Trends in Suicide and Suicidal Behaviors among Teens in the United States

Han Choi
Princeton University

Adriana Corredor-Waldron
North Carolina State University

Janet Currie
Princeton University

Chris Felton
Harvard University

Abstract

          Reports of suicide in children and teenagers in the United States have steadily increased over the past two decades. This paper explores how trends of suicidal behaviors, though predictive of suicide deaths, may not completely reflect trends of suicides and could be influenced by changes in reporting and screening. Using the National Emergency Department Sample Database (NEDS), we analyze trends of suicidal ideation, self-harm, and suicide deaths among children aged 10 to 19 in the U.S. between 2006 and 2020. We investigate the rise in adolescent suicide-related hospital visits in two inflection points, in 2012 after the release of screening recommendations and in 2016 after changes in the diagnostic coding. Our findings echo prior results in New Jersey showing sharp increases in emergency room (ER) visits related to suicidal ideation, in 2012 and 2016, which we speculate are likely influenced by changes in reporting and screening practices. Meanwhile, we find a gradual rise of self-harm behaviors and a flat consistency of suicide deaths. These results allude to how trends of suicide-related behaviors may not reflect trends of suicide deaths. Nonetheless, changes in screening and coding may bring greater attention to widespread mental health issues.

Introduction

          Suicide is the third leading cause of youth mortality in the United States, and suicide rates have continued to rise for the past few decades.[1] Suicide continues to take the lives of youth and has become an increasingly prominent public health issue. The rate of suicide among 15- to 24-year-olds in United States started to increase in the 1950s and then tripled by 1980.[2] Then, from 2000 to 2007, the suicide rate for 10- to 24-year-olds remained stable at around 6.8 per 100,000 in 2007 and then increased dramatically to 11.0 per 100,000 by 2021.[3] Researchers have pointed to social media, increased broadcasting of suicides, worldwide conflict and terror, high substance use, and economic instability as potential causes. We highlight that some of the recent influxes in suicidal ideation visits could be due to the changes in screening and coding.

          Recently, Corredor-Waldron and Currie (2024) analyzed the rise in reported rates of suicide-related behaviors among adolescents in New Jersey from 2008 to 2019. In the most recent updates by the CDC for 2021, New Jersey had the lowest suicide rate (7.1) among all states in America.[1] Meanwhile, suicide rates in the United States range from 7.1 (New Jersey) to 19.5 (Arizona) all the way to 32.3 per 100,000 (Wyoming). We examine national trends in suicide-related behavior to explore how reporting changes affected trends in suicide-related ER visits more broadly. In this paper, we focus on ER visits for suicidal ideation and self-harm among teens in the U.S. between 2008 to 2020, capturing recent screening and coding changes as well as the start of the recent COVID-19 pandemic. We also look more specifically within each of the four regions of the United States. We observe upward trends in ER visits for both self-harm and suicidal ideation, but only the latter shows sharp increases following reporting and coding changes.

          We pay close attention to the sharp increase in suicidal ideation among teenagers as most of the rise in suicide-related hospital events stems from rising rates of ER visits for suicidal ideation. Suicidal ideation defined by the National Institute of Health describes a "range of contemplations, wishes, and preoccupations with death and suicide."[4] Two events correspond with sharp increases in emergency department visits for suicidal ideation: (i) the changes in screening for depression among teenage girls that occurred around 2011 and (ii) the changes in the diagnostic coding of suicidal ideation in hospitals which started around October 2015. We examine the effects of these events on ER visits for suicidal ideation among teenagers in the

United States and explore how effects differ by sex and region. Our study attributes the spikes in ER visits for suicidal ideation to these changes in screening and coding.

Changes in Screening

The U.S. Preventive Services Task Force (USPSTF) is an independent panel of experts that develops recommendations for clinical preventive services.[5] Up to 2004, the USPSTF concluded that "the evidence is insufficient to recommend against routine screening by primary care clinicians to detect suicide in the general population." In 2008, the American Academy of Pediatrics (AAP) released the Third Edition of the Bright Futures Guideline for Healthy Supervision of Infants, Children, and Adolescents which had no mention of recommendations for mental health screening.[6] Then, in 2009, the USPSTF recommended screening of adolescents (12–18 years old) for major depressive disorder to be implemented with adequate systems to ensure accurate diagnosis, effective treatment, and appropriate follow-up, with a grade of B which recommends physicians to provide this service.[7] A year later, the Affordable Care Act (ACA) enacted in March 2010 required that most health insurance plans should provide at least minimum coverage and not impose any cost sharing requirements for several preventive services including evidence-based items that have a rating of "A" or "B" in the current recommendations of the USPSTF, care and screenings with respect to women in guidelines by the Health Resources and Services Administration, and more[8]. The ACA also commissioned the Department of Health and Human Services (HHS) to create further guidelines for women, which it did the following year. In August 2011, the HHS and the Health Resources and Services Administration (HRSA) developed the Women's Preventive Services Guidelines (WPSG) and by 2012, the ACA had mandated that insurance plans must cover the services outlined in these guidelines including an annual depression screening for women and girls aged 12 and older without cost sharing.[9,10] Consequently, most of the increase in ER visits for suicidal ideation that we observe occurs among teen girls.

Changes in Coding

Starting around 2014, the health care industry started to prepare the transition from the 9th edition of the International Classification of Diseases (ICD) to the 10th edition. Then, the HHS stated that the new compliance date for hospitals across the United States to switch to the new ICD-10 was October 1, 2015. In the same year of 2015, the AAP and the Bright Futures also released a recommendation for screening for depression as a preventive pediatric service starting from age 11. Additionally, in January 2016, the USPSTF released another recommendation with a grade of B, recommending screening for major depressive disorder for adolescents, but relaxed the requirement on systems that need to be in place.[7] Meanwhile, in 2015, the Centers for Disease Control and Prevention (CDC) posted some corrections to the ICD-10 coding guidelines, stating that some codes for mental health symptoms including suicidal ideation (R40–R46) can now be assigned with codes for mental disorders (F01–F99), although they previously were not permissible to be coded together (cite CDC). This revision in the ICD-10 instructional notes directly instructed the clinicians to record suicidal ideation as a secondary diagnosis in cases with a primary diagnosis of a mental health condition starting 2016.[11] Therefore, we also examine this period of 2016, where we note changes in emergency department visits for suicide-related behaviors, particularly suicidal ideation, among all teenagers. Later, in 2018, the AAP released a statement of endorsement recommending universal screening of depression or depressive disorders among adolescent patients 12 years of age and older at health care visits.[12]

Data

        This study uses data from the National Emergency Department Sample (NEDS) which is part of the Healthcare Cost and Utilization Project (HCUP). HCUP is the largest collection of longitudinal hospital care data in the United States and NEDS is the largest all-payer emergency department (ED) database in America[27]. Datasets from HCUP are restricted as they contain clinical and resource-use information from hospital medical records. NEDS contains "data from around 30 million ED visits in 2021, unweighted and estimates about 127 million hospital-owned ED visits, weighted".[27] The NEDS data includes a large sample size of "discharge data for ED visits from 993 hospitals located in 39 States and the District of Columbia, approximating a 20-percent stratified sample of U.S. hospital-owned Eds."[27] NEDS is a stratified cluster sample of hospitals where strata are defined by hospital characteristics, and every observation is taken for each cluster. The hospital data comes from the State Inpatient Databases and the State Emergency Department Databases to create national and regional estimates of ED care.

        The data includes the patient demographics characteristics including age, sex, urban-rural designation of residence (large central metro, large fringe metro, medium metro, small metro, micropolitan, noncore), national quartile of median household income for patient's zip code, hospital characteristics such as region, trauma center indicator, teaching status, expected payment source of insurance (Medicaid, Medicare, self-pay, private insurance, no charge, other), identification of injury-related visits, discharge status, and ICD-9 diagnosis prior to October 1, 2015 and ICD-10 diagnosis starting from the same date.[27] For our analysis, we include all patient demographics characteristics, year and month of hospitalization, hospital region, primary insurance payment source, and the ICD-9 and ICD-10 diagnoses.

Methods

For our graphical analysis, we aggregate the individual-level data to the annual level and compute rates per 100,000 teens ages 10–19 years old from 2006 to 2020 using population and mortality data from the Center for Disease Control (CDC).[28] In our graphical analysis, we utilize the HCUP-provided discharge weights for each year to graph nationally representative estimates of the suicidal ideation visits among teens. Then, we use a linear regression model with hospital, year, month, and age fixed effects and clustered standard errors to analyze the data. We estimate clustered standard errors at the hospital-year level to account for dependence across observations. The regression analyses assess whether the inflection points in 2011 and 2016 are associated with the screening recommendations and the changes in coding.

        The first model uses data at the individual visit level from 2006 to 2015 and explores the changes that may have happened in relation to the implementation of the annual depression screening for women and girls by the Women's Preventive Services Guidelines in 2011. Given that the mandate was only for females, we estimate the impact of the screening change on females relative to males. We restrict our data from 2006 to 2015 for the first model to specifically look at the screening change in 2011 and not capture any changes that were made in the following years.

$$
\begin{aligned}
Y_{ijt} = \alpha &+ \beta_1 2012 * FEMALE_i + \beta_2 2013 * FEMALE_i + \beta_3 2014 * FEMALE_i + \beta_4 2015 \\
&* FEMALE_i + \beta_5 URBAN_i + \beta_6 FEMALE_i + \beta_7 INS_i + \beta_8 ZIPINC_i \\
&+ \beta_9 MONTH_j + \beta_{10} HOSPITAL_j + \beta_{11} AGE_{it} + \beta_{12} YEAR_j + \varepsilon_{ijt}
\end{aligned}
$$

The coefficient β_6 represents the difference in diagnoses of suicidal ideation for females relative to males from 2006 to 2011. Coefficients β_1 through β_4 represent jumps 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.

The second model is the same as the first model, but we include the entire sample from 2006 to 2020. We run this model four times, once within each region of the U.S.: the Northeast, West, South, and Midwest.

$$Z_{ijt} = \alpha + \beta_1 2012 * FEMALE_i + \beta_2 2013 * FEMALE_i + \beta_3 2014 * FEMALE_i + \beta_4 2015 * FEMALE_i + \beta_5 2016 * FEMALE_i + \beta_6 2017 * FEMALE_i + \beta_7 2018 * FEMALE_i + \beta_8 2019 * FEMALE_i + \beta_9 2020 * FEMALE_i + \beta_{10} URBAN_i + \beta_{11} INS_i + \beta_{12} ZIPINC_i + \beta_{13} FEMALE_i + \beta_{14} MONTH_j + \beta_{15} HOSPITAL_j + \beta_{16} AGE_{it} + \beta_{17} YEAR_j + \varepsilon_{ijt} \ (region == 1,2,3,4)$$

Z_{ijt} is an indicator variable for emergency department visits with a suicidal ideation diagnosis, coded 0 or 1

Coefficients β_1 represents the difference in diagnoses of suicidal ideation for females relative to males from 2008 to 2011. Then, β_2 to β_9 represent the jump in diagnoses of suicidal ideation in each of the indicated years for females relative to males. In the case that the new screening guidelines prompted a rise in females being screened and subsequently, led to increased diagnoses of suicidal ideation among females, then we would observe statistically significant coefficients on β_2 to β_4 in each region. If the coding switch from ICD-9 to ICD-10 or the change in coding instructions increased suicidal ideation visits among females, we could find statistically significant coefficients on β_5 to β_9 in each region. We refrain from using discharge weights for our stratified random sample of hospitals in America because they vary only by stratum--year.

Results

Graphical Analysis

Our preliminary figures display trends in emergency department visits for suicidal ideation, self-harm, and suicide death among teens in the United States between 2006 and 2020. Figure 1 shows that the number of emergency department visits that were coded with suicidal ideation in any of the diagnosis orders sharply rose after 2011 and again after 2016. The figures include vertical lines at these two time points to better display the point of inflections in the data. The post-2016 rise in suicidal ideation diagnoses is exceptionally large. Figure 1 also shows that ER visits for self-harm and suicide deaths rose more gradually and without any sharp increases.

Figure 2 plots ER visits by sex because there are large differences in suicide and suicide-related behaviors between males and females. Males have higher rates of suicide deaths, but females are more likely to be diagnosed with mood disorders.[29,30] Additionally, the 2011 screening recommendation was for females only. The figure shows that suicide-related hospital visits for suicidal ideation are generally higher among females. It also shows that the post-2011, increase in suicidal ideation visits was larger for females. Being primarily diagnosed with a mood disorder such as depression or anxiety gave females a higher chance of receiving a secondary diagnosis of suicidal ideation. After 2016, we see sharp increases in ER visits coded with suicidal ideation as a secondary diagnosis for both males and females corresponding to the

changes in coding conventions for suicidal ideation following the switch from ICD-9 to ICD-10. NEDS contains no information on race prior to 2020 so we were unable to stratify by it.
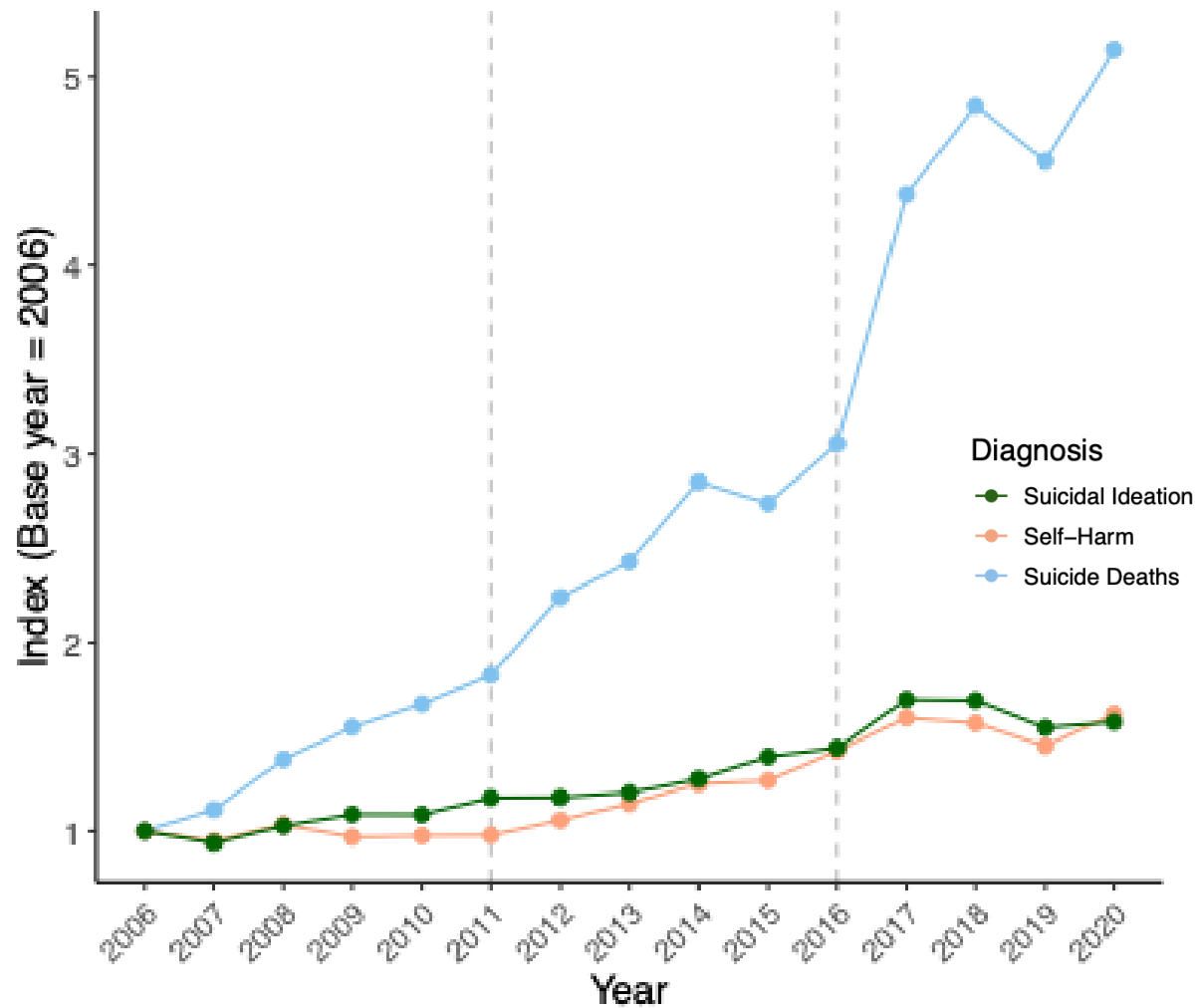
Figure 3 plots suicidal ideation visits among teens by sex and region. As mentioned, the NEDS indicates the region of hospitals in the Northeast, Midwest, South, or West. Because the West and Midwest have higher rates of suicide and suicide-related behavior, we suspected there may be differential impacts of the screening and coding changes on suicidal ideation ER visits. Furthermore, baseline coding practices may differ by region, so the effects of screening and coding changes may also differ. Baseline sex differences in suicidal ideation visits are similar across region. The South and the Midwest showed larger increases of suicidal ideation visits over time compared with the West and the Northeast. In the Northeast, Midwest, and West, suicidal ideation rose more sharply for females than males after 2011. The South shows no such sex difference. Across all regions, the rates of suicidal ideation visits are higher for females, and the gender gap widens over time. After 2016, we see a large rise in ER visits of suicidal ideation among both males and females, coinciding with the changes in coding that affected both groups. The jump is larger in the Midwest than the Northeast, suggesting the effects of coding changes may differ. Our graphical analysis highlights sex as a key demographic factor that predicts a diagnosis of suicidal ideation among patients with mental health disorders. This may be due to females being more likely to be screened and having a higher baseline risk of mood disorders. We find suggestive but not definitive evidence that the 2011 WPSG depression screening guideline and the 2012 insurance mandate to cover such screenings drove up reports of suicidal ideation and other suicide-related diagnoses among females relative to males.

In Figure 4, we see that even when we disaggregate the data by region, we find similar jumps in the trends of suicidal ideation after screening recommendations and coding changes in each region. In the regions except the South, we see a difference in the rates of suicidal ideation visits after the screening recommendation in 2011. Additionally, all four regions show a large jump in suicidal ideation visits after the coding changes in ICD-10. Meanwhile, we note that self-harm visits and suicide deaths stay flat over time after 2008. These findings may suggest that trends of suicidal ideation among teenagers are strongly influenced by the screening and coding of suicidal ideation and may not reflect trends of self-harm or suicide deaths.
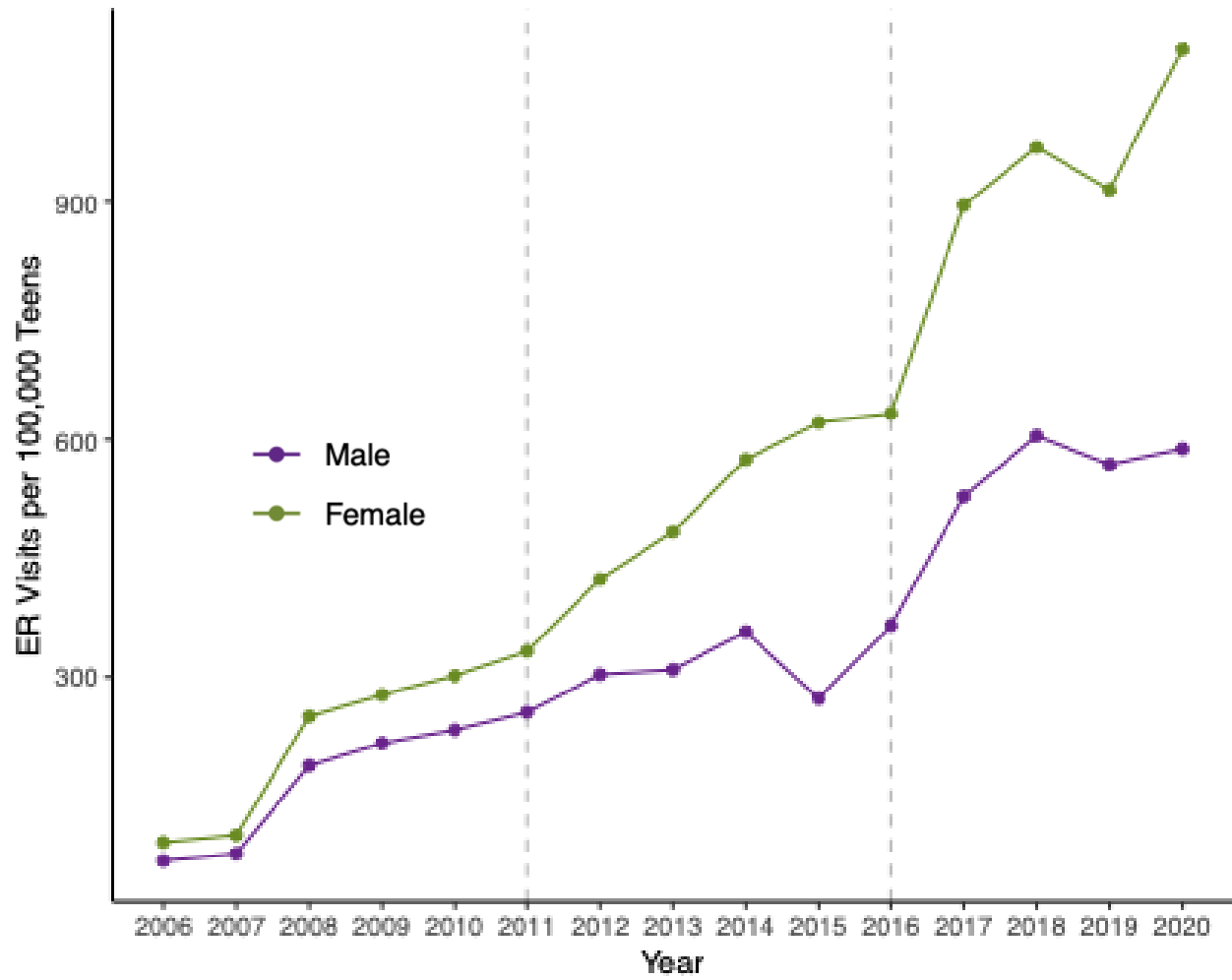
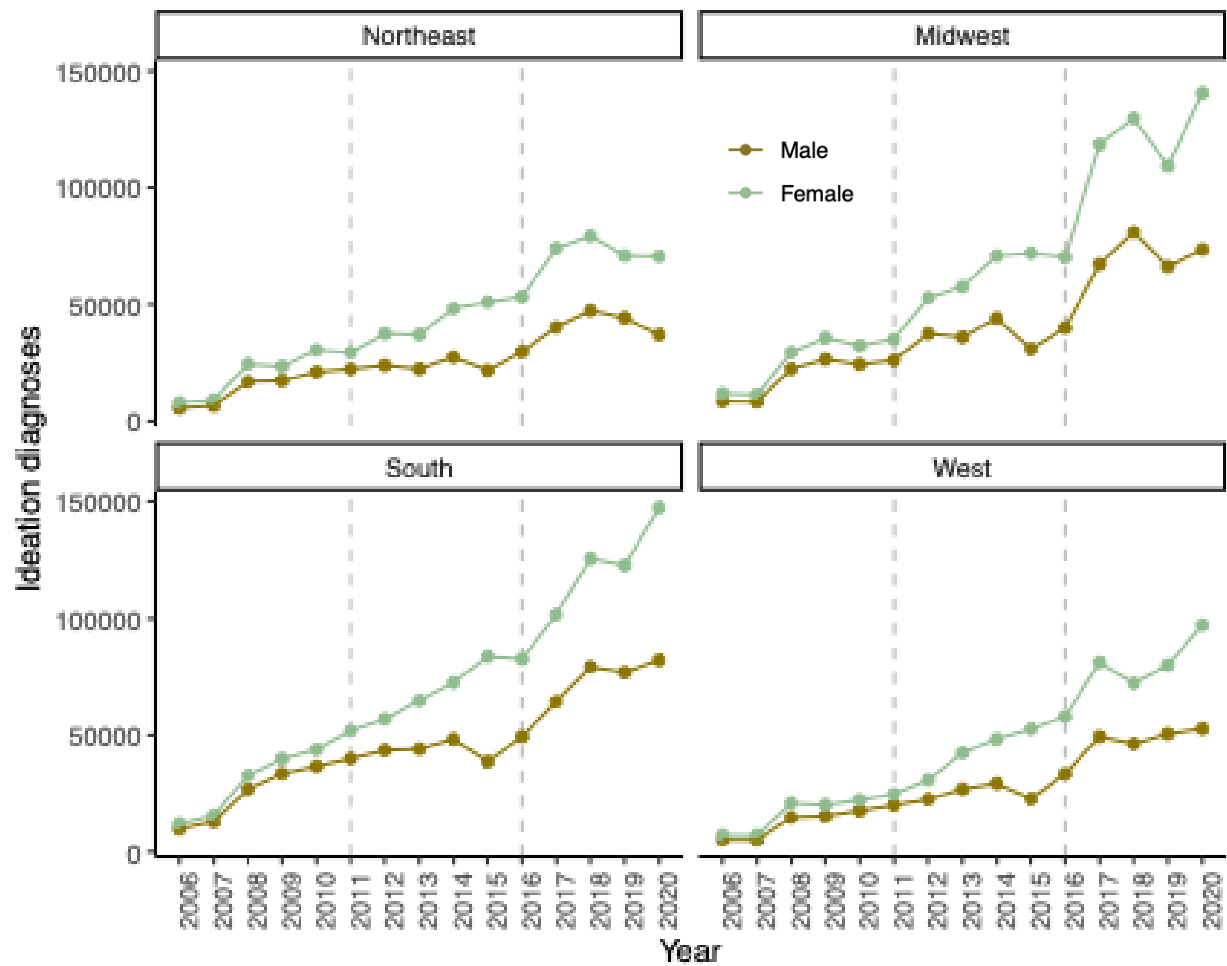**Figure 1: Suicidal Ideation, Self-Harm, and Suicide among Teens in the United States from 2006 to 2020**

Figure 2: Rates of Suicidal Ideation Visits for male and female teens in the United States from 2006 to 2020
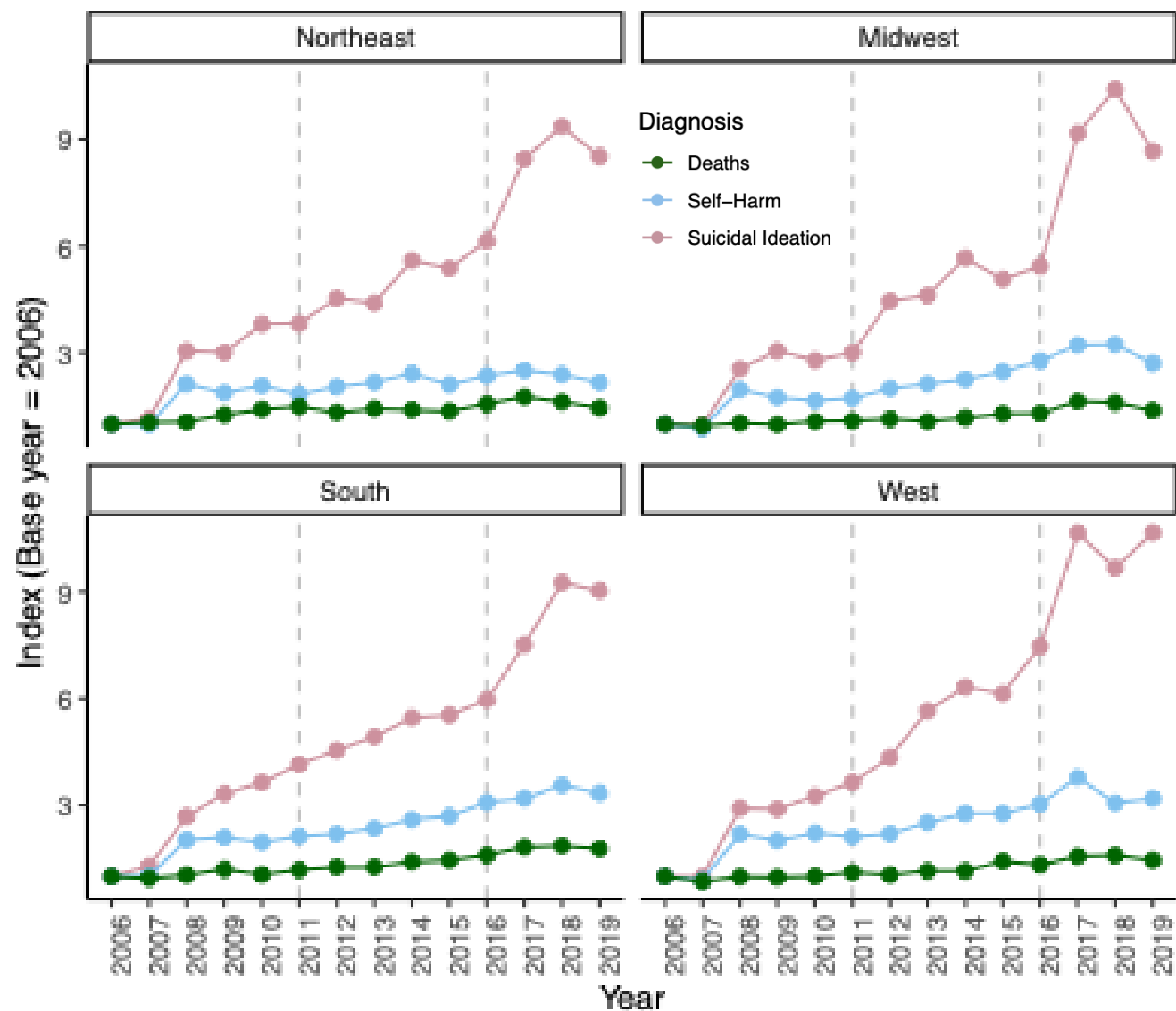
Figure 3: Suicidal Ideation Visits among teens in the U.S. by region and sex (2006 to 2020)

Figure 4: Suicidal Ideation, Self-Harm, and Suicide Deaths among teens in the U.S. by region (2006 to 2020)

References

1. Suicide Rates by State | Suicide Prevention | CDC. Published May 9, 2023. Accessed April 5, 2024. https://www.cdc.gov/suicide/suicide-rates-by-state.html

2. Mercy JA, Tolsma DD, Smith JC, Conn JM. Patterns of Youth Suicide in the United States. *Educ Horiz*. 1984;62(4):124-127.

3. Curtin SC, Garnett MF. Suicide and Homicide Death Rates Among Youth and Young Adults Aged 10–24: United States, 2001–2021. National Center for Health Statistics (U.S.), ed. 2023;(471). https://stacks.cdc.gov/view/cdc/128423

4. Harmer B, Lee S, Duong T vi H, Saadabadi A. Suicidal Ideation. In: *StatPearls*. StatPearls Publishing; 2024. Accessed April 1, 2024. http://www.ncbi.nlm.nih.gov/books/NBK565877/

5. US Preventive Services Task Force. Screening for Depression and Suicide Risk in Children and Adolescents: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2022;328(15):1534-1542. doi:10.1001/jama.2022.16946

6. Pediatrics AA of. *Bright Futures Guidelines for Health Supervision of Infants, Children, and Adolescents*. American Academy of Pediatrics; 2017. doi:10.1542/9781610020237

7. Archived: Depression in Children and Adolescents: Screening | United States Preventive Services Taskforce. Accessed April 2, 2024. https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/depression-in-children-and-adolescents-screening-2009

8. 42 U.S. Code § 300gg–13 - Coverage of preventive health services. LII / Legal Information Institute. Accessed April 2, 2024. https://www.law.cornell.edu/uscode/text/42/300gg-13

9. *Clinical Preventive Services for Women: Closing the Gaps*. National Academies Press; 2011. doi:10.17226/13181

10. Women's Preventive Services Guidelines | HRSA. Accessed April 2, 2024. https://www.hrsa.gov/womens-guidelines

11. CDC Interim Advice. Published online October 26, 2015.

12. Zuckerbrot RA, Cheung A, Jensen PS, et al. Guidelines for adolescent depression in primary care (GLAD-PC): Part I. Practice preparation, identification, assessment, and initial management. *Pediatrics*. 2018;141(3).

13. Esposito-Smythers C, Spirito A. Adolescent Substance Use and Suicidal Behavior: A Review With Implications for Treatment Research. *Alcohol Clin Exp Res*. 2004;28(s1):77S-88S. doi:10.1097/01.ALC.0000127417.99752.87

14. Miech RA, Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE, Patrick ME. Monitoring the Future National Survey Results on Drug Use, 1975-2019. Volume I, Secondary School Students. *Inst Soc Res*. Published online 2020.

15. Divin AL, Zullig KJ. The association between non-medical prescription drug use and suicidal behavior among United States adolescents. *AIMS Public Health*. 2014;1(4):226.

16. Khantzian EJ. The self-medication hypothesis of substance use disorders: a reconsideration and recent applications. *Harv Rev Psychiatry*. 1997;4(5):231-244. doi:10.3109/10673229709030550

17. Kaplow JB, Curran PJ, Angold A, Costello EJ. The prospective relation between dimensions of anxiety and the initiation of adolescent alcohol use. *J Clin Child Psychol*. 2001;30(3):316-326. doi:10.1207/S15374424JCCP3003_4

18. Wong SS, Zhou B, Goebert D, Hishinuma ES. The risk of adolescent suicide across patterns of drug use: a nationally representative study of high school students in the United States from 1999 to 2009. *Soc Psychiatry Psychiatr Epidemiol*. 2013;48:1611-1620.

19. Pirkis J, Blood RW. Suicide and the media: Part I. Reportage in nonfictional media. *Crisis J Crisis Interv Suicide Prev*. 2001;22(4):146-154. doi:10.1027/0227-5910.22.4.146

20. Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. *Adv Behav Res Ther*. 1978;1(4):139-161. doi:10.1016/0146-6402(78)90002-4

21. Movie & TV reviews for parents. The Common Sense Census: Media Use by Tweens and Teens, 2021 | Common Sense Media. Accessed April 4, 2024. https://www.commonsensemedia.org/research/the-common-sense-census-media-use-by-tweens-and-teens-2021

22. Guinovart M, Cobo J, González-Rodríguez A, Parra-Uribe I, Palao D. Towards the Influence of Media on Suicidality: A Systematic Review of Netflix's 'Thirteen Reasons Why.' *Int J Environ Res Public Health*. 2023;20(7):5270. doi:10.3390/ijerph20075270

23. Lantos JD, Yeh HW, Raza F, Connelly M, Goggin K, Sullivant SA. Suicide Risk in Adolescents During the COVID-19 Pandemic. *Pediatrics*. 2022;149(2):e2021053486. doi:10.1542/peds.2021-053486

24. Hill RM, Rufino K, Kurian S, Saxena J, Saxena K, Williams L. Suicide Ideation and Attempts in a Pediatric Emergency Department Before and During COVID-19. *Pediatrics*. 2021;147(3):e2020029280. doi:10.1542/peds.2020-029280

25. Ridout KK, Alavi M, Ridout SJ, et al. Emergency Department Encounters Among Youth With Suicidal Thoughts or Behaviors During the COVID-19 Pandemic. *JAMA Psychiatry*. 2021;78(12):1319-1328. doi:10.1001/jamapsychiatry.2021.2457

26. Bridge JA, Ruch DA, Sheftall AH, et al. Youth Suicide During the First Year of the COVID-19 Pandemic. *Pediatrics*. 2023;151(3):e2022058375. doi:10.1542/peds.2022-058375

27. NEDS Overview. Accessed March 21, 2024. https://hcup-us.ahrq.gov/nedsoverview.jsp

28. CDC. Underlying Cause of Death, 1999-2020 Request. Accessed February 23, 2024. https://wonder.cdc.gov/ucd-icd10.html

29. Canetto SS, Sakinofsky I. The gender paradox in suicide. *Suicide Life-Threatening Behav*. 1998;28(1):1-23.

30. Kessler R, Berglund P, Demler O. Mood disorders: Bipolar and major depressive disorders. *Jama*. 2003;289(23):3095-3105.

31. Owens PL, McDermott KW, Lipari RN, Hambrick MM. Emergency Department Visits Related to Suicidal Ideation or Suicide Attempt, 2008–201. Published online 2006. Accessed April 23, 2024. https://www.ncbi.nlm.nih.gov/books/NBK563021

32. Richter D, Wall A, Bruen A, Whittington R. Is the global prevalence rate of adult mental illness increasing? Systematic review and meta-analysis. *Acta Psychiatr Scand*. 2019;140(5):393-407. doi:10.1111/acps.13083