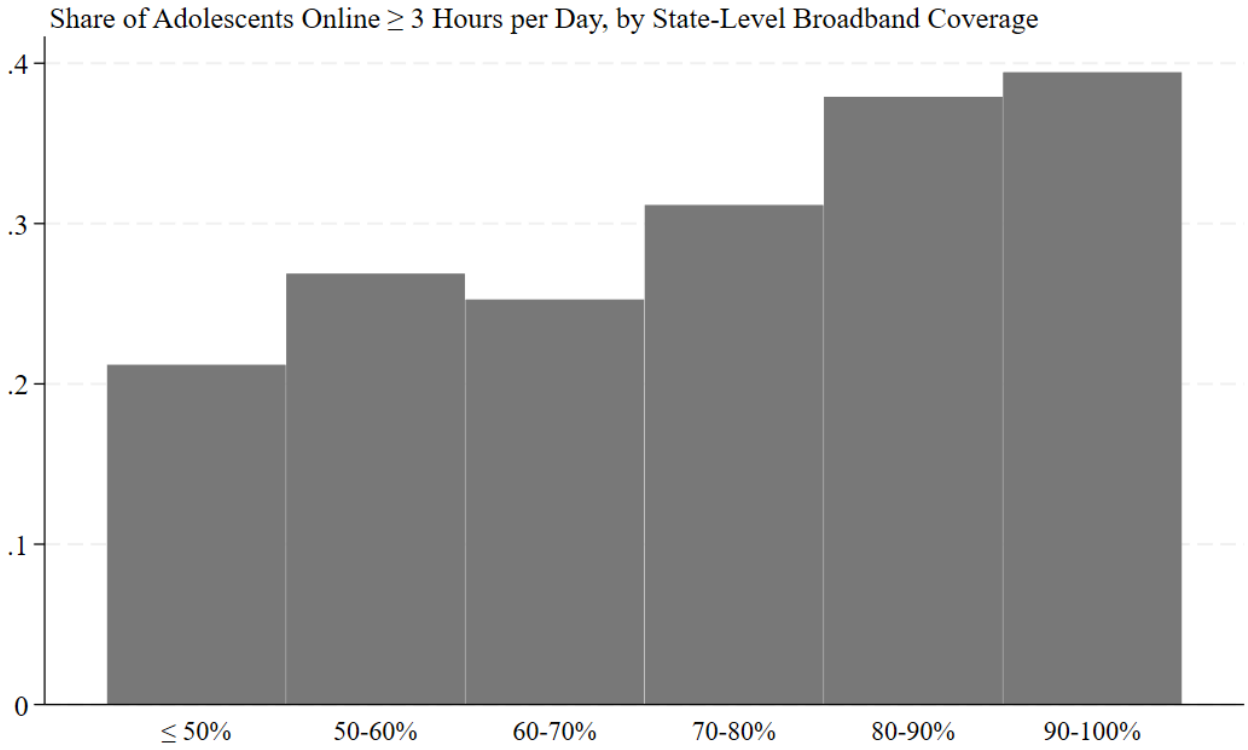
(A) 2009 **(B) 2012**

(C) 2015 **(D) 2018**

Source: FCC Form 477

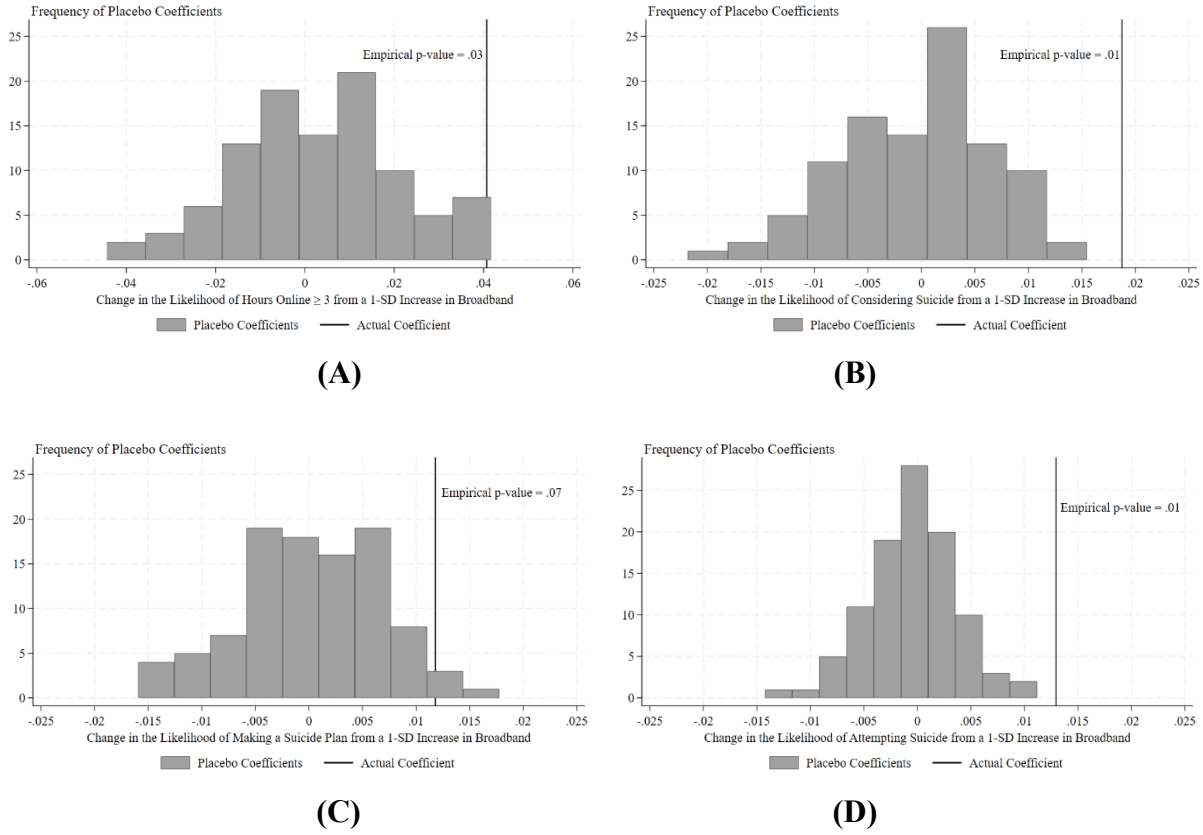
Note: The figure plots the share of each state with access to broadband internet ranging from 50 percent to near universal coverage. Lighter shaded states have relatively less coverage; darker shaded states have relatively more coverage.

Figure 3: Descriptive Relationship Between Broadband Internet Access and the Share of Adolescents Online at Least Three Hours per Day



Source: National and State Youth Risk Behavior Surveys, 2009–2019
Note: The figure plots the share of adolescents who reported that they spent three or more hours online per day based on the share of their state population that had broadband internet access. The summary statistics utilize population weights.

Figure 4: The Relationships Between Broadband Internet Access, Internet Use, and Suicide Ideation Are Robust to Randomization Inference



Source: National and State Youth Risk Behavior Surveys 2009–2019

Note: The dependent variable in Panel A is an indicator for whether the adolescent reported spending three or more hours online outside of schoolwork. The dependent variable in Panel B is an indicator for whether the adolescent reported seriously considering suicide, the dependent variable in Panel C is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel D is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regressions use the full set of controls from equation (1). The actual coefficients are displayed by the vertical black line. The grey bars denote the frequency of placebo estimates that are obtained from 100 iterations of randomly matching states to the broadband internet rollout of other states and estimating equation (1). The estimates utilize population weights.

7. Tables

Table 1: Summary Statistics for the Main Dependent Variables

	(1)	(2)	(3)
	All Adolescents	Adolescent Girls	Adolescent Boys
Online at Least 3 Hours per Day	0.352	0.338	0.367
	(0.478)	(0.473)	(0.482)
Considered Suicide	0.158	0.192	0.124
	(0.364)	(0.393)	(0.329)
Made a Suicide Plan	0.129	0.153	0.105
	(0.335)	(0.360)	(0.307)
Attempted Suicide	0.079	0.093	0.065
	(0.270)	(0.290)	(0.247)
Cyberbullied	0.152	0.199	0.106
	(0.359)	(0.399)	(0.308)
Self-Described Underweight	0.156	0.126	0.187
	(0.363)	(0.331)	(0.390)
Self-Described Normal Weight	0.545	0.537	0.553
	(0.498)	(0.499)	(0.497)
Self-Described Overweight	0.299	0.338	0.259
	(0.458)	(0.473)	(0.438)
Adequate Amount of Sleep	0.264	0.245	0.284
	(0.441)	(0.430)	(0.451)
BMI	23.259	23.000	23.513
	(4.921)	(4.772)	(5.050)

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The table reports the sample means and standard deviations (in parentheses). The summary statistics utilize population weights.

Table 2: Adolescents in States with Greater Broadband Internet Access Reported Spending More Time Online

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
1-SD ↑ Share Broadband	0.041**	0.049**	0.033**
	(0.015)	(0.020)	(0.013)
Mean	0.352	0.338	0.367
R^2	0.028	0.039	0.020
Observations	965,736	495,838	469,898

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is an indicator for whether the adolescent reported spending three or more hours online outside of schoolwork. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 3: Adolescents in States with Greater Broadband Internet Access Reported Elevated Levels of Suicide Ideation

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Outcome is an Indicator for Seriously Considering Suicide			
1-SD ↑ Share Broadband	0.019***	0.031***	0.006
	(0.006)	(0.007)	(0.006)
Mean	0.158	0.192	0.124
R^2	0.013	0.007	0.008
Observations	1,062,645	542,993	519,652
Panel B: Outcome is an Indicator for Making a Suicide Plan			
1-SD ↑ Share Broadband	0.012**	0.018***	0.005
	(0.005)	(0.006)	(0.005)
Mean	0.129	0.153	0.105
R^2	0.008	0.006	0.006
Observations	1,125,863	572,304	553,559
Panel C: Outcome is an Indicator for Attempting Suicide			
1-SD ↑ Share Broadband	0.013***	0.016***	0.009***
	(0.004)	(0.005)	(0.003)
Mean	0.079	0.093	0.065
R^2	0.008	0.006	0.009
Observations	924,417	474,736	449,681

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether the adolescent reported seriously considering suicide during the past year. The dependent variable in Panel B is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel C is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 4: Adolescent Girls in States with Greater Broadband Internet Access Were More Likely to Report Being Cyberbullied

	(1)	(2)	(3)
Sample →	All Adolescents	Adolescent Girls	Adolescent Boys
1-SD ↑ Share Broadband	0.006	0.018**	-0.006
	(0.005)	(0.008)	(0.005)
Mean	0.152	0.199	0.106
R^2	0.026	0.018	0.007
Observations	945,092	481,027	464,065

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is an indicator for whether the adolescent reported being cyberbullied. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 5: Adolescent Girls in States with Greater Broadband Internet Access Were More Likely to Describe Themselves as Being Overweight

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Outcome is an Indicator for Being Self-Described "Underweight"			
1-SD ↑ Share Broadband	0.001	0.002	0.001
	(0.007)	(0.007)	(0.007)
Mean	0.156	0.126	0.187
R^2	0.011	0.007	0.007
Observations	1,005,492	514,283	491,209
Panel B: Outcome is an Indicator for Being Self-Described "Normal Weight"			
1-SD ↑ Share Broadband	-0.019***	-0.029***	-0.010
	(0.007)	(0.008)	(0.008)
Mean	0.545	0.537	0.553
R^2	0.004	0.006	0.004
Observations	1,005,492	514,283	491,209
Panel C: Outcome is an Indicator for Being Self-Described "Overweight"			
1-SD ↑ Share Broadband	0.019**	0.027***	0.009
	(0.007)	(0.009)	(0.009)
Mean	0.299	0.338	0.259
R^2	0.012	0.008	0.007
Observations	1,005,492	514,283	491,209

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether adolescents described themselves as being "underweight," the dependent variable in Panel B is an indicator for whether adolescents described themselves as being "normal weight," and the dependent variable in Panel C is an indicator for whether adolescents described themselves as being "overweight." The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 6: Broadband Internet Access Was Associated with a Reduction in the Likelihood That Adolescent Boys Reported Getting an Adequate Amount of Sleep

	(1)	(2)	(3)
Sample →	All Adolescents	Adolescent Girls	Adolescent Boys
1-SD ↑ Share Broadband	-0.017	-0.005	-0.028*
	(0.013)	(0.018)	(0.014)
Mean	0.264	0.245	0.284
R^2	0.025	0.018	0.030
Observations	452,106	233,273	218,833

Source: National and State Youth Risk Behavior Surveys, 2009–2019.

Note: The dependent variable is an indicator for whether the adolescent reported getting an adequate amount of sleep for their age. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

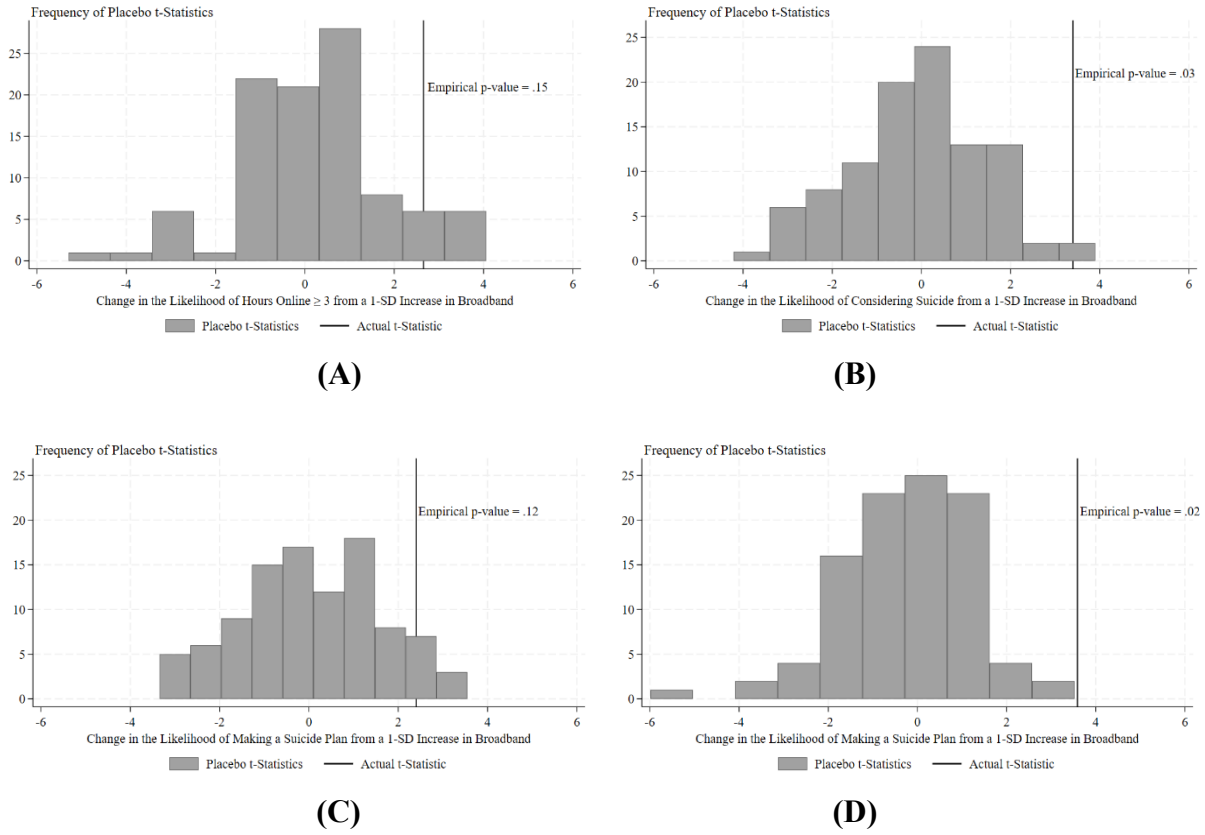
Table 7: Broadband Internet Access Was Unrelated to Adolescent BMI

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
1-SD ↑ Share Broadband	0.049	0.049	0.050
	(0.076)	(0.096)	(0.067)
Mean	23.259	23.000	23.514
R^2	0.042	0.048	0.036
Observations	1,159,531	588,576	570,955

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is the adolescent's body mass index (BMI) based on self-reported height and weight. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

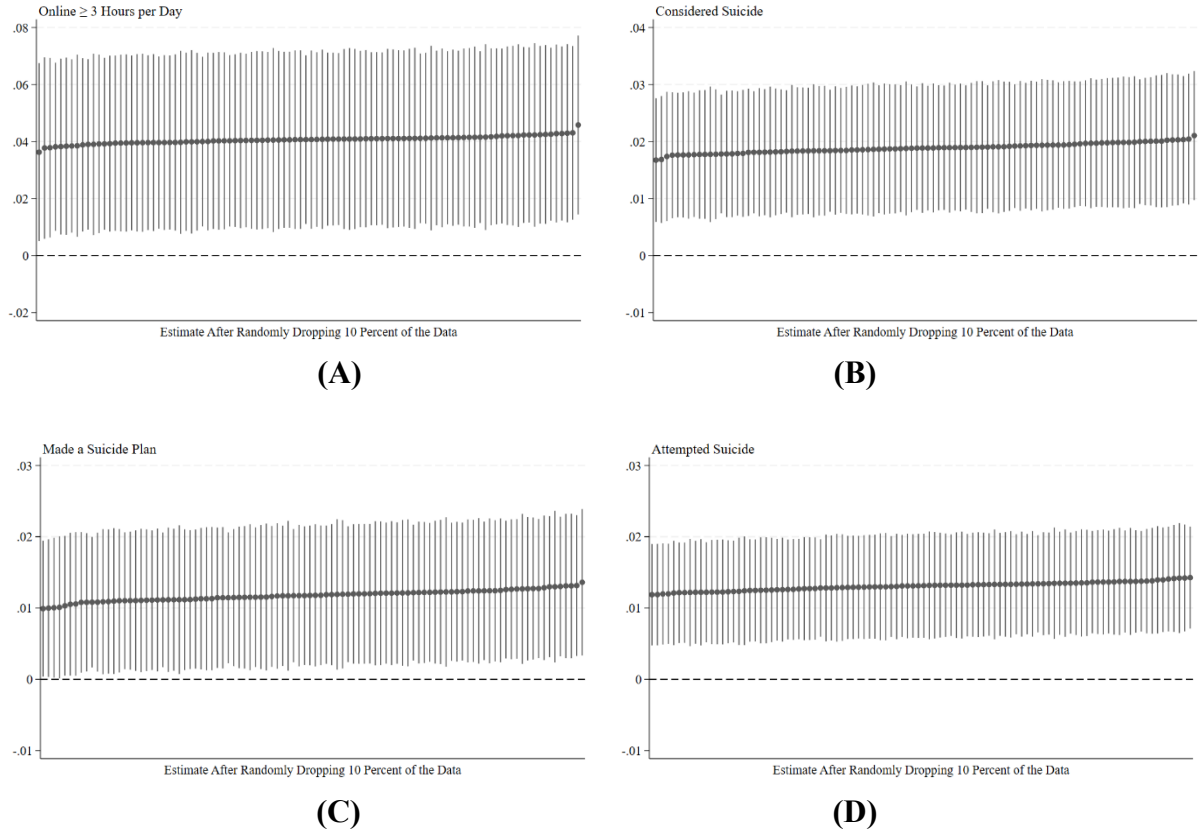
8. Appendix Figures

Appendix Figure 1: The Relationships Between Broadband Internet Access, Internet Use, and Suicide Ideation Are Robust to Randomization Inference of Test Statistics



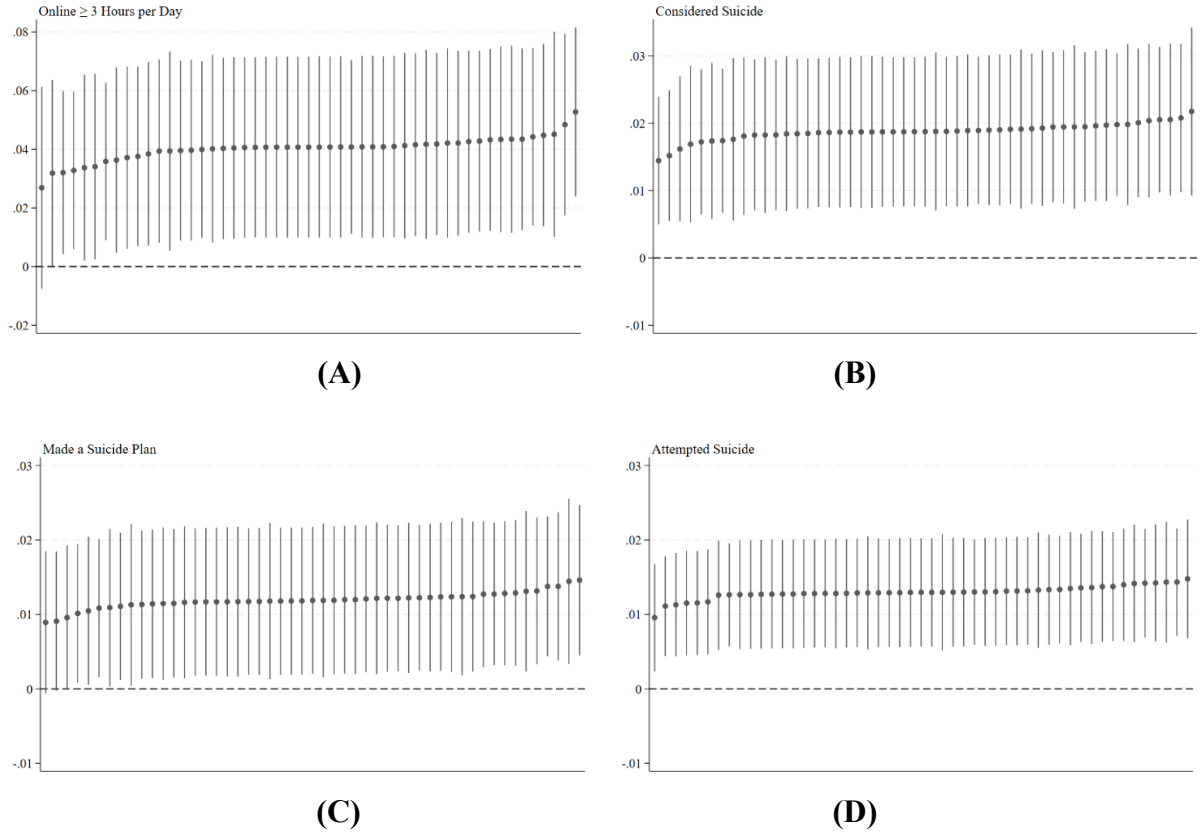
Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether the adolescent reported spending three or more hours online outside of schoolwork. The dependent variable in Panel B is an indicator for whether the adolescent reported seriously considering suicide, the dependent variable in Panel C is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel D is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regressions use the full set of controls from equation (1). The actual t-statistics are displayed by the vertical black line. The grey bars denote the frequency of placebo statistics that are obtained from 100 iterations of randomly matching states to the broadband internet rollout of other states and estimating equation (1). The estimates utilize population weights. Standard errors are clustered at the state level.

Appendix Figure 2: The Relationships Between Broadband Internet Access, Internet Use, and Suicide Ideation Are Robust to Randomly Dropping 10 Percent of the Sample



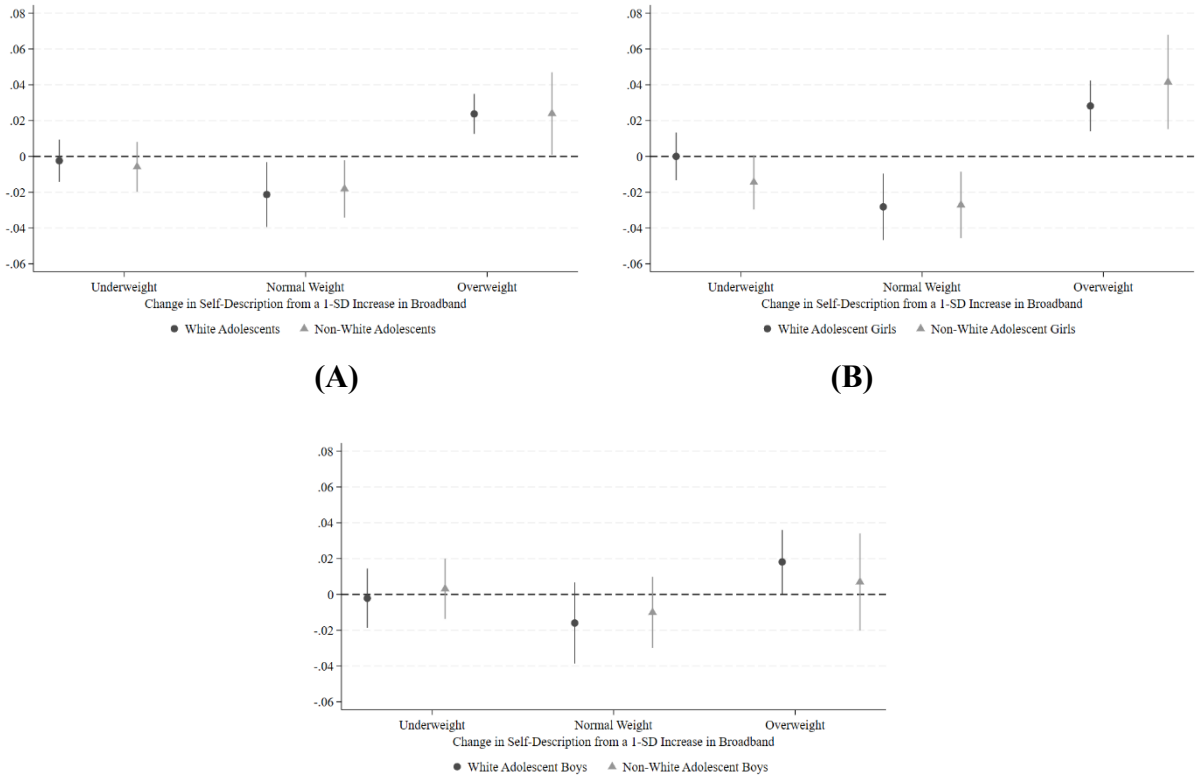
Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether the adolescent reported spending three or more hours online outside of schoolwork. The dependent variable in Panel B is an indicator for whether the adolescent reported seriously considering suicide, the dependent variable in Panel C is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel D is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regressions use the full set of controls from equation (1). The grey circles denote the point estimates and the vertical lines the corresponding 95 percent confidence intervals obtained from estimating equation (1) after 100 times after randomly dropping 10 percent of the sample. The estimates utilize population weights. Standard errors are clustered at the state level.

Appendix Figure 3: The Relationships Between Broadband Internet Access, Internet Use, and Suicide Ideation Are Robust Iteratively Excluding Each State



Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether the adolescent reported spending three or more hours online outside of schoolwork. The dependent variable in Panel B is an indicator for whether the adolescent reported seriously considering suicide, the dependent variable in Panel C is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel D is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regressions use the full set of controls from equation (1). The grey circles denote the point estimates and the vertical lines the corresponding 95 percent confidence intervals obtained from estimating equation (1) after iteratively excluding each state. The estimates utilize population weights. Standard errors are clustered at the state level.

Appendix Figure 4: The Relationships Between Broadband Internet Access and Self-Described Body Type, by Race/Ethnicity



(A) **(B)**

(C)

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variables, shown on the horizontal axes, are indicators whether the adolescents described themselves as being "underweight," "normal weight," or "overweight." The independent variable of interest is the share of the state population that had broadband internet access. The regressions use the full set of controls from equation (1). Panel A examines all adolescents, Panel B limits the sample to adolescent girls, and Panel C limits the sample to adolescent boys. The dark grey circles denote the estimates from regressions where the sample is limited to white adolescents, while the light grey triangles denote the estimates from regressions where the sample is limited to non-white adolescents. The vertical lines denote the corresponding 95 percent confidence intervals. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.

9. Appendix Tables

Appendix Table 1: Summary Statistics of Control Variables

	(1)	(2)
	Mean	SD
Demographic Variables		
Age	15.925	1.232
Male	0.501	0.500
Asian	0.016	0.126
Black	0.105	0.307
Hispanic	0.225	0.418
Other Race/Ethnicity	0.002	0.049
White	0.651	0.477
National YRBS Data	0.131	0.337
State-Level Variables		
Unemployment Rate	6.236	2.347
Personal Income	$48,089.210	$8,412.874
Income from Government Assistance	$54.073	$24.626
Poverty Rate	0.120	0.027
ln(Minimum Wage)	2.039	0.143
Share with a College Degree	0.336	0.060
Share Black	0.147	0.090
Share Hispanic	0.176	0.128
ln(Cigarette Tax)	0.460	0.751
Strong Anti-Bullying Law	0.298	0.457
Weak Anti-Bullying Law	0.527	0.499
Commonsense Consumption Act	0.468	0.499
School Meal Nutritional Standards	0.367	0.482
BMI Testing	0.600	0.490
Indoor Tanning Prohibition	0.309	0.462
Parental Presence Required for Indoor Tanning	0.022	0.146
Parental Consent Required for Indoor Tanning	0.437	0.496
Tanning Information Law	0.564	0.496

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The table reports the sample means and standard deviations (in parentheses). The summary statistics utilize population weights.

Appendix Table 2: Greater Broadband Internet Access Was Associated with an Increase in the Number of Hours That Adolescents Reported Spending Online

	(1)	(2)	(3)
Outcome →	All Adolescents	Adolescent Girls	Adolescent Boys
1-SD ↑ Share Broadband	0.139**	0.182**	0.098*
	(0.062)	(0.076)	(0.058)
Mean	1.644	1.899	2.057
R^2	0.031	0.039	0.022
Observations	965,736	495,838	469,898

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is the number of hours that adolescents reported spending online. The options include zero, less than one hour (coded as 0.5), one hour, two hours, three hours, four hours, or five or more hours (coded as 5). The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 3: The Relationship Between Broadband Internet and Suicide Ideation, by Race/Ethnicity

	(1)	(2)	(3)	(4)	(5)	(6)
Sample →	White Adolescents	White Adolescent Girls	White Adolescent Boys	Non-White Adolescents	Non-White Adolescent Girls	Non-White Adolescent Boys
Panel A: Outcome is an Indicator for Seriously Considering Suicide						
1-SD ↑ Share Broadband	0.013*	0.026***	-0.001	0.020**	0.035***	0.006
	(0.007)	(0.009)	(0.006)	(0.010)	(0.009)	(0.013)
Mean	0.157	0.192	0.124	0.158	0.193	0.123
R^2	0.013	0.007	0.007	0.015	0.009	0.011
Observations	558,325	284,034	274,291	504,320	258,959	245,361
Panel B: Outcome is an Indicator for Making a Suicide Plan						
1-SD ↑ Share Broadband	0.010*	0.016**	0.003	0.014*	0.023**	0.006
	(0.005)	(0.006)	(0.006)	(0.008)	(0.009)	(0.013)
Mean	0.127	0.151	0.104	0.133	0.157	0.108
R^2	0.008	0.005	0.006	0.011	0.010	0.008
Observations	655,258	332,794	322,464	470,605	239,510	231,095
Panel C: Outcome is an Indicator for Attempting Suicide						
1-SD ↑ Share Broadband	0.016***	0.021***	0.010***	0.004	0.010	-0.002
	(0.004)	(0.006)	(0.003)	(0.006)	(0.008)	(0.006)
Mean	0.071	0.083	0.058	0.096	0.111	0.079
R^2	0.007	0.005	0.008	0.008	0.006	0.010
Observations	549,057	281,123	267,934	375,360	193,613	181,747

Source: National and State Youth Risk Behavior Surveys, 2009–2019.

Note: The dependent variable in Panel A is an indicator for whether the adolescent reported seriously considering his or herself during the past year. The dependent variable in Panel B is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel C is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all white adolescents, column 2 limits the sample to white adolescent girls, and column 3 limits the sample to white adolescent boys. Column 4 examines all non-white adolescents, column 5 limits the sample to non-white adolescent girls, and column 6 limits the sample to non-white adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 4: The Relationship Between Broadband Internet and Suicide Ideation is Robust to Not Using Population Weights

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Outcome is an Indicator for Seriously Considering Suicide			
1-SD ↑ Share Broadband	0.013***	0.017***	0.009**
	(0.004)	(0.006)	(0.004)
Mean	0.166	0.201	0.130
R^2	0.016	0.011	0.011
Observations	1,062,645	542,993	519,652
Panel B: Outcome is an Indicator for Making a Suicide Plan			
1-SD ↑ Share Broadband	0.012***	0.016***	0.008*
	(0.004)	(0.005)	(0.004)
Mean	0.134	0.159	0.108
R^2	0.013	0.011	0.009
Observations	1,125,863	572,304	553,559
Panel C: Outcome is an Indicator for Attempting Suicide			
1-SD ↑ Share Broadband	0.009***	0.010***	0.007***
	(0.003)	(0.004)	(0.003)
Mean	0.083	0.096	0.069
R^2	0.013	0.011	0.015
Observations	924,417	474,736	449,681

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether the adolescent reported seriously considering his or herself during the past year. The dependent variable in Panel B is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel C is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 5: The Relationship Between Broadband Internet and Suicide Ideation is Robust to Replacing the Census Division-by-Year Fixed Effects with State-Specific Linear Time Trends

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Outcome is an Indicator for Seriously Considering Suicide			
1-SD ↑ Share Broadband	0.017***	0.023***	0.010
	(0.006)	(0.007)	(0.010)
Mean	0.158	0.192	0.124
R^2	0.013	0.007	0.008
Observations	1,062,645	542,993	519,652
Panel B: Outcome is an Indicator for Making a Suicide Plan			
1-SD ↑ Share Broadband	0.010	0.010	0.010
	(0.006)	(0.008)	(0.008)
Mean	0.129	0.153	0.105
R^2	0.009	0.006	0.006
Observations	1,125,863	572,304	553,559
Panel C: Outcome is an Indicator for Attempting Suicide			
1-SD ↑ Share Broadband	0.007*	0.012**	0.001
	(0.003)	(0.005)	(0.004)
Mean	0.079	0.093	0.065
R^2	0.008	0.006	0.009
Observations	924,417	474,736	449,681

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether the adolescent reported seriously considering his or herself during the past year. The dependent variable in Panel B is an indicator for whether the adolescent reported making a suicide plan, and the dependent variable in Panel C is an indicator for whether the adolescent reported attempting suicide. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1) but replaces the Census Division-by-Year Fixed Effects with state-specific linear time trends. Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 6: Greater Broadband Internet Access Was Associated with an Increase in the Likelihood That White Adolescent Girls Reported Being Cyberbullied

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Sample is Limited to White Adolescents			
1-SD ↑ Share Broadband	0.011*	0.030***	-0.007
	(0.006)	(0.009)	(0.006)
Mean	0.171	0.229	0.113
R^2	0.026	0.007	0.005
Observations	557,338	282,893	274,445
Panel B: Sample is Limited to Non-White Adolescents			
1-SD ↑ Share Broadband	-0.010	-0.016	-0.004
	(0.007)	(0.012)	(0.009)
Mean	0.115	0.138	0.090
R^2	0.016	0.015	0.011
Observations	387,754	198,134	189,620

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is an indicator for whether the adolescent reported being cyberbullied. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. Panel A limits the sample to white adolescents, while Panel B limits the sample to non-white adolescents. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 7: The Relationship Between Broadband Internet Access and School Bullying

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Sample is All Adolescents			
1-SD ↑ Share Broadband	0.012	0.021	0.005
	(0.009)	(0.013)	(0.007)
Mean	0.193	0.218	0.168
R^2	0.022	0.022	0.016
Observations	921,296	472,858	448,438
Panel B: Sample is Limited to White Adolescents			
1-SD ↑ Share Broadband	0.019*	0.031*	0.006
	(0.011)	(0.016)	(0.008)
Mean	0.217	0.248	0.186
R^2	0.015	0.011	0.011
Observations	498,404	254,059	244,345
Panel C: Sample is Limited to Non-White Adolescents			
1-SD ↑ Share Broadband	-0.002	-0.003	0.005
	(0.010)	(0.015)	(0.013)
Mean	0.145	0.160	0.130
R^2	0.018	0.019	0.016
Observations	422,892	218,799	204,093

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is an indicator for whether the adolescent reported being bullied at school. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. Panel A limits the sample to white adolescents, while Panel B limits the sample to non-white adolescents. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 8: Greater Broadband Internet Access Was Associated with a Reduction in the Likelihood That White Adolescent Boys Reported Receiving an Age-Appropriate Amount of Sleep

	(1)	(2)	(3)
Sample →	All Adolescents	Adolescent Girls	Adolescent Boys
Panel A: Sample is Limited to White Adolescents			
1-SD ↑ Share Broadband	-0.026**	-0.008	-0.050***
	(0.012)	(0.017)	(0.015)
Mean	0.268	0.244	0.291
R^2	0.024	0.017	0.029
Observations	246,861	125,844	121,017
Panel B: Sample is Limited to Non-White Adolescents			
1-SD ↑ Share Broadband	-0.001	0.021	-0.015
	(0.017)	(0.029)	(0.014)
Mean	0.256	0.246	0.267
R^2	0.029	0.025	0.037
Observations	205,245	107,429	97,816

Source: National and State Youth Risk Behavior Surveys, 2009–2019.

Note: The dependent variable is an indicator for whether the adolescent reported receiving an age-appropriate amount of sleep. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. Panel A limits the sample to white adolescents, while Panel B limits the sample to non-white adolescents. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.

Appendix Table 9: Greater Broadband Internet Access Was Unrelated to Changes in Adolescent BMI Categories

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Outcome is an Indicator for Being Classified as Underweight			
1-SD ↑ Share Broadband	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)
Mean	0.024	0.019	0.030
R^2	0.004	0.004	0.003
Observations	1,159,531	588,576	570,955
Panel B: Outcome is an Indicator for Being Classified as Healthy Weight			
1-SD ↑ Share Broadband	-0.007	-0.006	-0.007
	(0.005)	(0.007)	(0.005)
Mean	0.668	0.710	0.627
R^2	0.022	0.024	0.009
Observations	1,159,531	588,576	570,955
Panel C: Outcome is an Indicator for Being Classified as Overweight			
1-SD ↑ Share Broadband	0.006	0.006	0.007
	(0.005)	(0.007)	(0.005)
Mean	0.307	0.271	0.343
R^2	0.023	0.028	0.011
Observations	1,159,531	588,576	570,955

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable in Panel A is an indicator for whether an adolescent was classified as "underweight," in Panel B an indicator for whether an adolescent was classified as "healthy weight," in Panel C an indicator for whether an adolescent was classified as "overweight." These BMI classifications are based on self-reported height and weight and age-for-sex BMI distributions. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. The estimates utilize survey weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table 10: The Relationship Between Greater Broadband Internet Access and BMI, by Race/Ethnicity

Sample →	(1) All Adolescents	(2) Adolescent Girls	(3) Adolescent Boys
Panel A: Sample is Limited to White Adolescents			
1-SD ↑ Share Broadband	0.084	0.045	0.123*
	(0.077)	(0.104)	(0.066)
Mean	22.894	22.534	23.244
R^2	0.036	0.030	0.032
Observations	668,011	338,844	329,167
Panel B: Sample is Limited to Non-White Adolescents			
1-SD ↑ Share Broadband	0.005	0.157	-0.137
	(0.114)	(0.154)	(0.096)
Mean	23.969	23.888	24.051
R^2	0.029	0.034	0.031
Observations	491,520	249,732	241,788

Source: National and State Youth Risk Behavior Surveys, 2009–2019.
Note: The dependent variable is body mass index (BMI) based on self-reported height and weight. The independent variable of interest is the share of the state population that had broadband internet access. The regression uses the full set of controls from equation (1). Column 1 examines all adolescents, column 2 limits the sample to adolescent girls, and column 3 limits the sample to adolescent boys. Panel A limits the sample to white adolescents, while Panel B limits the sample to non-white adolescents. The estimates utilize population weights. Standard errors, shown in parentheses, are clustered at the state level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$