

Research

Comparison of temporal trends in suicidal behaviors among high school students in Mississippi and the United States

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Abstract

Background Mississippi youth are demographically unique compared to that of the nation. The purpose of this study is to determine the prevalence and trend of suicide ideation, suicide plans, suicidal attempts, and suicidal injury among high school students in Mississippi vs. in the United States (U.S.).

Method Summary statistics, prevalence ratio (PR), and trend analysis were generated and compared between Mississippi high school students and their U.S. counterparts.

Results The 2021 prevalences for suicide plans, suicide attempts, and suicide injury are all significantly higher for Mississippi high school students compared to their national counterparts. From 2001 to 2021, on the national level, none of the four suicide behaviors showed significant change, whereas, in Mississippi, suicide plans, suicide attempts, and suicide injury all had an increasing trend.

Conclusions Our study reveals alarming increasing trends and significantly greater severity of suicidal burdens among Mississippi high school students compared to the nation. Left unattended, these trends may continue quicker due to a clustering effect. There is an urgent need for Mississippi to implement more and better intervention and prevention measures to stop and reverse the increasing trend of suicidal behaviors among its 9–12 graders.

Keywords Prevalence trend · Risk behavior · Suicidal ideation · Suicide plan · Suicide attempt · Suicide injury

1 Introduction

Adolescents' suicidal behaviors are serious public health challenges with long term ramifications for individuals, families, and society. Despite efforts in research and prevention, the prevalence of adolescent suicide remains alarmingly high, with various studies indicating an upward trend over the past decade [1–3]. Adolescents' visits to hospital emergency department due to suicidal attempts are increasing [4, 5]. Nationally, the suicide death rate increased from 6.8 per 100,000 people in 2007 to 11 per 100,000 in 2021 among the 10–24 years-olds [6, 7]. Center for Disease Control and Prevention (CDC) reported that suicide is the second leading cause of death among youth 14–18 years old [2]. Furthermore, CDC sources show the severity of the full scope of suicidal behaviors including suicidal ideation, planning, non-fatal suicide attempts, and injurious suicide attempts. In 2021, approximately 22.2% of U.S. high school students seriously considered attempting suicide, 17.6% made a suicide plan, 10.2% made a suicide attempt, and 2.9% sustained non-fatal injury caused by attempted suicide that needed medical attention [8].

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The developmental period of adolescence involves important biological and psychological changes, which can impact vulnerabilities and contribute to the risk of suicidal behavior. Psychological factors, such as sadness, depression, anxiety, and mental health disorders are strong predictors of suicidal behavior among adolescents. Other key factors such as substance use, adverse peer relationships, being bullied, exposure to trauma of physical and/or sexual abuse all significantly increase the risk of suicidal behavior. Family dynamics and access to means of suicide also play a crucial role. In addition, the excessive social media consumption and cyberbullying is significantly associated with suicidal behavior [9–11].

Research demonstrates that many demographic factors such as age, sex, and racial composition should be considered. Older adolescents exhibit higher suicide rates compared to younger adolescents [12]. Sex differences are pronounced, as females show higher rates of suicidal ideation and attempts [13, 14]. Racial disparities are also evident. Studies with national data suggest that both Black female and male students were more likely to report having attempted suicide compared to their respective White counterpart in 2021 [15]. Furthermore, CDC recently reported that suicide rates among persons age 10–24 years old showed a 36.6% significant increased during 2018 to 2021 among Black persons, while no significant changes were found among other races of the same age group. However, due to population base ratio, non-Hispanic White still makes up the majority of total suicide death in 2021 [16].

Mississippi is demographically and social-economically unique compared to the nation. Among other economic, health, and populational characteristics, Mississippi has a distinctive racial composition: a much higher percentage of Black residents, 37.8%, compared to the national average 13.7%. Approximately 58.7% of Mississippi's population is White, lower than the national average of around 75.3%. Hispanic make up 3.9% of Mississippi population, much lower compared to the national average 19.5% [17]. Mississippi's suicide rate in 2021 reached its highest level in 20 years [18]. For youth specifically, suicide is the third leading cause of death for Mississippians aged 15–24 [18]. Curtin et al. reported that in Mississippi, suicide death rates among persons aged 10–24 years increased 26.6% from 2007–2009 to 2016–2018 [6].

Although there are several studies on adolescent suicide trends at the national level for various time intervals, no such work has been done for the Mississippi adolescent population. Differences in suicide trends between Mississippi and the nation have also not been evaluated. This study aims to examine the difference in temporal trends for suicide ideation, planning, attempt, and suicidal injury, and to determine the difference by sex and by race between Mississippi and the U.S. in 2021. The underline assumption is that the suicide risk of Mississippi youth is significantly greater compared to that of the nation, following similar unfortunate pattern that Mississippi ranks at the bottom in almost every leading health outcome [19]. This study also seeks to monitor the current state of Mississippi adolescent suicide, thus contributing to the development of effective prevention and intervention strategies that are tailored according to the Mississippi needs.

2 Method

2.1 Participants

2001 to 2021 National and Mississippi Youth Risk Behavior Survey (YRBS) data are obtained from CDC public domain (<https://www.cdc.gov/yrbs/data/index.html>) for this study. Participants for the national level survey is a representative sample of high school students from both United States private and public schools, whereas participants of the Mississippi YRBS include a random sample of students from public high schools.

2.2 Instrumentation

The four data points of interest for this study are: –1) “During the past 12 months, did you Ever seriously consider attempting suicide” (Q26)? –2) “During the past 12 months, did you make a plan about how you would attempt suicide” (Q27)? –3) “During the past 12 months, how many times did you attempt suicide” (Q28)? –and, 4) “If you attempted suicide during the past 12 months, did any attempt result in an injury, poisoning, or overdose that had to be treated by a doctor or nurse” (Q29)? Student's responses to these questions were recoded dichotomously (Yes, No).

In this study sex and race/ethnicity variables are also used. Sex has self-reported responses of two values (Male, Female). As for race/ethnicity, YRBS data has two variables: “race4” has four values—“White”, “Black or African American”, “Hispanic/Latino” and “All other races”; “race7” has seven values—“Non-Hispanic American Indian or Alaska Native”, “Non-Hispanic Asian”, “Non-Hispanic Black”, “Hispanic”, “Non-Hispanic Native Hawaiian or Other Pacific Islander”, “Non-Hispanic White” and “Non-Hispanic Multiple races”. [20, 21]. We elected to use “race4” for this study due to consideration of small sample size. Sample size for some race/ethnicity group in Mississippi YRBS data is as low as being single digit.

2.3 Procedure

YRBS is a complex sample survey [22, 23]. Every other year YRBS collects high school student's health risk behaviors in six categories. CDC conducts national-level survey by administering survey questionnaires to both private and public school students in 50 U.S. states plus the District of Columbia. Mississippi YRBS is administrated by the collaboration of State Departments of Health and of Education. The three-stage complex sample design of YRBSS ensures that representative samples are collected. First, primary sampling unit is designed at the county level. Then based on characteristics of racial composition and metropolitan urbanity, primary sampling unites are further classified into strata. Then secondary sampling unit is specified at the school level. The sampling proportions correspond to school enrollment size. The final stage is to randomly sample 1 or 2 classrooms in each grade 9–12 of the selected schools.

2.4 Data analysis

We calculated and compared the prevalence ratios with confidence 95% intervals (CI) between US and Mississippi high scholars using year 2021 YRBS data. Following other researchers [24, 25], we declare statistical significance in rare cases when the p value being less than 0.05 but the 95% confidence interval equals 1.

In order to detect linear or non-linear trends, we adopted CDC's methods for trend analysis [26] by including linear, quadratic and cubic time variables in the logistic regression models where log odds ratios were estimated. Linear trends were tested by using a model that contains only a linear time variable plus variables controlling for sex, race and grade; Quadratic trends were tested by re-running the model with both linear and quadratic time variables; likewise cubic trends were tested. When only a linear year-contrast term is found to be significant, the related beta with its p-value are used to establish the direction and significance of the trend [26, 27]. If non-linear changes are detected, we calculate the sex, race, and grade adjusted prevalence and standard error for each survey years 2001 through 2021. These adjusted annual prevalences were used as input for further joinpoint regression analysis. Also known as segmented regression, joinpoint regression has been recognized as a valuable modeling procedure for studying changes in trends over time [28–30]. Based on assumption that data can be divided into subsets and each subset has its own linear trend [31], joinpoint regression establishes critical values, or joinpoints, between adjacent linear segments and subsequently determines Annual Percent Change (APC) for each resulting segments, as well as the Average Annual Percent Change (AAPC) for the whole study time frame [32], in our case, from 2001 to 2021. We employed permutation test technique to determine the number of joinpoints and we applied a parametric method to calculate the confidence intervals for the APCs and AAPCs.

The survey package of statistical software R (version 4.4.0) was used for data analysis. Along with SUDAAN, SAS, Stata, SPSS and Epi Info, R is recommended by the CDC YRBS trend analyses due its capability to account for the complex sampling design of YRBS data [33]. With permission from the National Cancer Institute, we downloaded Joinpoint software (version 5.1.0) for joinpoint regression analysis.

3 Results

3.1 Demographic characteristics of 2021 YRBS data

The 2021 YRBS sample sizes for Mississippi and the U.S. are 1747 and 17,232, respectively. Proportion of female and male students are nearly equal in the Mississippi sample—49.2% female and 49.5% male, while the national data shows slightly a higher male percentage: 47.3% female and 51.2% male. Significant difference is observed between the racial proportions of the two samples. The U.S. YRBS sample consists of 53.1% White, 18.8% Hispanic, 13.5% Black, and 12.1% Other races. In contract, Mississippi YRBS sample consists of 47.1% Black, 33.8% White, 8.9% Hispanic, and 5.8% Other races. Compared to the U.S. sample, the Mississippi data includes more 9th graders (36.1% vs. 27.0%) and fewer 12th graders (17.5% vs. 22.3%), while the percentages for 10th and 11th graders are similar.

Table 1 Prevalence comparison of suicidal behaviors: Mississippi vs. U.S., YRBS 2021

Risk behavior	Mississippi (%)	U.S. (%)	PR* (95% CI)	p
Suicide ideation	21.6	22.2	1.0 (0.9, 1.1)	0.58
Suicide plan	19.7	17.6	1.1 (1.0, 1.3)	< 0.05
Suicide attempt	16.2	10.2	1.6 (1.4, 1.9)	< 0.001
Suicide injury	5.1	2.9	1.7 (1.3, 2.3)	< 0.001

PR* Prevalence ratio

Table 2 Prevalence comparison of suicidal behaviors: Mississippi vs. U.S. by sex, YRBS 2021

Risk behavior	Mississippi (%)	U.S. (%)	PR* (95% CI)	p
Suicide ideation				
Female	27.1	30.0	0.9 (0.8, 1.0)	0.09
Male	15.3	14.3	1.1 (0.9, 1.3)	0.48
Suicide plan				
Female	25.0	23.6	1.1 (0.9, 1.2)	0.45
Male	14.3	11.6	1.2 (1.0, 1.5)	0.07
Suicide attempt				
Female	17.3	13.3	1.3 (1.1, 1.6)	< 0.05
Male	13.9	6.6	2.1 (1.6, 2.7)	< 0.001
Suicide injury				
Female	6.0	3.9	1.5 (1.1, 2.2)	< 0.05
Male	4.0	1.7	2.4 (1.6, 3.5)	< 0.001

PR* Prevalence ratio

3.2 prevalence comparison: Mississippi vs. U.S.

3.2.1 Overall prevalence

Table 1 shows that suicide ideation prevalence is similar for Mississippi and the U.S.: 21.6% vs. 22.2% ($p = 0.58$). Suicide plan prevalence is 10% higher in Mississippi than that of the U.S. ($p < 0.05$); Suicide attempt is 60% higher in Mississippi than that of the U.S. ($p < 0.001$); Suicide injury is 70% higher in Mississippi than that of the U.S. ($p < 0.001$).

3.2.2 Prevalence by sex

Table 2 shows that suicide ideation and suicide plan do not have a significant difference between Mississippi students and those in the U.S. by sex. However, Mississippi female students are 30% more likely to attempt suicide ($p < 0.05$), and 50% more likely to incur suicide caused injury ($p < 0.05$), while Mississippi male students were 2.1 times more likely to attempt suicide ($p < 0.001$) and 2.4 times more likely to incur suicide caused injury ($p < 0.001$), compared to their U.S. counterpart.

3.2.3 Prevalence by race

Table 3 shows that no difference in suicide ideation was observed between Mississippi and the U.S. students by race. However, compared to the U.S., Mississippi White students are 30% more likely to make a suicide plan ($p < 0.05$), 40% more likely to attempt suicide ($p < 0.05$) and 90% more likely to incur suicide related injury ($p < 0.05$); Mississippi Hispanic students are 40% more likely to make a suicide plan ($p < 0.05$), and 90% more likely to attempt suicide ($p < 0.01$); Mississippi other race students are 60% more likely to make suicide plan ($p < 0.05$), 90% more likely to attempt suicide ($p < 0.05$) and 3 times more likely to incur suicide-related injury ($p < 0.05$). Mississippi Black students, however, did not show a significant difference in the suicide plan, suicide attempt, or suicide injury from those of the U.S.

Table 3 Prevalence comparison of suicidal behaviors: Mississippi vs. U.S. by race, YRBS 2021

Risk behavior	Mississippi (%)	U.S. (%)	PR* (95% CI)	p
Suicide ideation				
White	23.6	22.7	1.0 (0.9, 1.2)	0.57
Black	18.2	21.6	0.8 (0.7, 1.0)	0.14
Hispanic	24.6	22	1.1 (0.9, 1.4)	0.40
Other	32.2	21.5	1.5 (1.0, 2.3)	0.12
Suicide plan				
White	21.7	16.9	1.3 (1.1, 1.6)	< 0.05
Black	16.4	17.7	0.9 (0.7, 1.1)	0.48
Hispanic	26.3	18.7	1.4 (1.0, 1.9)	< 0.05
Other	29.5	18.9	1.6 (1.1, 2.3)	< 0.05
Suicide attempt				
White	13.0	9.0	1.4 (1.1, 1.9)	< 0.05
Black	17.8	14.5	1.2 (1.0, 1.6)	0.08
Hispanic	20.0	10.7	1.9 (1.3, 2.7)	< 0.01
Other	18.8	9.7	1.9 (1.1, 3.4)	< 0.05
Suicide injury				
White	4.6	2.4	1.9 (1.1, 3.3)	< 0.05
Black	5.0	4.4	1.1 (0.7, 1.8)	0.60
Hispanic	5.7	3.8	1.5 (0.8, 2.8)	0.20
Other	7.0	2.3	3.0 (1.2, 7.9)	< 0.05

PR* Prevalence ratio

3.3 2001 to 2021 temporal trends comparison using APC and AAPC: Mississippi vs. U.S.

3.3.1 Suicide ideation

As shown in Table 4 and Fig. 1, Joinpoint regression models identified a significant increasing trend of suicide ideation prevalence from 2001 to 2021 among Mississippi high school students (AAPC = 2.2%, $p < 0.001$). For the U.S., a decreasing–increasing pattern was observed with 2009 being the joinpoint: 2001 to 2009 (APC = −3.1%, $p = 0.08$); 2009 to 2021 (APC = 3.2%, $p < 0.01$), but the overall change from 2001 to 2021 was not significant (AAPC = 0.6%, $p = 0.40$).

Table 4 Trends of suicidal behaviors among Mississippi and U.S. Adolescents, YRBS 2001—2021

YRBS Questions	AAPC* (95% CI), %	p	Segment 1	APC** (95% CI), %	p	Segment 2	APC (95% CI), %	p
Suicide ideation								
Mississippi	2.2 (1.3, 3.1)	< 0.001	NA	NA	NA	NA	NA	NA
U.S	0.6 (−0.7, 2.0)	0.4	2001–2009	−3.1 (−6.6, 0.6)	0.08	2009–2021	3.2 (1.7, 4.7)	< 0.01
Suicide plan								
Mississippi	2.4 (−3.1, 8.2)	0.4	2001–2007	−2.5 (−24.3, −25.6)	0.80	2007–2021	4.6 (2.2, 6.9)	< 0.01
U.S	0.7 (−0.6, 1.9)	0.30	2001–2009	−3.3 (−6.2, −0.2)	< 0.05	2009–2021	3.4 (1.8, 5.0)	< 0.01
Suicide attempt								
Mississippi	4.5 (3.6, 5.3)	< 0.001	NA	NA	NA	NA	NA	NA
U.S	0.2 (−1.2, 1.7)	0.75	2001–2009	−3.4 (−6.7, 0.0)	< 0.05	2009–2021	2.7 (0.9, 4.6)	< 0.001
Suicide injury								
Mississippi	4.3 (1.5, 7.2)	< 0.01	NA	NA	NA	NA	NA	NA
U.S	−0.2 (−2.5, 2.1)	0.86	NA	NA	NA	NA	NA	NA

AAPC* Average annual percent change, APC** Annual percent change

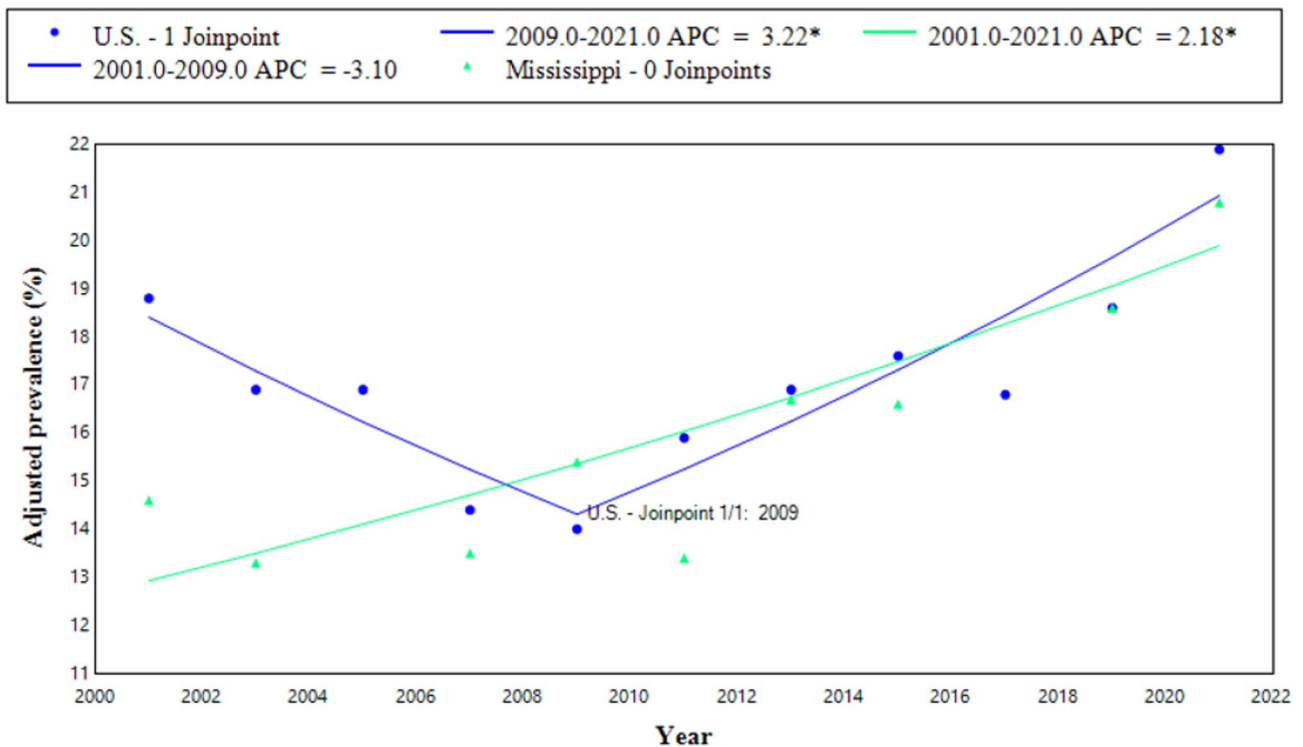


Fig. 1 Joinpoint regression showing trends of suicide ideation from 2001 to 2021, Mississippi vs. U.S

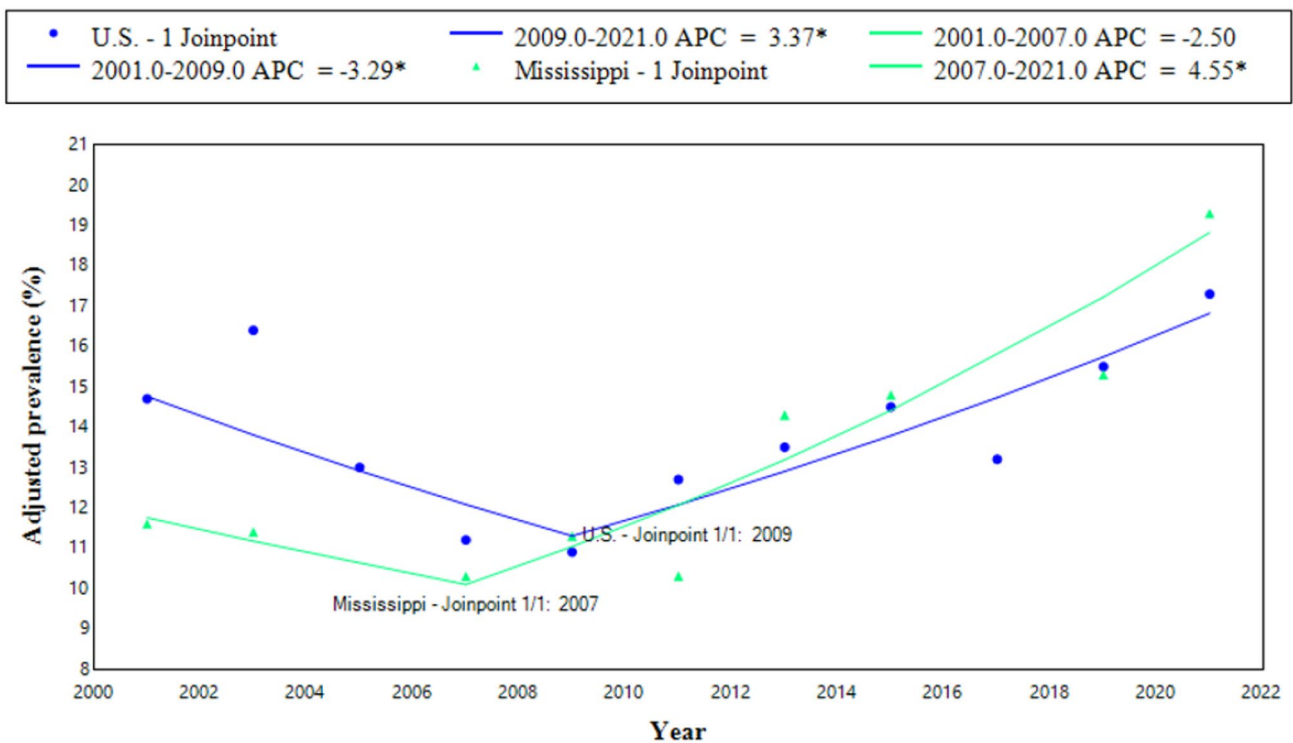


Fig. 2 Joinpoint regression showing trends of suicide plan from 2001 to 2021, Mississippi vs. U.S

3.3.2 Suicide plan

As shown in Table 4 and Fig. 2, suicide plan prevalence did not demonstrate a significant overall change from 2001 to 2021 for either Mississippi (AAPC = 2.2%, $p = 0.40$) or the U.S. (AAPC being 0.7%, $p = 0.3$). For Mississippi, Joinpoint regression models identified two segments with 2007 being the joinpoint: from 2001 to 2007 no significant change (APC = -2.5%, $p = 0.8$); from 2007 to 2021 there was a significant increase trend (APC = 4.6%, $p < 0.01$). For the U.S., a decreasing-increasing pattern was observed with 2009 being the joinpoint: 2001 to 2009 (APC = -3.3%, $p < 0.05$); 2009 to 2021 (APC = 3.4%, $p < 0.01$).

3.3.3 Suicide attempt

As shown in Table 4 and Fig. 3, there was a significant increasing trend of suicide attempt prevalence from 2001 to 2021 in Mississippi high school students (AAPC = 4.5%, $p < 0.001$). For the U.S., a decreasing-increasing pattern was observed with 2009 being the joinpoint: 2001 to 2009 (APC = -3.4%, $p < 0.05$); 2009 to 2021 (APC = 2.7%, $p < 0.01$). However, the overall change from 2001 to 2021 was not significant (AAPC = 0.2%, $p = 0.75$).

3.3.4 Suicide injury

As shown in Table 4 and Fig. 4, there was a significant increasing trend of suicide injury prevalence from 2001 to 2021 in Mississippi high school students (AAPC = 4.3%, $p < 0.01$). For the U.S., overall change from 2001 to 2021 was not significant (AAPC = -0.2%, $p = 0.86$).

4 Discussion

Based on the literature review, this epidemiologic study of suicide prevalence and trend comparisons between Mississippi youth and their U.S. counterparts is the first of its kind. Our findings are alarming. In 2021, Mississippi youth had a significantly greater prevalence for three of the four YRBS suicide risk behaviors: suicide plan, suicide attempt,

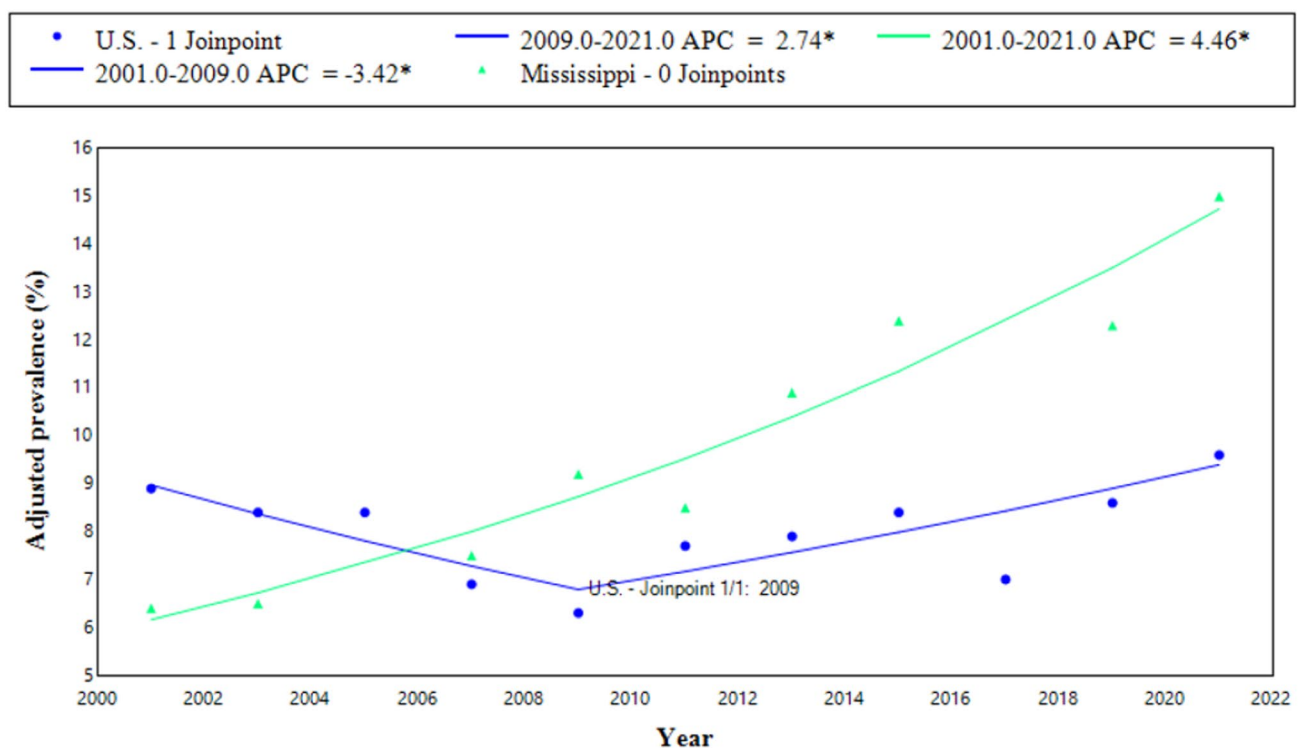


Fig. 3 Joinpoint regression showing trends of suicide attempt from 2001 to 2021, Mississippi vs. U.S

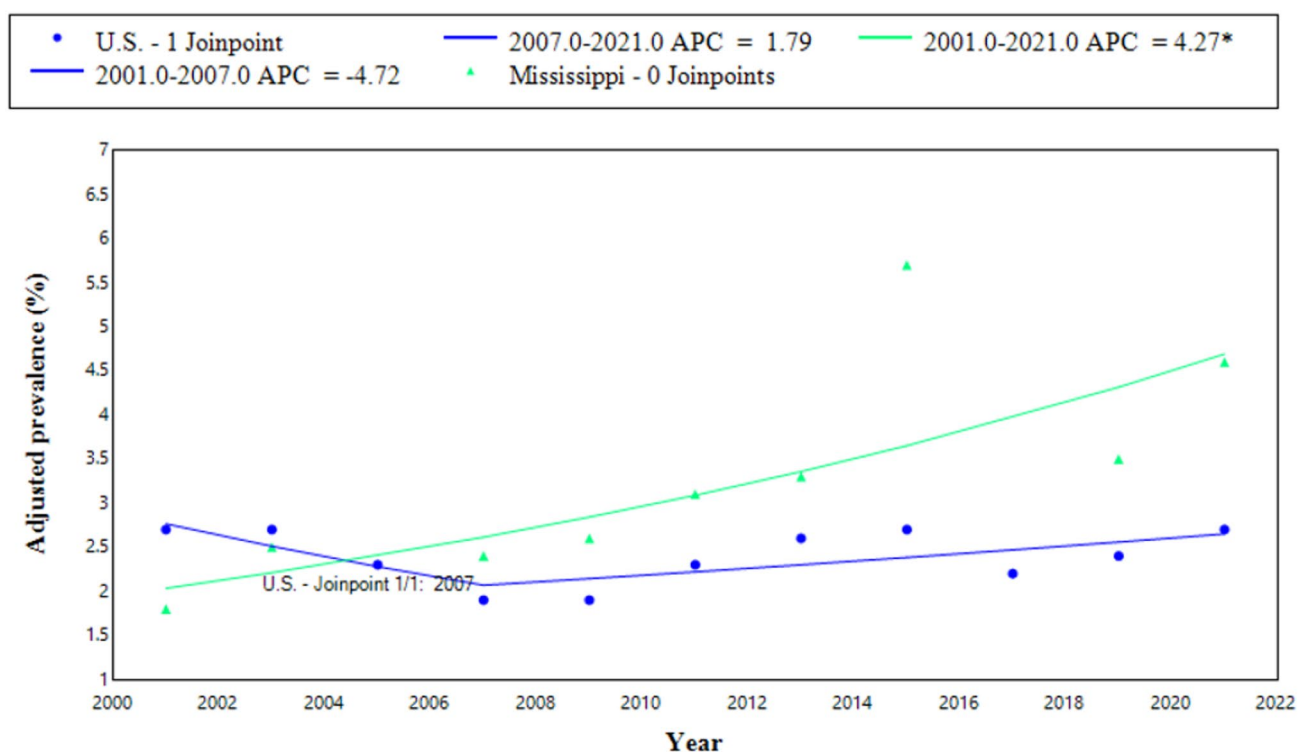


Fig. 4 Joinpoint regression showing trends of suicide injury from 2001 to 2021, Mississippi vs. U.S

and suicide injury. Furthermore, suicide attempt and suicide injury prevalence for Mississippi male students both more than doubled that of their U.S. counterparts, while Mississippi female students also have a 30% and 50% greater prevalence for suicide attempt and suicide injury. In addition, we found that compared to their U.S. counterparts, Mississippi whites, Hispanic, and other races have greater prevalences for suicide plans, suicide attempts, and suicide injuries. From 2001 to 2021, while no significant changes were observed in U.S. youth in all four YRBS suicide behaviors, Mississippi youth had a troubling increase trend in suicide ideation, suicide attempt and suicide injury, as well as substantial suicide plan increase trend for segment 2007 to 2021.

Adolescent suicide remains a serious issue for both Mississippi and the U.S., and it continues to increase in Mississippi. For the U.S., a V-shaped decrease-increase pattern was observed for suicide ideation, suicide plan, and suicide attempt—all have a joinpoint in 2009. From 2009 to 2021, there were significant increase trends for the above three outcomes. As reported by various studies, these trends correlate with increased emergency department visits [34, 35].

For Mississippi, there were substantial increase trends in all four suicidal behaviors, which correlates to the Mississippi teen suicide death trend reported by the United Health Foundation [36]. The largest APC/AAPC is suicide plan at 4.6%, followed by suicide attempt at 4.5%, suicide injury at 4.3%, and suicide ideation at 2.2%. These linear trends of increases are very concerning. Left unattended, these trends may continue to expand due to a clustering effect [37, 38].

It is worth noticing that in 2021 while Mississippi White, Hispanic and Other races students showed significantly higher rates for suicide attempt, Mississippi Black students showed comparable rate compared to the nation.

Adolescent suicide is a complex issue that demands a comprehensive approach. The findings of this study help to promote awareness of the severity of adolescent suicide behavior in Mississippi. This study serves as an urgent call for more and improved interventions at the family, community, school, and government levels. Parents can be educated to recognize the early signs of suicidal behavior; tailored interventions addressing specific cultural contexts that involve community leaders can boost the effectiveness of community actions; and school based programs such as mental health and anti-bullying programs can be instrumental in reducing suicide attempts and suicide rates. Governments should allocate more funding for adolescent mental health and suicide prevention services and should bring this need into the policy-making and legislation process.

5 Conclusions

We found that Mississippi adolescent suicide behaviors are on the rise, which underscores the pressing need for Mississippi to take concerted action to battle adolescent suicide. We found that Mississippi male students are two times more likely to attempt suicide and two times more likely to incur suicidal injury compared to their U.S. counterparts. Male-specific risk factors such as greater access to firearms at home and being more reluctant to seek help [10, 39] need to be taken into consideration when prevention programs are developed. The results of this research can guide educators, healthcare providers, local community leaders, and policymakers in the development of comprehensive suicide prevention initiatives.

6 Limitations

This study had data limitations. Mississippi YRBS only surveys students from public high schools, the data does not represent all high school students in that it excludes students from private schools, homeschools, and those not in school. In addition, data bias may exist because of the self-reporting nature of the survey. Furthermore, this study is limited by its main focus on the trends comparison between Mississippi and the U.S.. The “why” for such trends divergence warrants future studies that dig into social economical determinants and youth risk behavior factors that might be unique to the Mississippi youth population.

Author contributions Conceptualization and Methodology: Zhen Zhang; Data curation and statistical analysis: Zhen Zhang and Wesley Zhang; Writing, Reviewing and editing: Zhen Zhang, Wesley Zhang and Marinelle Payton.

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Data availability Publicly archived datasets from the Centers for Disease Control and Prevention were analyzed or generated during the study. Data are available at the following link: <https://www.cdc.gov/healthyyouth/data/yrbs/index.htm>, (accessed on 10 March 2024).

Declarations

Ethics approval and consent to participate Not applicable.

Informed consent Not applicable.

Competing interests The authors declare no competing interests.

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References

1. Hedegaard H, Curtin SC, Warner M. Suicide mortality in the United States, 1999–2019. NCHS Data Brief. 2021;398:1–8.
2. Ivey-Stephenson AZ, Demissie Z, Crosby AE, et al. Suicidal ideation and behaviors among high school students—youth risk behavior survey, United States, 2019. MMWR Suppl. 2020;69(Suppl-1):47–55. <https://doi.org/10.15585/mmwr.su6901a6>.
3. Akkas F. Youth suicide risk increased over past decade—new national data highlights concerning trends among high schoolers. Pew; 2023. <https://www.pewtrusts.org/en/research-and-analysis/articles/2023/03/03/youth-suicide-risk-increased-over-past-decade>. Accessed 10 May 2024.
4. Ting SA, Sullivan AF, Boudreaux ED, Miller I, Camargo CA Jr. Trends in US emergency department visits for attempted suicide and self-inflicted injury, 1993–2008. Gen Hosp Psychiatry. 2012;34(5):557–65. <https://doi.org/10.1016/j.genhosppsych.2012.03.020>.
5. Yard E, Radhakrishnan L, Ballesteros MF, et al. Emergency department visits for suspected suicide attempts among persons aged 12–25 years before and during the COVID-19 pandemic—United States, January 2019–May 2021. Morb Mortal Wkly Rep. 2021;70(24):888–94.
6. Curtin SC. State suicide rates among adolescents and young adults aged 10–24: United States, 2000–2018. Natl Vital Stat Rep. 2020;69(11):1–10.

7. Curtin SC and Garnett MF. Suicide and homicide death rates among youth and young adults aged 10–24: United States, 2001–2021. NCHS Data Brief, No. 471; 2023. <https://www.cdc.gov/nchs/data/databriefs/db471.pdf>. Accessed 17 June 2024.
8. CDC. Youth online. <https://nccd.cdc.gov/youthonline/App/Results.aspx?LID=XX>. Accessed 17 May 2024.
9. CDC. Risk and protective factors for suicide. Suicide prevention; 2024. <https://www.cdc.gov/suicide/risk-factors/index.html>. Accessed 17 May 2024.
10. Bilsen J. Suicide and youth: risk factors. *Front Psychiatry*. 2018;30(9):540. <https://doi.org/10.3389/fpsy.2018.00540>.
11. Van Heeringen K. The suicidal process and related concepts. In: van Heeringen K, editor. *Understanding suicidal behavior*. Chichester: John Wiley & Sons Ltd; 2001. p. 136–59.
12. Roh BR, Jung EH, Hong HJ. A comparative study of suicide rates among 10–19-year-olds in 29 OECD countries. *Psychiatry Investig*. 2018;15(4):376–83. <https://doi.org/10.30773/pi.2017.08.02>. (Epub 2018 Feb 28).
13. Xiao Y, Cerel J, Mann JJ. Temporal trends in suicidal ideation and attempts among US adolescents by sex and race/ethnicity, 1991–2019. *JAMA Netw Open*. 2021;4(6): e2113513. <https://doi.org/10.1001/jamanetworkopen.2021.13513>.
14. Arisoyin AE, Adeyemi AH, Okobi OE, Alaga AH, Adekunle OJ, Ajayi OO, Aladeniyi F, Oni EO, Okobi E, Okeaya-Inneh M, Young CL. Analyzing trends in suicide attempts among the pediatric population in the United States: a study using CDC's youth risk behavior surveillance system (YRBSS) database. *Cureus*. 2023;15(8): e44099. <https://doi.org/10.7759/cureus.44099>.
15. Gaylor EM, Krause KH, Welder LE, et al. Suicidal thoughts and behaviors among high school students—youth risk behavior survey, United States, 2021. *MMWR Suppl*. 2023;72(Suppl-1):45–54. <https://doi.org/10.15585/mmwr.su7201a6>.
16. Stone DM, Mack KA, Qualters J. Notes from the field: recent changes in suicide rates, by race and ethnicity and age group—United States, 2021. *MMWR*. 2023;72:160–2. <https://doi.org/10.15585/mmwr.mm7206a4>.
17. United States Census Bureau. QuickFacts. <https://www.census.gov/quickfacts/fact/table/MS,US/PST045223>. Accessed 1 June 2024.
18. Dankins A. State's suicide rate climbed to 20-year high—'these are someone's loved ones'. *Mississippi Today*; 2023. <https://mississippitoday.org/2023/09/27/mississippi-suicide-rate-climbed-to-20-year-high-in-2021/>. Accessed 17 June 2024.
19. Mississippi State Department of Health. Health equity. <https://msdh.ms.gov/page/44,0,236.html#:~:text=Mississippi%20ranks%20last%2C%20or%20close,and%20results%20in%20unnecessary%20costs>. Accessed 19 Oct 2024.
20. CDC. 2021 YRBS data user's guide. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2021/2021_YRBS_Data_Users_Guide_508.pdf. Accessed 1 Mar 2024.
21. CDC. 2021 YRBS National, state, and district combined datasets user's guide. <https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2021/2021-YRBS-SADC-Documentation508.pdf>. Accessed 20 Feb 2024.
22. CDC. Overview and methods for the youth risk behavior surveillance system—United States. *MMWR Suppl*. 2020;69(1):1–10.
23. CDC. Morbidity and mortality weekly report. Supplement/Vol.72/No.1.
24. Greenland S, Senn SJ, Rothman KJ, Carlin JB, Poole C, Goodman SN, Altman DG. Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. *Eur J Epidemiol*. 2016;31(4):337–50. <https://doi.org/10.1007/s10654-016-0149-3>. (Epub 2016 May 21).
25. Mulla ZD, Cole SR. Re: "epidemiology of salmonellosis in California, 1990–1999: morbidity, mortality, and hospitalization costs". *Am J Epidemiol*. 2004; 159(1):104; author reply 104–5. <https://doi.org/10.1093/aje/kwh007>.
26. CDC. Conducting Trend Analysis of YRBS Data. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2021/2021_yrbs_conducting_trend_analysis_508.pdf. Accessed 1 Mar 2024.
27. Anthony Damico. Analyze Survey Data for Free. <https://asdfree.com/trend-analysis-of-complex-survey-data.html>. Accessed 1 Apr 2024.
28. Barrio G, Pulido J, Bravo MJ, Lardelli-Claret P, Jimenez-Mejias E, de la Fuente L. An example of the usefulness of joinpoint trend analysis for assessing changes in traffic safety policies. *Accid Anal Prev*. 2015;75(6):292–7.
29. Long NP, Huy NT, Trang NTH, Luan NT, Anh NH, Nghi TD, Van Hieu MK, Hirayama K, Karbwang J. Scientific productivity on research in ethical issues over the past half century: a joinpoint regression analysis. *Trop Med Int Health*. 2014;42(3):121.
30. Dyvesether S, Nordentoft M, Forman J, Erlangsen A. Joinpoint regression analysis of suicides in Denmark during 1980–2015. *Danish Med J*. 2018;65(4):A5477.
31. Gillis D, Edwards BPM. The utility of joinpoint regression for estimating population parameters given changes in population structure. *Heliyon*. 2019;5(11): e02515.
32. National Cancer Institute. <https://surveillance.cancer.gov/help/joinpoint/setting-parameters/method-and-parameters-tab/apc-aapc-tau-confidence-intervals>. Accessed 5 Mar 2024.
33. CDC. Software for Analysis of YRBS Data. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2019/2019_yrbs_analysis_software.pdf. Accessed 24 Jan 2024.
34. Kalb LG, Stapp EK, Ballard ED, Holingue C, Keefer A, Riley A. Trends in psychiatric emergency department visits among youth and young adults in the US. *Pediatrics*. 2019;143(4): e20182192. <https://doi.org/10.1542/peds.2018-2192>. (Epub 2019 Mar 18).
35. Bombersbach TJ, McKean AJ, Olsson M, Rhee TG. National trends in mental health-related emergency department visits among youth, 2011–2020. *JAMA*. 2023;329(17):1469–77. <https://doi.org/10.1001/jama.2023.4809>.
36. United Health Foundation. https://www.americashealthrankings.org/explore/measures/teen_suicide/MS. Accessed 19 June 2024.
37. Hawton K, Hill NTM, Gould M, John A, Lascelles K, Robinson J. Clustering of suicides in children and adolescents. *Lancet Child Adolesc Health*. 2020;4(1):58–67. [https://doi.org/10.1016/S2352-4642\(19\)30335-9](https://doi.org/10.1016/S2352-4642(19)30335-9). (Epub 2019 Oct 9).
38. Trinh E, Ivey-Stephenson AZ, Ballesteros MF, Idaikkadar N, Wang J, Stone DM. CDC guidance for community assessment and investigation of suspected suicide clusters, United States, 2024. *MMWR Suppl*. 2024;73(Suppl-2):8–16. <https://doi.org/10.15585/mmwr.su7302a2>.
39. Simonetti JA, Mackelprang JL, Rowhani-Rahbar A, Zatzick D, Rivara FP. Psychiatric comorbidity, suicidality, and in-home firearm access among a nationally representative sample of adolescents. *JAMA Psychiat*. 2015;72(2):152–9. <https://doi.org/10.1001/jamapsychiatry.2014.1760>.