VERY PRELIMINARY AND INCOMPLETE

Understanding Trends in Suicide and Suicidal Behaviors Among US Teens

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July 2024

Reports of suicidal behaviors in children and youth have steadily increased in the United States since the mid 2000s. These alarming trends have led the American Academy of Pediatrics to declare a state of national emergency in child mental health (AAP, 2021). The Surgeon General was moved to issue an advisory about child mental health (Murthy, 2021). As of 2021, suicide was the second leading cause of death for children 10-14 and the third leading cause of death for youth 15-19 making it imperative to try to understand the root causes of this increase. This paper seeks to shed light on these trends.

Conceptually, suicidal behaviors can be broken into three groups: Suicidal ideation or rumination about committing suicide (SI); non-lethal self-harming behavior including suicide attempts (self-harm); and completed suicides. We use data from the National Emergency Department Sample (NEDS) and from the Youth Risk Behavioral Surveillance System to examine trends in SI and self-harm, along with data about completed suicides from the Centers for Disease Control (CDC). We then further examine suicide deaths by cause and relate them to factors that may be related including measurement issues, changes in stigma and mental health treatment, social media use, firearm access, the opioid epidemic, and economic insecurity.

One reason to focus on SI and self-harm in addition to completed suicides is that they are thought to be strongly predictive of future suicide attempts. However, as we demonstrate below, trends in SI on the one hand, and self-harm and suicides on the other have increasingly diverged since the mid-2000s. Startling increases in SI appear to be driven at least in part by changes in hospital coding practices and increases in screening.

There are also huge level differences in the prevalence of these different behaviors. For example, in 2018-2019, teen suicide rates in New Jersey were 6 per 100,000, while the rate for any teen suicidal behavior among visitors to the emergency department (ED) was 756 per 100,000 with 619 of those visits involving SI. Cutler, Gleaser, and Norbert (2001) argue that suicides may be driven by different factors than other forms of suicidal behavior, which provides an additional reason for distinguishing clearly between them.[1]

We find that [to be completed when we have more results]

- SI, self-harm, and suicides follow different trends. The coding of SI during ED visits increased among girls following increases in depression screening, and in both girls and boys following changes in hospital coding of mental disorders which encouraged the coding of SI.
- The youth mental health crisis is of long standing. There have been large numbers of youth reporting "hopelessness" for as long as the question has been asked.
- These two points suggest that it is important not to conflate trends in depression, SI, self-harm, and suicide as they may have quite different determinants.
- Trends in hopelessness were flat until 2017 when they began to increase sharply.

[1] Cutler, Gleaser, and Norbert (2001) argue that completed suicide reflect a "strongly held intent to end one's life," but that most suicide attempts among youth are strategic actions intended to resolve conflicts. In keeping with this view, they also argue that family resources increase attempts but decrease completed suicides.

- The introduction of social media around 2004-2006 does not match trends in self-reported youth hopelessness.
- Youth hopelessness declined during the Great Recession.
- There are strong geographic differences in youth suicide rates and in other suicidal behaviors. It seems unlikely that differences in social media use can account for these patterns.
- Some western states have much higher youth suicide rates, as they have for decades. Suicide deaths have also increasingly diverged between high and low youth suicide states.
- Most youth suicides involve firearms, followed by strangulation. All other causes including poisonings are much less important.
- States with weak gun safety laws have much higher rates of youth suicide, largely because they have higher rates of firearm deaths.
- States with strong gun safety laws have low and stable rates of youth suicide by firearms. They have slightly higher rates of youth suicide by other means, but this does not offset the large gap in suicides by firearm.
- The gap in firearm suicides between states with strong and weak gun safety laws has grown since the mid 2000s.

Background: Trends and Possible Contributing

The literature on youth suicides focuses on documenting trends and on trying to identify the underlying causes of the increase over time. This section discusses several possible determinants of observed trends: Measurement issues, changes in stigma and mental health treatment, social media use, firearm access, economic uncertainty, and the opioid epidemic.

The role of measurement: Changes in screening and in the coding of suicidal behaviors

SI and self-harm (including suicide attempts) are often grouped together in analyses of trends in suicidal behaviors. In fact, both the commonly used Clinical Classification Software and the Child and Adolescent Mental Health Disorders Classification System combine the two into one measure (Zima et al. 2020; Children's Hospital Association 2019). In their study of suicidal behaviors and social media, Leventhal et al. (2021) define suicidal behaviors as "suicidal thoughts, plans, or attempts." And in their analysis of Health Care Utilization Project data on ED visits for suicidal behaviors Owens et al. (2020) only report data on the combined measure.

However, the recording of these conditions may be sensitive to measurement issues. Increases in screening would be expected to increase measured prevalence by finding cases that would otherwise have been missed. In 2011, two Affordable Care Act (ACA) mandates combined to increase depression screening. First, the ACA required the U.S. Preventive Services Task Force (USPSTF) to develop new guidelines for women's preventive care. The task force recommended screening women and girls over 12 for depression annually. Perhaps more importantly, starting in 2012 the Affordable Care Act required insurers to pay for all USPSTF-recommended screenings without patient cost-sharing. This change meant that providers could be confident that they would be reimbursed for screening girls. Importantly, screeners for

depression usually includes questions about SI (Patra and Kumar, 2022). Clearly, these changes would be expected to have had more of an impact on girls than boys.

A second important change occurred when hospitals were mandated to adopt the 10th edition of the International Classification of Disease (ICD10) in October 2015. The ICD10 brought many changes to the coding of mental health disorders including suicide and suicidal behaviors (Park and Kim, 2020; Grohol and Wright, 2022). Practitioners could no longer code the cause of an injury or poisoning as "undetermined" and had to take a stand on whether it was caused by self-harm or not. Stewart et al. (2016) use data from 10 large medical networks to show that this change was accompanied by a sharp increase in the number of injuries or poisonings due to self-harm (from about 10 to 15 per 100,000) and an offsetting decline in the number of injuries or poisonings with undetermined causes.

The ICD10 also brought more subtle changes. In October 2016, the Cooperating Parties in charge of implementing the ICD-10 recommended that providers code SI as a secondary diagnosis if present. Previously, claims could not be submitted with SI as a secondary diagnosis if the primary diagnosis was a mental health disorder. With this change, SI went from being treated as a symptom of another mental health condition to being treated like a condition in itself. This change is expected to have increased diagnoses of SI, and was reinforced by provider incentives to code multiple diagnoses if applicable in order to receive higher reimbursements for more complex cases.

Corredor-Waldron and Currie (2023) show that in New Jersey, these screening and coding changes were followed by large increases in the coding of SI. We ask whether those changes also occurred in other, higher suicide states. These changes suggest that it is increasingly necessary to disaggregate suicidal behavior into its component parts to properly understand trends in underlying behaviors.

Social media

Much has been made of the relationship between youth social media use and suicidal behaviors. For example, Twenge and Campbell (2019) use three different data sets to look at the relationship between screen time and mental health. One of these data sets, the Youth Risk Behavioral Surveillance Study (YRBSS) is the only one that has questions about suicidal behaviors. They show that the relationship is J-shaped. Youth with no social media time and those with high social media time both report poorer mental health than those with low but non-zero use of social media. However, those with the highest use report by far the worst mental health. Leventhal et al. (2021) look across waves of the same (cross sectional) survey and find that only a small proportion of the self-reported increases in suicidal behaviors is associated with self-reported increases in social media use. Several authors have concluded that the overall effects of social media use on mental health and suicidal behaviors are modest (Orben and Przybylski, 2019; Odgers and Jensen, 2020). Interestingly, it does not appear that anyone has investigated state or region-level differences in social media use and their relationship to suicidal behaviors using these data, possibly because geographic differences in social media use are small.

In economics, several studies report on experiments in which treated subjects were induced to reduce their social media use (Allcott et al. 2020; Mosquera et al. 2020; and Allcott, Gentzkow, and Song 2021). Treated subjects generally reported improvements in mental health relative to controls. Braghieri et al. (2022) study the effect of the staggered introduction of Facebook on over 700 college campuses between 2004 and 2005 on the mental health of college students. Although extrapolating the results to the present requires strong assumptions, they estimate that as much as a quarter of the measured increase in self-reported incidents of severe depression in young people between 2008 and 2018 might be due to the introduction of social media. Even taking this estimate at face value, this number still leaves much of the trend increase to be explained.

Although the three are clearly related, the relationship between changes in self-reported depression, completed suicides and other suicidal behaviors is unclear. In what follows, we use state-level data on social media use from the YRBSS to examine these relationships. In addition to questions on hours on social media, the survey asks whether teens have been bullied on social media. Bullying has been shown to be related to suicides among girls though not among boys (Rees et al., 2022).

Economic insecurity

Some observers have argued that economic factors are an important driver of suicide and that increases in economic insecurity following the Great Recession in 2007-2008 have had long-lasting effects on the mental health of young adults (Blanchflower et al., 2024). Employment did not recover until 2014, while median household income did not recover until 2016. However, as discussed below, we see a dip in concurrent youth suicides during the Great Recession, suggesting that any effects would have to have been delayed. In 2022 (the last year of our data), the current generation of 10 to 19-year-olds would have been quite young even at the end of the recession suggesting that any effects were likely to come through changes in parental stress levels and behaviors. Following this line of thought, we look for possible lingering effects of high unemployment rates among prime age adults at the time when the child state-age cohorts in our data were less than five years old and when they were 5 to 10 years old.

Firearms

Most deaths by suicide involve firearms even among the young, suggesting that differences in access to guns could make a major difference in the incidence of youth suicide. Having ready access to lethal means could mean the difference between momentary despair and a completed suicide. On the other hand, a lack of access to guns could merely cause people to substitute to other means.

It is remarkably difficult to accurately measure access to guns. Survey questions about whether respondents have a gun in their household are one common measure. The General Social Survey suggests that the number of households with a gun changed very little, from 36.5 to 35.2 percent, between 2000 and 2021 (Violence Policy Center, 2022). However, it is possible that many gun-owning households do not respond to social surveys such as the GSS. Estimates of the number of gun sales (based largely on background checks that are required in some states and for some

types of weapons but not for others) suggest that sales have continued to grow, and that they surged in 2020 (Joint Economic Committee Democrats, 2023). In terms of the stock of guns, it is estimated that there are about 120 civilian guns per 100 persons in the U.S., more than in any other country (Karp, 2018). These data suggest that many U.S. firearm owners have multiple guns, complicating attempts to measure gun access via gun ownership. Moreover, the type of gun could matter – it is considerably easier to commit suicide with a handgun compared to a rifle or shotgun.

In this paper we take a different tack, measuring the relationship between youth suicide and the strength of state gun laws using time-varying data from Everytown for Gun Safety (EGS). EGS rates the strength of state gun laws and has created an index that considers laws such as those that require background checks, safe gun storage, and preventing people in crisis from obtaining firearms as well as laws that allow concealed carrying of handguns or that allow people who feel threatened to "shoot first" (Suplino, 2024). They note that the gap in legal regimes between states has widened greatly in the last decade, suggesting that if gun access is an important factor, then trends in suicides are also likely to diverge between states with stricter and looser gun laws. Studies have shown that in the cross section, states with stricter gun laws have lower youth suicide rates (for example, Haines et al., 2024) but have not linked changes in gun laws to changes in youth suicide over time.

The YRBSS has several questions about guns and gun victimization that we examine. These include how many days the student carried a gun in the past 30 days, whether they were threatened with a weapon in the past 30 days, and whether anyone in their neighborhood has been injured by a weapon.

Other factors

Additional factors that are often discussed in conjunction with youth suicides are mental health stigma, mental health treatment, suicide contagion, drug use and other forms of delinquency, and the social disruption and loss surrounding the COVID-19 pandemic. These factors may have played a role in driving trends.

Pescosolido et al. (2021) use data from three waves of the General Social Survey (GSS, 1996, 2006, 2018) to argue that mental health stigma has fallen in the U.S. Over time, respondents were more likely to endorse a genetic basis for depression and were less likely to want to distance themselves from a depressed person at work or socially. At the same time, attitudes towards mental health care, and knowledge about mental health conditions have improved (Angermeyer et al., 2017). Since stigma leads to significant under-reporting of mental health conditions relative to other health conditions (Bharadwaj, Pai, and Suziedelyte, 2017) reductions in stigma might be expected to drive increases in the reporting of mental health conditions, increases in treatment, and greater openness about suicidal behaviors. Improvements in treatment, such as the introduction of SSRIs (Selective Seratonin Reuptake Inhibitors) may also have caused people with mental health problems to be more likely to seek treatment which might reduce suicide rates (Conti, Busch, and Cutler, 2011). Alternatively, greater openness about

mental illness combined with a higher probability of being in treatment could increase the counts of completed suicides by making the intentions of the deceased clearer.[2]

These observations raise the possibility that youth mental health as measured by indicators including hopelessness, SI, and self-harm could appear to be getting worse in part because of reductions in stigma and improvements in treatment. Although the available data is limited, we will ask whether the states or regions with the greatest reductions in stigma and increases in treatment rates have experienced changes in youth SI, self-harm, and completed suicide.

In the cross section, youth who use drugs or engage in other delinquent behavior are more likely to die by suicide (Cutler, Glaeser, and Norberg, 2001). However, it seems unlikely that these behaviors are driving aggregate trends given general reductions in youth delinquency following a peak in 1999 (Rovner, 2023). What might be more important is the alarming increase in opioid deaths, which have risen along with the increase in youth suicides. Among teens themselves, trends in drug use remained stagnant and trends in total deaths from drug overdoses were flat until 2019, when they began to spike. However, the spike appears to be due largely to the contamination of the drug supply with fentanyl (Friedman et al., 2021). At this point many teens have been impacted by losing friends or family members to the drug epidemic. We measure trends in drug deaths across areas using vital statistics mortality data and relate those to trends in suicidal behaviors.

Cutler, Glaeser, and Norberg (2001) cite a large literature about the contagion effects of suicide. They propose an indirect way to measure the importance of contagion based on an examination of "excess" variation in suicide rates across areas. Each area has some probability, ρ of youths dying by suicide, as well as some variance associated with ρ. The probability ρ is a binomial variable so its theoretical variance is known. Comparing the theoretical and the actual variances shows whether there is excess variance, which can be interpreted as indirect evidence of contagion effects. A contagion index can be defined as follows:

$$(1)\quad \text{index} = \{\text{var}\,[\rho_j - \rho_{us}]N_j^{**0.5}\}/\rho_{us}(1-\rho_{us}),$$

where N_j is the area j population, ρ_j is the area j suicide rate, and ρ_{US} is the U.S. suicide rate for the relevant demographic group. An index of one indicates that there are no contagion effects. We implement this test and compare the value obtained to that obtained by Cutler, Glaeser, and Norberg (2001) using data from 1989-1990 (that value was 156 computed using data at the county-group level). Note that while social media might amplify contagion effects, it may also make it harder to detect them using geographical differences since on social media teens can be influenced by deaths of people who are socially close by geographically far away.

The COVID-19 pandemic impacted every aspect of children's lives and had a large impact on children's mental health. Ng and Ng (2022) review more than 2000 articles on this theme and find abundant evidence of increases in both internalizing (e.g. mood disorders) and externalizing (e.g. ADHD) behaviors among children during the pandemic. Ridout et al. (2021) discuss

[2] O'Carroll (1989) and Breiding and Wiersema (2006) point out that the deceased intentions are often unclear, especially in the case of drug overdoses.

changes in the use of EDs for suicide-related behaviors. Bridge et al. (2023) show that there were more youth suicides during the later months of 2020 than would have been expected based on data from the previous five years. However, these rates seem to have declined again in 2022 and this temporary change is not our main focus.

Finally, Cutler, Glaeser, and Norberg (2001) argue that single-parent households and female labor supply explained much of the cross-sectional variation in youth suicides across county groups in 1989-1991, especially among males. However, female labor force participation has been largely stagnant since 2000 and the number of children living in single-parent households has only increased slightly. In what follows, these variables are treated as controls.

Data

Data for studying SI and self-harm comes from the 2006 to 2021 NEDS from the Healthcare Cost and Utilization Project (HCUP)[3] and from the YRBSS.

NEDS is the largest all-payer ED database in America with data from around 30 million ED visits in 2021. The data represent ED visits from hospitals in 39 States and the District of Columbia and approximate a 20 percent sample of hospital-owned EDs.[4] The NEDS data includes patient age and sex, urban-rural residence (large central metro, large fringe metro, medium metro, small metro, micropolitan, noncore), national quartile of median household income for the patient's zip code, expected payment source of insurance (Medicaid, Medicare, self-pay, private insurance, no charge, other), identification of injury-related visits, discharge status, and diagnosis codes (ICD-9 before October 1, 2015 and ICD-10 afterwards). These data also include hospital characteristics such as trauma center indicators and teaching status. These data do not include any geographic indicator except for four Census regions. They are also missing household background information such as family income or labor supply. In our graphical analyses, we utilize the NEDS discharge weights for each year to graph nationally representative estimates of the suicidal ideation visits among teens.

Information about suicides by state, year, and five-year age groups (10-14, 15-19, 20-24) comes from the Center for Disease Control's CDC Wonder Underlying Cause of Death Files. County-level data comes from the National Vital Statistics Mortality files. Because youth suicide is a thankfully rare outcome, many cells (especially for females) have suppressed data even at the state level. Moreover, data about many important explanatory variables is available only at the state level. Therefore much of our analysis is at the state level though we conduct some analyses at the county-group level; that is we use data on large counties where available and group other counties in a state into a "rest of state" county group.

The YRBSS-Highschool is set of surveys of high schoolers that have been conducted biannually since 1999. It is the largest source of health surveillance data about highschoolers. In addition to the national YRBS, most states (45 in 2021) administer their own YRBS surveys. The survey

[3] Further information about the NEDS is available here: NEDS Overview. Accessed July 20, 2024. https://hcup-us.ahrq.gov/nedsoverview.jsp.

[4] NEDS is designed as a stratified cluster sample where strata are defined by hospital characteristics such as urban or rural, hospitals are sampled, and every observation for a sampled hospital is included.

is conducted in schools, usually in the spring. In addition to the questions about social media and gun use discussed above, students are asked about about suicidal ideation (considering suicide), making a plan to commit suicide, and attempting suicide. The survey also asks about whether there was a time in the past 12 months that the student felt so sad or hopeless that they stopped some of their usual activities, and about internet use and internet bullying, as discussed above. A disadvantage of the YRBSS is that little demographic information is available beyond age and gender making it impossible to control for family income and family structure.

Everytown for Gun Safety conducts an annual survey of state gun safety laws and collects information about whether states have passed (or repealed) more than 50 separate laws. They have also created an index based on this survey which allows states to be ranked in terms of the strength of their gun safety laws. And they identify the subset of laws that they consider most important to promoting gun safety.

State-year level data to be included as controls – current and past unemployment and employment to population ratios; percent college educated; percent poor; percent white, Black, Hispanic, other race; percent young; percent with health insurance; percent single parent households; female labor force participation.

General Social Survey 1996, 2006, 2018 [for stigma measures]

[To be completed]

Methods

Much of our analysis of trends is graphical. [All of it to date]. Individual-level data is aggregated to either the age-group, state, and year level or the age-group, region, and year level depending on data availability. Our focus is on 10–19-year-old youth.

Analyzing Screening and Coding Changes in the NEDS

We then turn to regression analysis to test specific hypotheses about the data. The discussion of screening and coding changes above suggested two specific hypotheses that can be examined using the individual-level NEDS ED data. First, diagnoses of SI are expected to have increased among girls more than boys following the new USPSTF guidelines in 2011. To test this hypothesis, we estimate the following model using NEDS individual ED visit-level data from 2006 to 2015:

$$(1)\ Y_{ijt} = \alpha + \beta_1 2012 * FEMALE_{it} + \beta_2 2013 * FEMALE_{it} + \beta_3 2014 * FEMALE_{it} + \beta_4 2015 * FEMALE_{it} + \beta_5 FEMALE_{it} + \beta_6 AGE_{it} + \beta_7 INS_{it} + \beta_8 MONTH_{ijt} + \beta_9 HOSPITAL_{jt} * YEAR_t + \varepsilon_{ijt},$$

where Y_{ijt} is an indicator variable for emergency department visits with a suicidal ideation diagnosis for person *i*, in hospital *j*, and year *t*. The coefficients of interest are the interactions on the indicator for $FEMALE_i$ interacted with indicators for each year after 2011. To focus on the changing effect of being female, the model controls for several variables that may be associated

with the coding of SI including a vector of single year of age indicators; an indicator for whether the person was covered by Medicaid, private insurance, or a residual category; indicators for the month of the ED visit; and a full set of hospital by year fixed effects. The latter control for differences in the way that hospitals may be coding visits over time, as well as differences in geographic location and time trends. By including these controls, we focus on the differences between the way that males and females are treated within the same hospital year. The coefficient β_5 represents the difference in diagnoses of suicidal ideation for females relative to males from 2008 to 2011. Coefficients β_1 through β_4 represent differences in diagnoses of suicidal ideation in each of the indicated years for females relative to males. Positive estimates for β_1 through β_4 indicate an increasing gender gap in suicidal ideation diagnoses post-2011.

A second model focuses on the switch in coding instructions that accompanied the change from ICD-9 to ICD-10. Since the change in coding instructions for SI involved coding secondary diagnoses of SI when a mental health diagnosis was primary, the increase in SI post-2016 should be greater for youth with a primary diagnosis of mental illness. Moreover, this effect may be particularly large for people with mood disorders, since screening for mood disorders may uncover SI. This model is estimated using individual-level ED visits from 2013 to 2021 to capture the coding change after 2016 and takes the form:

$$(2)\ SI_{ijt} = \alpha + \beta_1 2016 * MD_{ijt} + \beta_2 2017 * MD_{ijt} + \beta_3 2018 * MD_{ijt} + \beta_4 2019 * MD_{ijt} + \beta_5 2020 * MD_{ijt} + \beta_6 2021 * MD_{ijt} + \beta_7 2016 * OMH_{ijt} + \beta_8 2017 * OMH_{ijt} + \beta_9 2018 * OMH_{ijt} + \beta_{10} 2019 * OMH_{ijt} + \beta_{11} 2020 * OMH_{ijt} + \beta_{12} 2021 * OMH_{ijt} + \beta_{13} MD_{ijt} + \beta_{14} OMH_{ijt} + \beta_{15} FEMALE_{it} + \beta_{16} AGE_{it} + \beta_{17} INS_{it} + \beta_{18} MONTH_{ijt} + \beta_{19} HOSPITAL_{jt} * YEAR_t + \varepsilon_{ijt},$$

Where SI_{ijt} is an indicator for ED visits with SI, MD_{ijt} is an indicator for mood disorder as the primary diagnosis, OMH_{ijt} is an indicator for other mental health disorders as the primary diagnosis, and the other variables are defined as before. In these models, the coefficients on β_1 to β_6 measure the extent to which new SI diagnoses take the form of secondary diagnoses for people with mood disorders. The coefficients on β_7 to β_{12} capture to the extent to which increases in SI are associated with primary diagnoses of other mood disorders.

As discussed above, the NEDS does not allow us to identify state of residence, making it difficult to test hypotheses about determinants of trends in suicidal behaviors. However, we can estimate models like (1) and (2) separately for each region to see if changes in screening and coding had a greater impact in some regions than others.

State-year-age-gender level analyses

To investigate hypotheses about causes of the trends, we turn to data aggregated by state, year, gender, and age group. Even with aggregation, the very low number of suicides in some cells makes inference difficult. Another difficulty is that some policies may be endogenous – for example, states might enact changes in gun laws in response to a spike in youth suicides. Hence, the main aim of these analyses is to see whether within-state variation in suicide rates varies with

factors such as gun safety laws, social media use, early life exposure to economic hardship during the Great Recession, mental health treatment, and stigma surrounding mental illness.

For example, regressions examining variation in gun safety laws take the form:

$$(3)\ SR_{st} = \alpha + \beta_1 GUN_{st-1} + \beta_2 STATE + \beta_3 YEAR + \beta_4 STATECHARS_{st} + \varepsilon_{ijt},$$

where SR_{st} is the suicide rate in the relevant state, year, gender, and age group and GUN_{st-1} is an indicator for the index of gun safety laws in the previous year. We use laws in the previous year to try to avoid reverse causality and also investigate both leads (which should not matter) and lags of changes in gun laws. The model controls for a vector of state and year effects, as well as time-varying state characteristics such as unemployment and/or employment to population ratios; percent college educated; percent poor; percent white, Black, Hispanic, other race; percent young; percent with health insurance; percent single-parent families; and female labor force participation. The model will be estimated separately for each age and gender group as well as for combinations of these groups.

Models for other factors are specified similarly. The aim is to zero in on those factors that are most highly correlated with the trends we observe, and therefore most likely to be contributors.

[To be continued]

Results

[There will be discussion of a means table here]

Figure 1 shows trends in teen suicide rates from 2008-2020 in four Census regions

[This will be updated to 1999-2022].

Figure 1 shows that teen suicides peaked in 2017. After 2017, they fell in the Northeast and Midwest and leveled off in the South and West. The figure shows a strong regional difference in both levels and trends in suicide rates. By 2019-2021, Western states including Montana, South Dakota, and Alaska had suicide rates of 34.1, 37.2, and 41.3 per 100,000 15–19-year-old youths.[5] In contrast, rates in Massachusetts, New Jersey, New York, and California were 4.8, 5.2, 5.4 and 6.5 per 100,000 15–19-year-old youths. These large differences suggest that focusing on regions obscures important variation especially since the West includes both some states with the lowest youth suicide rates and some states with the highest. The pattern of extreme variation suggests that state-level factors such as gun laws may be important determinants of youth suicide.

Suicidal Ideation and Self-Harm

Figure 2 shows trends in SI and self-harm, from 2008 to 2020, for teens 10-19 in four Census regions from the NEDS [This will be updated 2006-2022]. The 2011 change in screening girls

[5] Cutler, Glaeser, and Norberg (2021) point out that some of these same states experienced the largest increases in youth suicides between 1950 and 1990.

for depression, and the post 2016 change to the ICD10 coding instructions are indicated by dashed vertical lines in each quadrant. Because the level of suicides is so different from that of other suicidal behaviors, it is omitted from this graph.

Figure 2 shows that ED visits for SI and self-harm were initially more similar to each other in all four regions, though they were lower in the South and in the West than in the Northeast or Midwest. However, SI diagnoses pulled away from self-harm over the entire period. One can see trend breaks in SI in three out of four regions after 2011 (but not in the South) and in all four regions after 2016. Trends in self-harm are smoother, although there is an uptick after 2017 in the West and Midwest. By the end of the period, visits for self-harm were lowest in the Northeast and far higher in the Midwest.

Figure 3 normalizes all three series to start with 2008=1. [This will be updated to 2006]. The figure shows that deaths and self-harm track each other closely while SI increasingly diverges from the other two. Hence, measures of suicidal behaviors that include SI are misleading if they are presented as synonymous with trends in suicide deaths.

Figures 2 and 3 indicate that diagnoses of SI rose rapidly throughout most of the period with some evidence of inflection points after 2011 and 2016. To see the association with increases in screening after 2011, Figure 4 breaks down SI diagnoses by gender. Figure 4 clearly shows a gender gap in SI diagnoses that widened after 2011. In contrast, the coding changes after 2016 appear to have affected both males and females so that gender gaps remain constant after that point.

These data suggest that recorded rates of SI are influenced by screening and coding changes and do not necessarily track underlying rates of self-harm or suicide rates in youth. Moreover, the extent to which screening and coding changes mattered appears to have varied substantially between regions making comparisons of trends in SI across regions problematic.

Self-Reported Data from the YRBSS

Figure 5 shows self-reported data from high school students who participated in the YRBSS between 1999 and 2021. [Will also report this by region and/or state. Also, although not shown trends for males and females are similar though female levels are about 2X higher]. Comparing the series for "seriously considered suicide" and "made a plan for a suicide attempt" from 2008 onwards to Figures 2 and 3 suggests that the trends are roughly similar in that they increase after 2011 and again after 2017. However, the rates for SI and attempted suicide are more parallel in the YRBSS than in the hospital-reported data in the NEDS, which again suggests that the NEDS data are being influenced by the screening and coding changes discussed above.

Looking further back, these series all show a pronounced dip during the Great Recession and then a rise subsequently. This pattern means that analyzing data starting from the Great Recession to the present is likely to yield a steeper increase in the trends than if one starts at an earlier date.

A second striking feature of Figure 5 is the sharp rise in all series after 2017. The increase in the fraction of teens who said they felt hopeless enough in the past year to change their usual activities is especially striking because the rate had been hovering at slightly less than 30% since 1999 when the question was first asked. Then, between 2017 and 2021, the rate rose from around 30% to over 40%. It is notable that suicides spike in 2017 and then fall while self-reported hopelessness continues to rise suggesting that there is no simple relationship between these series.

Figure 5 shows that the youth mental health crisis is of long-standing. There have been large numbers of youth reporting hopelessness for as long as the question has been asked. Figure 5 also suggests that the idea that the introduction of social media around 2004-2006 is responsible for the recent deterioration in youth mental health does not match well with the time series evidence. It is also notable that youth mental health apparently improved in the depths of the Great Recession relative to just before or just afterwards, casting some doubt on the theory that economic insecurity had a negative impact, at least immediately. Finally, Figure 5 strongly suggests that something changed around 2017, and that potential explanations should take this timing into account.

Cause of Death

Figure 6 shows suicide deaths for 10–14-year-old and 15–19-year-old teens by cause. Suicide is thankfully rare among 10–14-year-old teens, so that the overall statistics for 10-19 are dominated by the older teens. In this group, firearms are the leading cause of death, followed closely, or at times equaled by, suffocation. All other means, including poisonings are quite small.

The sheer number of firearm suicides suggest that gun safety policies may be important. The relationship between gun laws and teen suicide is explored using state-level data in Figure 7. The Figure shows trends in the 8 states with the strictest gun safety laws (California, New York, Illinois, Connecticut, Hawaii, Massachusetts, New Jersey, and Maryland) and the 14 states with the loosest gun safety laws (Kansas, Missouri, New Hampshire, Kentucky, Alaska, Arizona, Oklahoma, Wyoming, South Dakota, Georgia, Montana, Idaho, Mississippi, and Arkansas) as of 2024 (Everytown Research and Policy, 2024).

Figure 7 shows that in the weak gun law states, firearm suicides approximately doubled between 2006 and 2017, while in strong gun law states, they were almost flat. In the weak gun law states, most of the increase is accounted for by gun deaths, though there is also a somewhat smaller rise in deaths by suffocation. Other means of death account for negligible numbers of suicide deaths. In the strong gun law states, suffocation accounts for the majority of the increase in suicides, with other causes also showing a very modest increase. Suicide deaths by suffocation are quite similar in the two groups of states, suggesting little scope for substitution between guns and other means. However, only a small fraction of the gap in gun deaths is accounted for by other means of death, leaving a wide and widening gap between the two groups of states.

[Regression estimates aimed at identifying the impacts of changes in factors discussed above to be added here]

Discussion and Conclusions

[To be completed]

Figure 1:

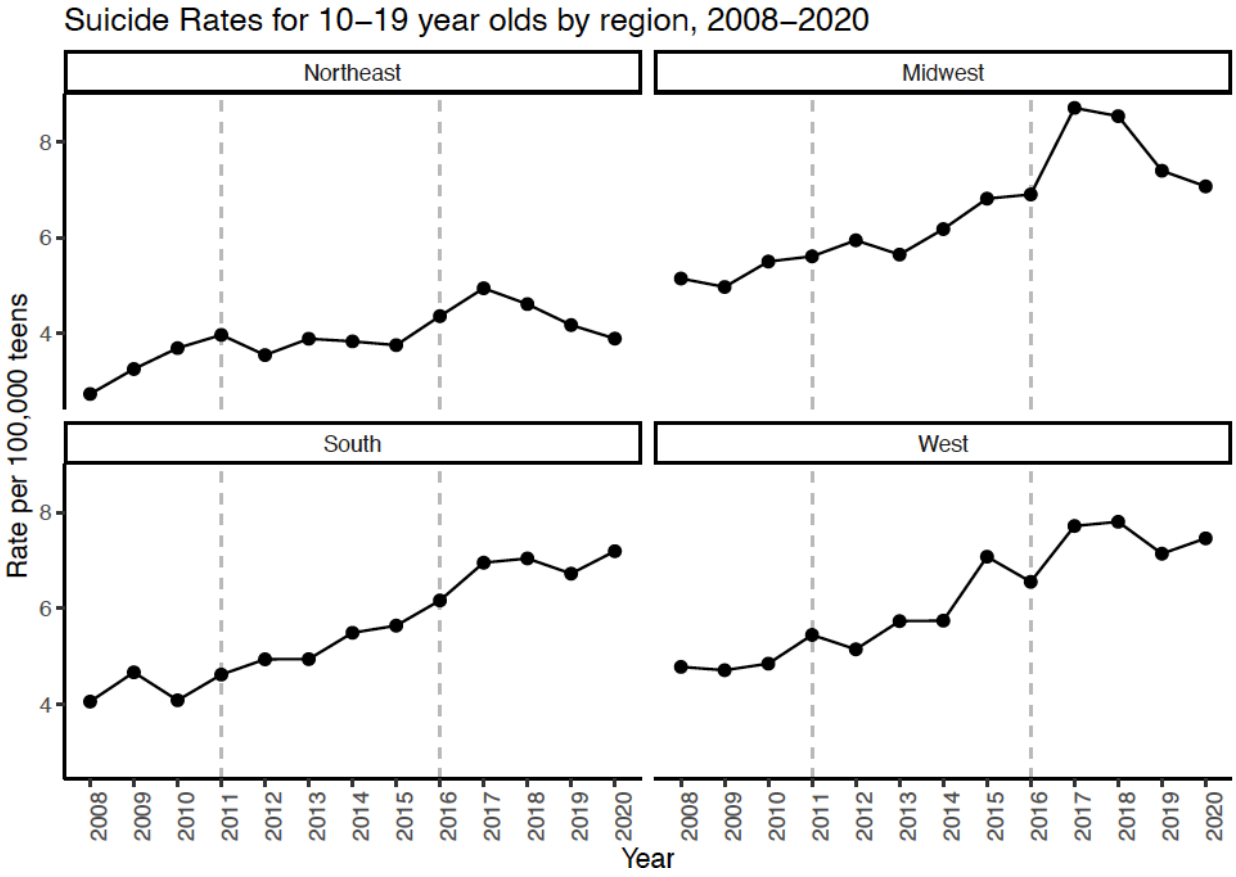

Suicide Rates for 10–19 year olds by region, 2008–2020
Northeast
Midwest
South
West
Rate per 100,000 teens
4
6
8
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year

Figure 2:

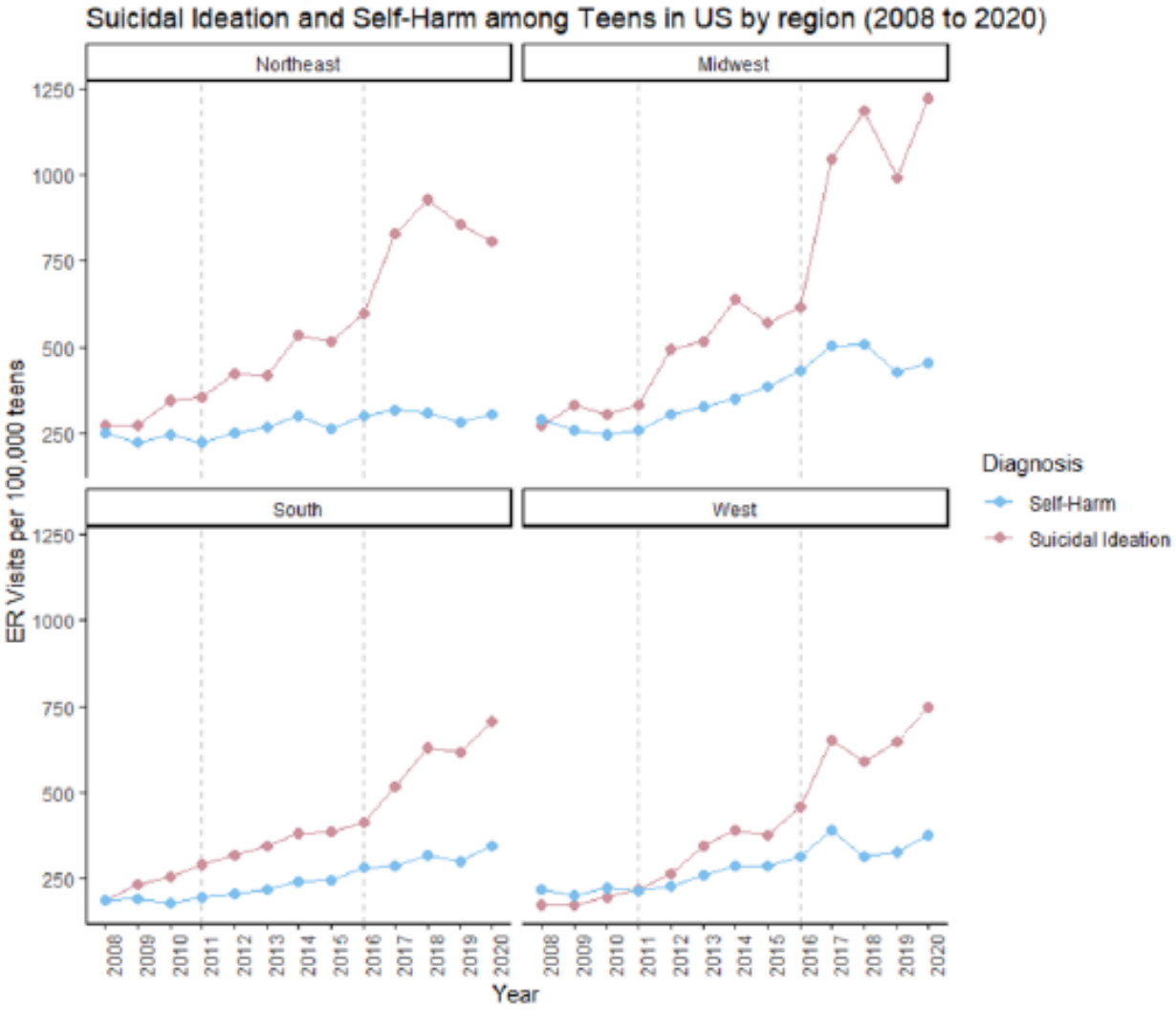

Suicidal Ideation and Self-Harm among Teens in US by region (2008 to 2020)
Northeast
Midwest
South
West
ER Visits per 100,000 teens
1250
1000
750
500
250
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year
Diagnosis
Self-Harm
Suicidal Ideation

Figure 3:

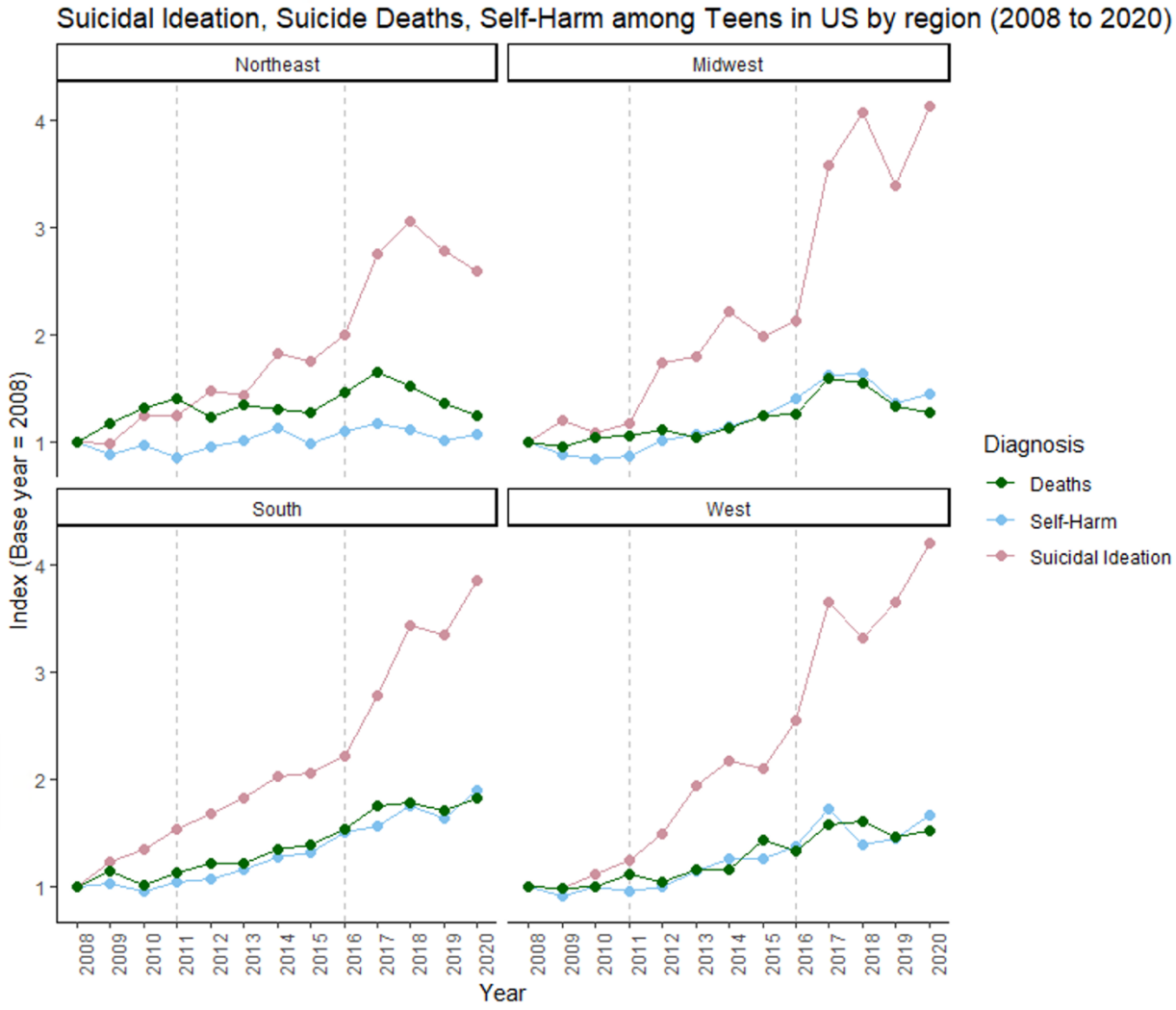

Suicidal Ideation, Suicide Deaths, Self-Harm among Teens in US by region (2008 to 2020)
Northeast
Midwest
South
West
Index (Base year = 2008)
Year
Diagnosis
Deaths
Self-Harm
Suicidal Ideation

Figure 4: Trends in Suicidal Ideation Diagnoses by Gender and Census Region

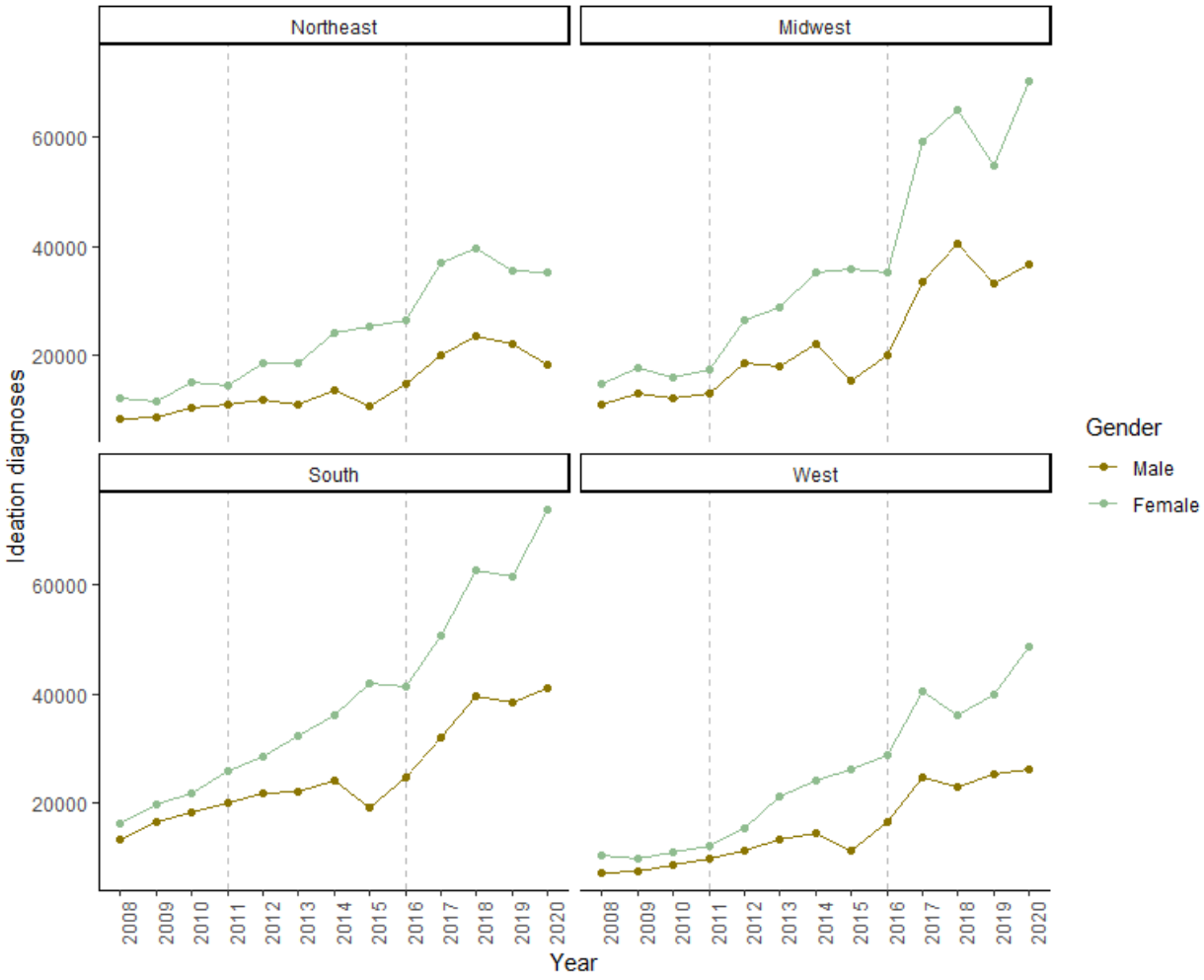


Figure 5: Trends in Self-Reported Suicidal Behaviors and Hopelessness Among High School Students

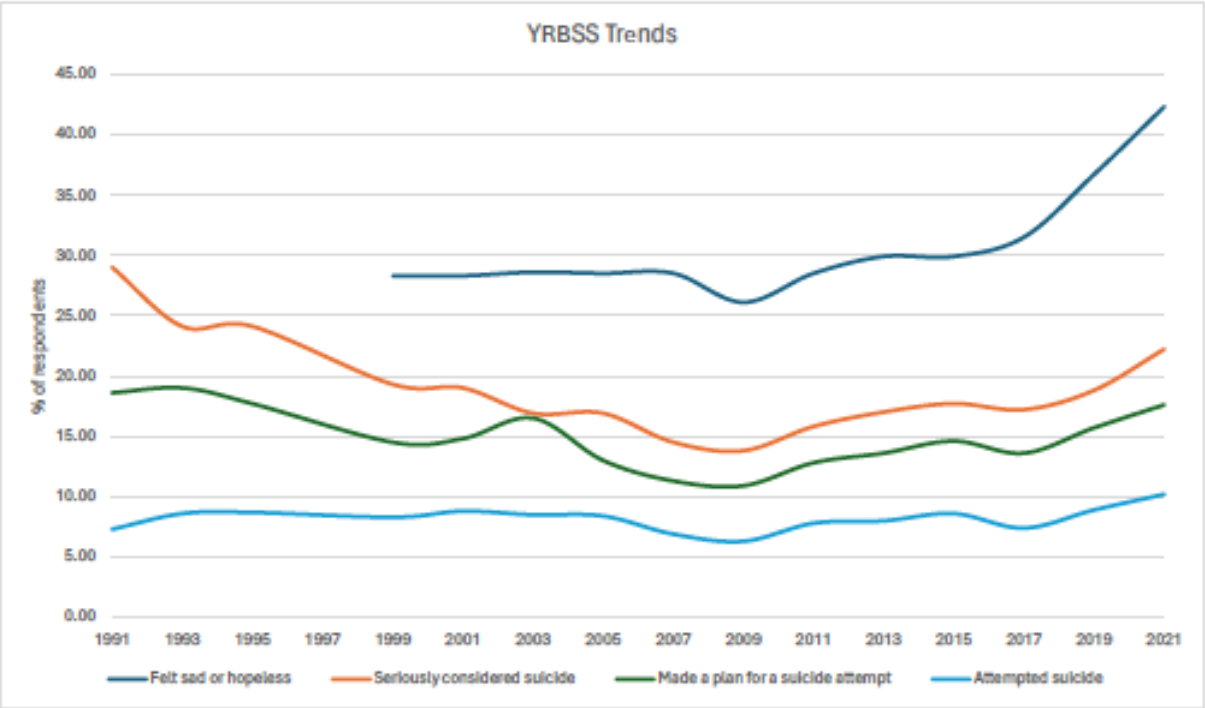


Figure 6: Suicide Deaths per 100,000 10-14 or 15-19 Year Old Teens by Cause

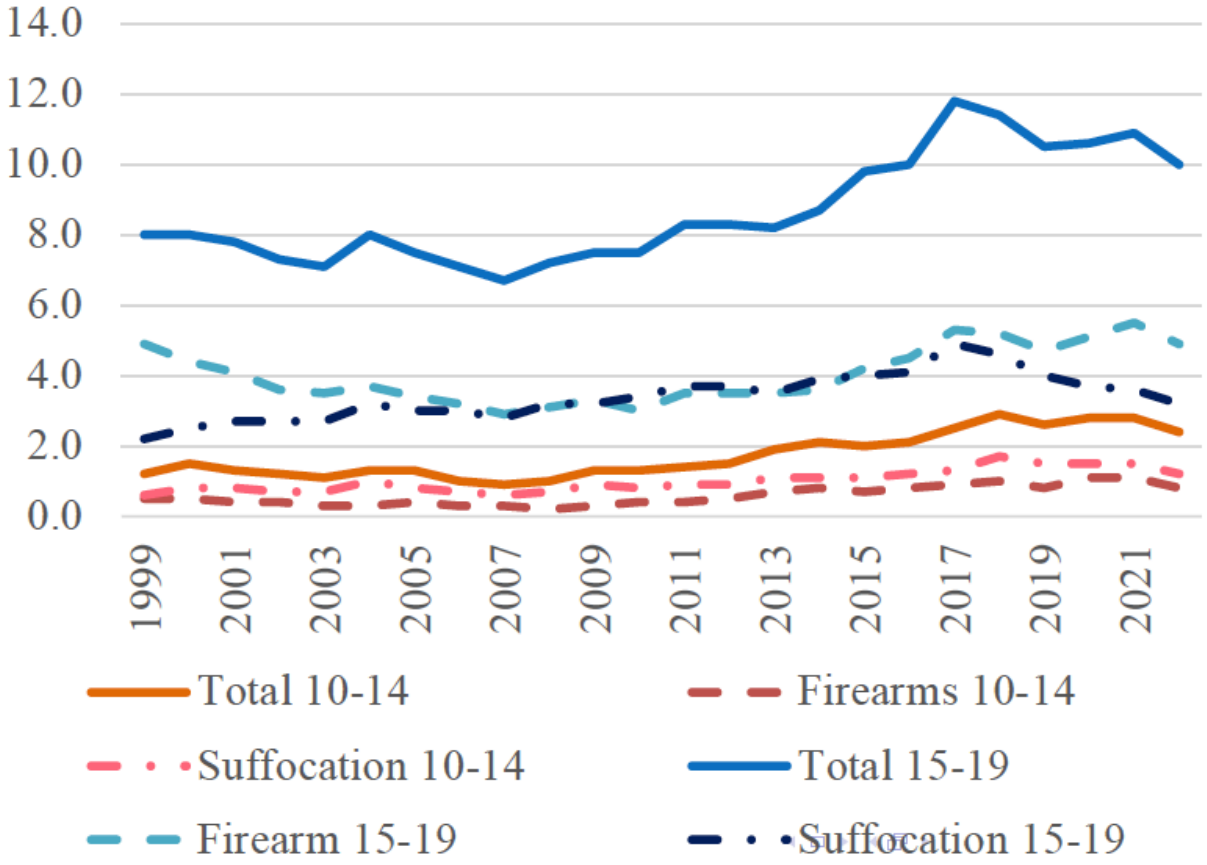


Figure 7A: Self-Harm Deaths per 100,000 Teens 10-19, States with Weak Gun Laws

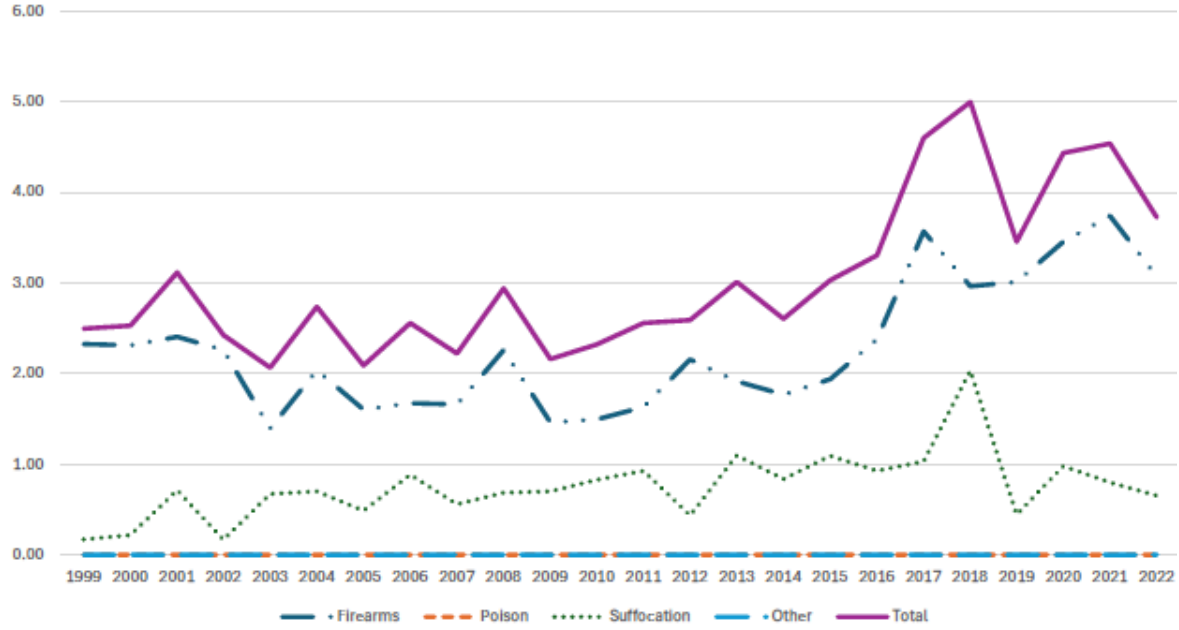
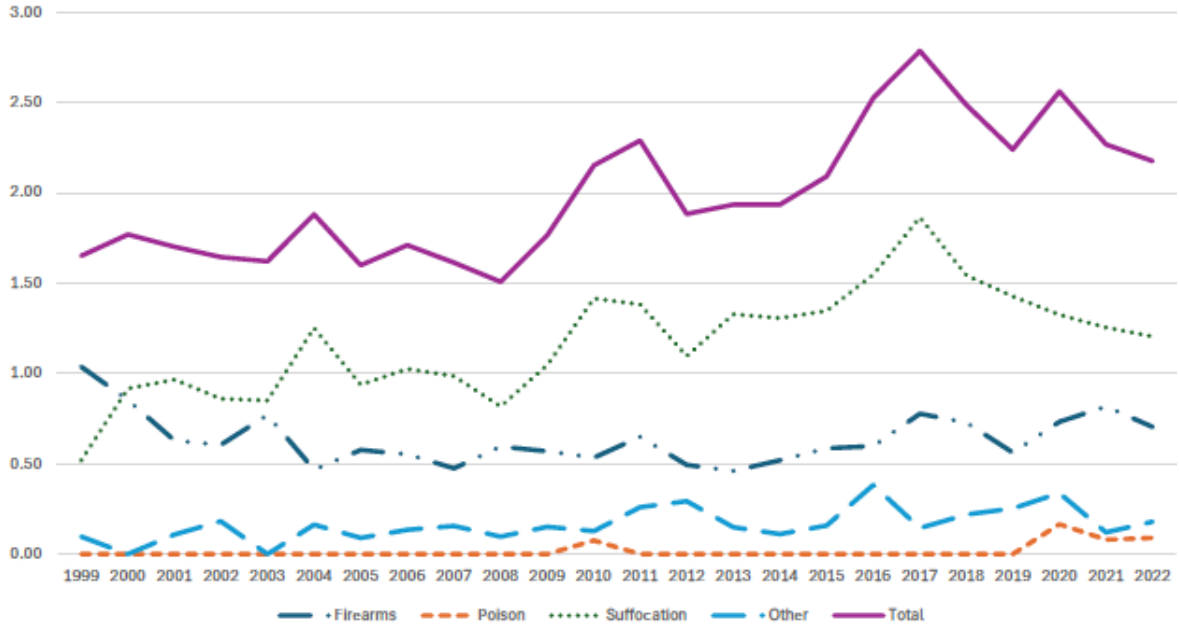


Figure 7B: Self-Harm Deaths per 100,000 Teens 10-19, States with Strong Gun Laws



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