HHS Public Access

Author manuscript

JAMA Pediatr. Author manuscript; available in PMC 2018 April 01.

Published in final edited form as:

JAMA Pediatr. 2017 April 01; 171(4): 350–356. doi:10.1001/jamapediatrics.2016.4529.

Difference-in-Differences Analysis of the Association Between State Same-Sex Marriage Policies and Adolescent Suicide Attempts

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Abstract

IMPORTANCE—Suicide is the second leading cause of death among adolescents between the ages of 15 and 24 years. Adolescents who are sexual minorities experience elevated rates of suicide attempts.

OBJECTIVE—To evaluate the association between state same-sex marriage policies and adolescent suicide attempts.

DESIGN, SETTING, AND PARTICIPANTS—This study used state-level Youth Risk Behavior Surveillance System (YRBSS) data from January 1, 1999, to December 31, 2015, which are weighted to be representative of each state that has participation in the survey greater than 60%. A difference-in-differences analysis compared changes in suicide attempts among all public high school students before and after implementation of state policies in 32 states permitting same-sex marriage with year-to-year changes in suicide attempts among high school students in 15 states without policies permitting same-sex marriage. Linear regression was used to control for state, age, sex, race/ethnicity, and year, with Taylor series linearized standard errors clustered by state and classroom. In a secondary analysis among students who are sexual minorities, we included an interaction between sexual minority identity and living in a state that had implemented same-sex marriage policies.

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Study concept and design: All authors.

Acquisition, analysis, or interpretation of data: Raifman, Moscoe, McConnell.

Drafting of the manuscript: Raifman, Moscoe, McConnell.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Raifman, Moscoe, McConnell.

Obtained funding: Raifman.

Administrative, technical, or material support: Raifman.

Study supervision: Raifman, McConnell.

Conflict of Interest Disclosures: None reported.

INTERVENTIONS—Implementation of state policies permitting same-sex marriage during the full period of YRBSS data collection.

MAIN OUTCOMES AND MEASURES—Self-report of 1 or more suicide attempts within the past 12 months.

RESULTS—Among the 762 678 students (mean [SD] age, 16.0 [1.2] years; 366 063 males and 396 615 females) who participated in the YRBSS between 1999 and 2015, a weighted 8.6% of all high school students and 28.5% of students who identified as sexual minorities reported suicide attempts before implementation of same-sex marriage policies. Same-sex marriage policies were associated with a 0.6–percentage point (95% CI, −1.2 to −0.01 percentage points) reduction in suicide attempts, representing a 7% relative reduction in the proportion of high school students attempting suicide owing to same-sex marriage implementation. The association was concentrated among students who were sexual minorities.

CONCLUSIONS AND RELEVANCE—State same-sex marriage policies were associated with a reduction in the proportion of high school students reporting suicide attempts, providing empirical evidence for an association between same-sex marriage policies and mental health outcomes.

Suicide is the second most common cause of death among adolescents aged 15 to 24 years.[1] Adolescents who are sexual minorities are at increased risk of suicide attempts. Evidence from nationally representative 2015 Youth Risk Behavior Surveillance System (YRBSS) data indicates that more than 29% of gay, lesbian, and bisexual high school students reported attempting suicide within the past 12 months, relative to 6% of heterosexual students.[2] Adolescent suicide causes decades of life lost, reflects great suffering leading up to the event, and has substantial mental health ramifications for families and communities.[3,4] Previous suicide attempts are the strongest known predictor of suicide fatality[5] and are associated with poorer long-term health outcomes among survivors.[6]

Although it is unclear what drives greater rates of suicide attempts among adolescents who are sexual minorities, prior evidence suggests several potential mechanisms, including stigma. Link and Phelan[7] defined *stigma* as the confluence of labeling, stereotyping, differentiation from the norm, status loss, and discrimination in the context of differential power. Stigma based on sexual orientation is associated with mental distress, anxiety and depression, and greater rates of suicide attempts.[8–10] Policies preventing same-sex marriage constitute a form of structural stigma because they label sexual minorities as different and deny them legal, financial, health, and other benefits that are associated with marriage.[7,11] Legalization of same-sex marriage is also often accompanied by media attention and increased visibility of sexual minorities,[12] which is associated with increased social support for the rights of sexual minorities.[13,14] This increased social support could translate into improved familial and peer acceptance of sexual minorities, which has been shown to be associated with improved mental health.[15,16] For each of these reasons, same-sex marriage policies may reduce the stigma experienced by adolescents who are sexual minorities. On the other hand, same-sex marriage laws could negatively affect the mental health of adolescents who are sexual minorities. Increased visibility of sexual minorities accompanying same-sex marriage[12] could lead to rejection in hostile family environments[15] and brings the potential for political and social backlash.[17] The increased resources devoted

to the efforts to legalize same-sex marriage may also detract from the resources devoted to serving youth who are sexual minorities.[18]

Prior research suggests an association between same-sex marriage policies and mental health.[9,11,19–21] Use of and expenditures on mental health care significantly decreased among men who have sex with men in the year following legalization of same-sex marriage relative to the year prior in Massachusetts.[22] The effect was not dependent on partnership status, suggesting that same-sex marriage policies may have broad effects on the mental health of sexual minorities beyond the direct benefits of partnership or marriage. Hatzenbuehler and colleagues[19] also found that psychiatric disorders increased among adults who were sexual minorities after same-sex marriage was banned in 16 states. We contribute evidence linking same-sex marriage policies and health with a study based on the natural experiment created by geographic and temporal variation in state same-sex marriage policies.

We estimated the association between same-sex marriage policies and the proportion of adolescents attempting suicide based on a difference-in-differences analysis using YRBSS data.[23] We hypothesized that state same-sex marriage policies would be associated with reductions in the proportion of adolescents attempting suicide.

Methods

Data and Sample

We obtained data on demographic information and suicide attempts from the state YRBSS, a Centers for Disease Control and Prevention–supported survey on high school student risk behaviors conducted every 2 years. The state YRBSS uses 2-stage sampling of schools and classrooms to develop a representative sample of all public school students in grades 9 to 12 in each US state.[24] We used data from all 47 YRBSS states in all years with weighted data,[25] which included data from 32 of 35 states that implemented same-sex marriage policies between January 1, 2004 and January 1, 2015. We used data from January 1, 1999, to December 31, 2015, to capture trends in suicide attempts 5 years before the first same-sex marriage policy in Massachusetts. We used only deidentified data for this study. The Johns Hopkins Bloomberg School of Public Health Institutional Review Board and the Harvard T. H. Chan School of Public Health Institutional Review Board approved exemption from human participants review for this study.

We conducted our primary analysis in the full population of high school students and a secondary analysis in the subset of students who self-identified as sexual minorities. We report demographic characteristics including age, race/ethnicity, and sex. We classified students as sexual minorities if they responded that they were gay, lesbian, bisexual, or not sure, when asked “Which of the following best describes you?”[2] Twenty-five states included this question in 2015 (eTable 1 and eTable 2 in the Supplement). Although students who died through suicide are not captured in the data, the mean annual suicide rate of 5.3 per 100 000 adolescents between the ages of 14 and 17 years between 1999 and 2014 is small relative to suicide attempts and should not significantly bias the results.[1]

We focused our analysis on the full population of students for the following 3 reasons: we were able to include data from all participating states in all years without restricting the analysis to states that collected information on sexual orientation, the full population includes sexual minorities who may not identify as sexual minorities in the YRBSS, and same-sex marriage policies may affect the composition of the self-identified sexual minority population.[26] We conducted a subgroup analysis of sexual minorities to assess whether changes in suicide attempts were concentrated in this population but emphasize that these estimates are vulnerable to bias.

Exposure and Outcome

We defined the exposure as a state-level policy granting same-sex couples equivalent marriage rights as opposite-sex couples. We categorized states as having same-sex marriage policies if same-sex marriage was legal during the full period of YRBSS data collection; we considered students exposed to the policy even if same-sex marriage was legal for only part of the 12-month recall period for a suicide attempt, but only if same-sex marriage was legal during the full data collection period. A timeline of same-sex marriage laws and method of enactment is depicted in the eFigure and eTable 2 in the Supplement.

The main outcome of interest was whether students reported 1 or more suicide attempts in response to the question, “During the past 12 months, how many times did you actually attempt suicide?” In a study of the test-retest reliability from the 1999 YRBSS national survey, the κ statistic for this question was 72.7, indicating substantial reliability.[27] This finding is consistent with other studies indicating high sensitivity and specificity of self-reported suicide attempts, and self-report is the standard approach to assessing suicide attempts.[28] Although suicide attempts do not always represent a desire to die, there is a consensus that attempted suicide reflects great emotional distress.[6,28–30] We selected suicide attempts as the main outcome because there are large disparities in suicide attempts based on sexual orientation, attempts are strongly associated with suicide,[5] and most states collected information on suicide attempts in most years. We did not use death from suicide as our main outcome because it is a rare event,[31] because it is difficult to identify the sexual orientation of individuals who committed suicide, and because data on suicide mortality can be subject to underreporting owing to stigma.[32]

Statistical Analysis

We estimated the association between implementation of same-sex marriage policies and the proportion of adolescents attempting suicide through a difference-in-differences analysis, an approach that entails comparing mean changes in an outcome in a treatment group before and after a policy change with mean changes in a control group with no policy change.[23,33,34] The method requires that baseline temporal trends (but not absolute levels) of the outcome are equivalent in states that did and did not implement same-sex marriage policies by 2015; the corollary is that the trends in both groups would have continued to be the same in the absence of a policy change. We tested this assumption with a linear regression analysis of suicide attempts before implementation of same-sex marriage policies. We estimated an interaction term between linear year and states with same-sex marriage policies, allowing for a different intercept in states with same-sex marriage policies and

controlling for age, race/ethnicity, sex, state, annual state unemployment rates,[35] and state-level policies preventing employment discrimination on the basis of sexual orientation.

For our main analysis, we estimated a linear regression difference-in-differences model with a binary indicator for same-sex marriage policies, with state and year fixed effects, and with controls for state, year, annual state unemployment rates,[35] state-level policies preventing employment discrimination on the basis of sexual orientation, and individual race/ethnicity, age, and sex. We estimated linear models rather than logit models owing to their unbiased estimation properties with fixed effects analyses.[36] We accounted for the complex survey design of the YRBSS by using Taylor series linearization with clustering by state and classroom to estimate standard errors. In the analysis focused on youth who are sexual minorities, we estimated the interaction between state same-sex marriage policies and sexual minority identity and included controls for state same-sex marriage policies and for sexual minority identity.

Controlling for each state serves 2 important functions in our analysis. First, controlling for each state means that the analysis captures only relative changes in suicide attempts in each state, preventing differing baseline state rates of adolescent suicide attempts from affecting the analysis. Second, controlling for each state controls for time-invariant state characteristics such as cultural, political, historical, and other differences that could otherwise confound the analysis.

We conducted several robustness checks. First, we repeated our main analyses with a binary lead exposure indicator that states would implement same-sex marriage policies 2 years in the future. If the lead variable for implementing same-sex marriage policies in the future was associated with suicide attempts, it would indicate that our results may be owing to time trends in states with same-sex marriage policies being systematically different from time trends in states without same-sex marriage policies.[37] Second, we tested a lagged exposure variable for states implementing same-sex marriage policies 2 or more years in the past to assess whether the effects of same-sex marriage policies persisted. We conducted an analysis excluding Massachusetts to assess whether results were driven by the earliest state to implement a same-sex marriage policy. Finally, we conducted falsification tests by assessing the association between same-sex marriage policies and behaviors that we would not expect to be affected by changes in the legal status of same-sex marriage, including fruit juice and carrot consumption within the past 7 days and never using a seatbelt.[37,38] If same-sex marriage policies were associated with these behaviors, it would suggest that omitted variables affecting youth health decisions were driving our results.

Results

We analyzed data from 762 678 adolescents who participated in the YRBSS in 47 states between 1999 and 2015. As Table 1 indicates, the weighted percentages of male and female students were similar in states that did and did not implement same-sex marriage policies before 2015 (same-sex marriage policies, 49.7% males and 50.3% females; no same-sex marriage policies, 49.6% males and 50.4% females). Students in states with same-sex marriage policies were slightly younger than those in states without same-sex marriage

policies (mean [SD], 15.9 [1.2] vs 16.0 [1.2] years). A larger weighted proportion of students in states without same-sex marriage policies were were Hispanic (16.1% vs 11.3%) and African American (18.6% vs 14.3%). In states that inquired about sexual minority orientation in 2015, a weighted mean of 12.7% of students identified as sexual minorities. Among students in these states, 2.3% identified as gay or lesbian, 6.4% as bisexual, and 4.0% as not sure of their orientation.

Figure 1 shows that trends in suicide attempts were relatively flat and were similar in the comparison states and in the intervention states that we visualize in 2 waves (wave 1, states that implemented same-sex marriage policies before 2013; wave 2, states that implemented same-sex marriage policies in 2013–2014). Before the implementation of same-sex marriage policies, temporal trends in suicide attempts were not significantly different in states with same-sex marriage policies relative to temporal trends in suicide attempts in states without same-sex marriage policies (0.001 percentage points; 95% CI, more than −0.001 to 0.001; eTable 3 in the Supplement).

Table 2 presents the net change in high school students' reported suicide attempts after implementation of same-sex marriage policies in the states with those policies relative to states without same-sex marriage policies. Across all states before the implementation of same-sex marriage policies, a weighted 8.6% of all high school students and 28.5% of students who were sexual minorities reported 1 or more suicide attempts within the past year. Although high school students who were sexual minorities made up a weighted 12.7% of the population, they accounted for 34.1% of students reporting 1 or more suicide attempts in 2015. Same-sex marriage was associated with a statistically significant decline in the proportion of all students attempting suicide of 0.6 percentage points (95% CI, −1.2 to −0.01 percentage points) across the full time period following implementation of same-sex marriage policies, for a relative reduction of 7%. In the analysis in which we assessed an interaction term for minority sexual orientation and implementation of same-sex marriage policies, such policies were associated with a statistically significant decline in the proportion of adolescents who were sexual minorities who reported attempting suicide in the past year (−4.0 percentage points; 95% CI, −6.9 to −1.2 percentage points). These results are equivalent to a 14% relative decline in the proportion of adolescents who were sexual minorities reporting suicide attempts in the past year. The full regression output for these analyses is in eTable 4 and eTable 5 in the Supplement. The decline in overall suicide attempts by high school students following implementation of same-sex marriage policies in the states that implemented these policies is depicted in Figure 2 and Figure 3. A 0.6–percentage point decline in suicide rates for all students would be equivalent to an estimated 134 446 (95% CI, 16 890–252 437) fewer adolescents attempting suicide each year, based on the 2015 US population estimates of adolescents aged 15 to 19 years.[39]

The results of sensitivity analyses are in eTables 6–9 in the Supplement. A lead indicator for states implementing same-sex marriage policies in the following 2 years was not associated with suicide attempts among all high school students or among students who were sexual minorities (eTable 6 in the Supplement), indicating that our main findings are not owing to changes in trends that occurred before implementation of same-sex marriage policies.[37,40] A lagged indicator for states implementing same-sex marriage policies 2 or more years prior

was significantly associated with reduced suicide attempts (−0.7 percentage points; 95% CI, −1.3 to −0.2 percentage points), indicating that reductions in suicide attempts persisted over time in the years following implementation of same-sex marriage policies (eTable 7 in the Supplement). We also found that the estimated effect of same-sex marriage policies was robust to the exclusion of Massachusetts (eTable 8 in the Supplement) and, in falsification checks, that same-sex marriage policies were not associated with behaviors that should not be affected by such policies (eTable 9 in the Supplement).

Discussion

Our study documents that implementation of same-sex marriage policies was associated with a significant decrease in the proportion of high school students attempting suicide in 32 states that implemented same-sex marriage policies by January 1, 2015, relative to 15 states that did not implement same-sex marriage policies by that date. After same-sex marriage laws were implemented, the proportion of high school students reporting suicide attempts in the past year decreased by 0.6 percentage points, equivalent to a 7% decline. Reductions in the proportion of high school students attempting suicide were concentrated among students identifying as sexual minorities. Furthermore, we found that the effects of legalization persisted 2 years after legalization, suggesting that social and political backlash does not have the effect of worsening mental health outcomes in this window. The 7% reduction in adolescent suicide attempts suggests that same-sex marriage policies may contribute to the Healthy People 2020 goal of reducing adolescent suicide attempts by 10%.[41] We estimated that, each year, same-sex marriage policies would be associated with more than 134 000 fewer adolescents attempting suicide. These results reflect an important reduction in adolescent emotional distress[29] and risk of mortality from suicide.[5]

This study addresses 2 important challenges to analyzing the association between state same-sex marriage policies and health: underlying state characteristics are likely to influence both state same-sex marriage policies and the prevalence of suicide attempts, and states have different baseline levels of suicide attempts. We addressed both of these issues by controlling for state, which accounts for time-invariant state characteristics such as cultural and political differences and controls for baseline state differences in the prevalence of suicide attempts. In this manner, we focused on the differences in suicide attempts within each state before and after the implementation of same-sex marriage policies relative to year-to-year differences in states that did not implement same-sex marriage policies.

Our results build on prior research indicating that state same-sex marriage bans were associated with increased rates of psychiatric disorders[19] and that health expenditures decreased following implementation of a same-sex marriage policy in Massachusetts.[22] Our study contributes evidence on the association between same-sex marriage and mental health based on a robust analysis that controls for differences in state characteristics and for other state-level events that may affect suicide attempts, which are unlikely to systematically vary with the same geographic and temporal pattern as same-sex marriage implementation.

Our findings are particularly meaningful in the context of the statistically insignificant effects of most school-based, mass media, and other interventions to reduce suicide attempts

in the general population.[30,31] We did not identify suicide intervention studies that addressed the substantially elevated risk of suicide attempts among adolescents who identifed as sexual minorities.[42] Although implementation of same-sex marriage policies reduced suicide attempts among adolescents who were sexual minorities, more than 1 in 5 adolescents who identified as sexual minorities reported attempting suicide after same-sex marriage laws were implemented in same-sex marriage states. Interventions addressing suicide attempts among adolescents who identify as sexual minorities should be a research priority.

Limitations

Our study has some limitations. The main outcome is based on self-report, which is the standard approach to assessing suicide attempts, given that a minority of individuals who attempt suicide present to hospitals and that suicides are rare[31] and often underreported.[32] The analyses on the association between implementation of same-sex marriage policies and adolescent suicide attempts among those identifying as sexual minorities should be interpreted with caution given the limited data availability on sexual orientation (eTables 1 and 2 in the Supplement) and the potential for same-sex marriage to affect sexual minority identity.[26] We also could not control for unmeasured individual-level characteristics, including socioeconomic status, or for unmeasured state characteristics that may change over time, such as religious affiliation or acceptance of sexual minorities. Finally, our analysis does not allow us to understand the mechanisms through which implementation of same-sex marriage policies reduced adolescent suicide attempts. There is a need for further research to understand the association between sexual minority rights, stigma, and sexual minority health.

Conclusions

We provide evidence that implementation of same-sex marriage policies reduced adolescent suicide attempts. As countries around the world consider enabling or restricting same sex marriage, we provide evidence that implementing same-sex marriage policies was associated with improved population health. Policymakers should consider the mental health consequences of same-sex marriage policies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding/Support: Ms Raifman is supported by training grants T32AI102623 and R25MH083620 from the National Institutes of Health. Dr Austin is supported by training grants T71-MC-00009 and T76-MC-00001 from the Maternal and Child Health Bureau, Health Resources and Services Administration, US Department of Health and Human Services.

Role of the Funder/Sponsor: The funding sources played no role in the design and conduct of the study; collection, management, analysis, or interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Additional Contributions: We thank the Centers for Disease Control and Prevention; the Colorado, Massachusetts, Pennsylvania, and New Mexico Departments of Education; the Florida, Hawaii, Indiana, Ohio, South Dakota, and

Vermont Departments of Health; and the Texas Department of State Health Services for sharing Youth Risk Behavior Surveillance System data.

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Key Points

Question

Are state same-sex marriage policies associated with a reduction in adolescent suicide attempts?

Findings

This difference-in-differences analysis of representative data from 47 states found that same-sex marriage policies were associated with a 7% reduction in the proportion of all high school students reporting a suicide attempt within the past year. The effect was concentrated among adolescents who were sexual minorities.

Meaning

Same-sex marriage policies are associated with reduced adolescent suicide attempts.

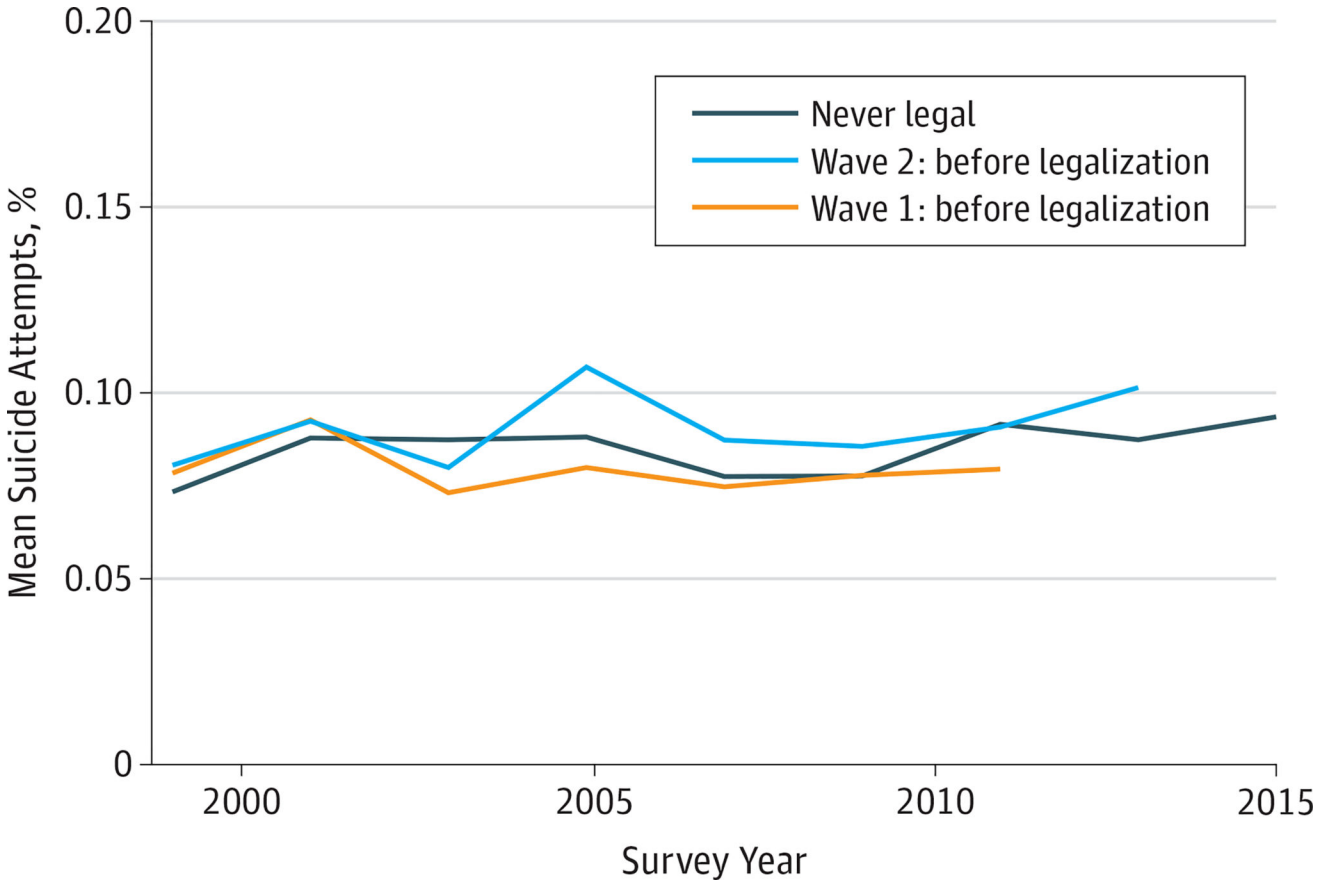

Figure 1. Trends in Suicide Attempts Before Implementation of Same-Sex Marriage Policies

States are grouped based on the years when they implemented same-sex marriage. Wave 1 is states that implemented same-sex marriage policies before 2013, and Wave 2 is states that implemented same-sex marriage policies in 2013 or 2014. There were no overall statistically significantly different trends in suicide attempts in states without same-sex marriage policies relative to those with same-sex marriage policies before implementation of such laws (interaction term between same-sex marriage policies and linear year, 0.001 percentage points; 95% CI, more than −0.001 to 0.001 percentage points) or by wave (wave 1, −0.06 percentage points; 95% CI, −0.1 to 0.03 percentage points; wave 2, 0.01 percentage points; 95% CI, −0.06 to 0.08 percentage points).

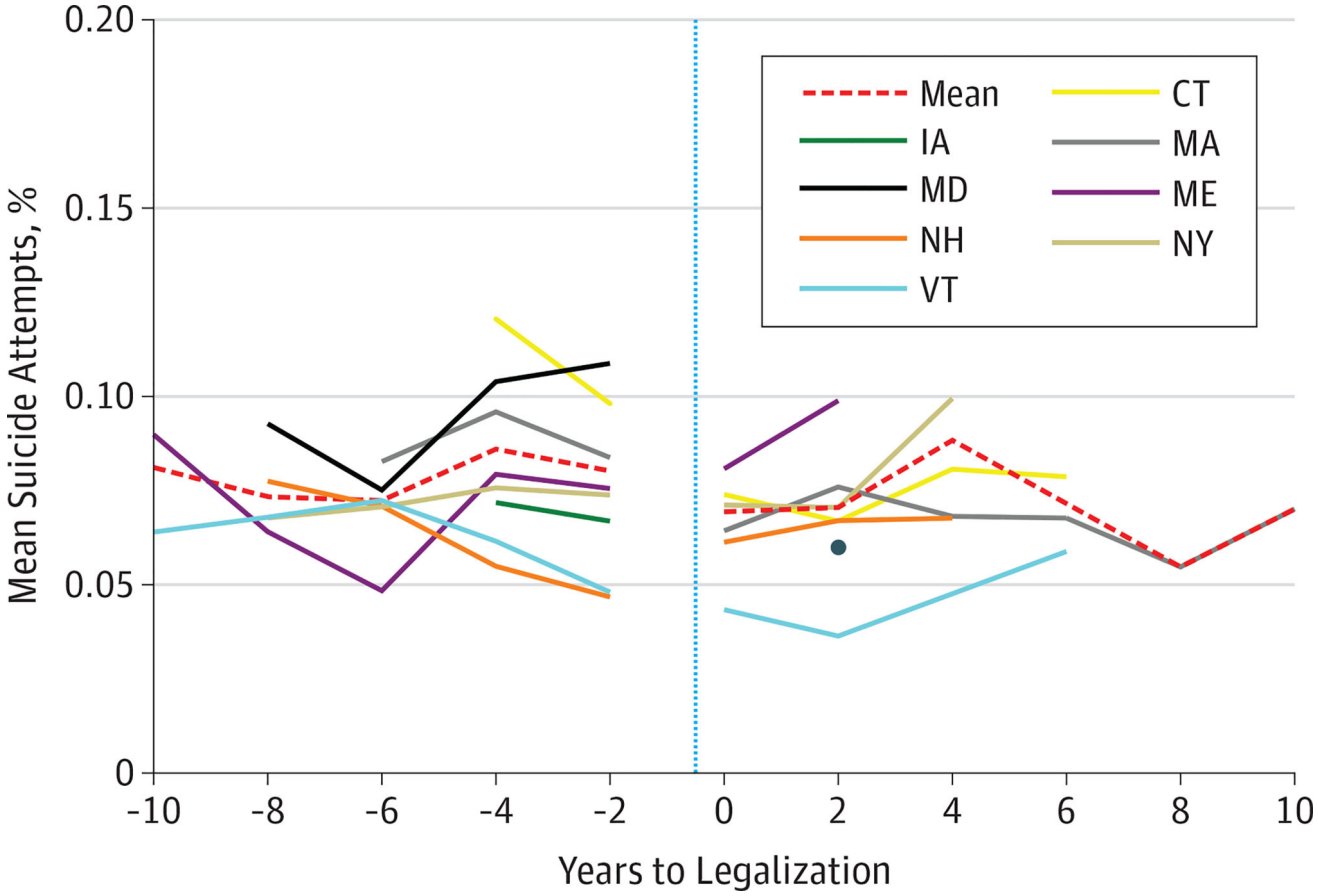

Figure 2. Suicide Attempts by Years Relative to Implementation of Same-Sex Marriage Policies in States Implementing Same-Sex Marriage Policies Before 2013

Year 0 reflects the first Youth Risk Behavior Surveillance System (YRBSS) data collection period after same-sex marriage policies were implemented. The vertical line marks the beginning of year 0. The 2-year increments on the x-axis reflect the 2-year increments of YRBSS data collection. Point estimates in Table 2 reflect the mean of the period after implementation of same-sex marriage policies relative to the mean of the period before implementation of such policies. Time trends depicted in the graph suggest that the proportion of students attempting suicide declined following implementation of same-sex marriage policies.

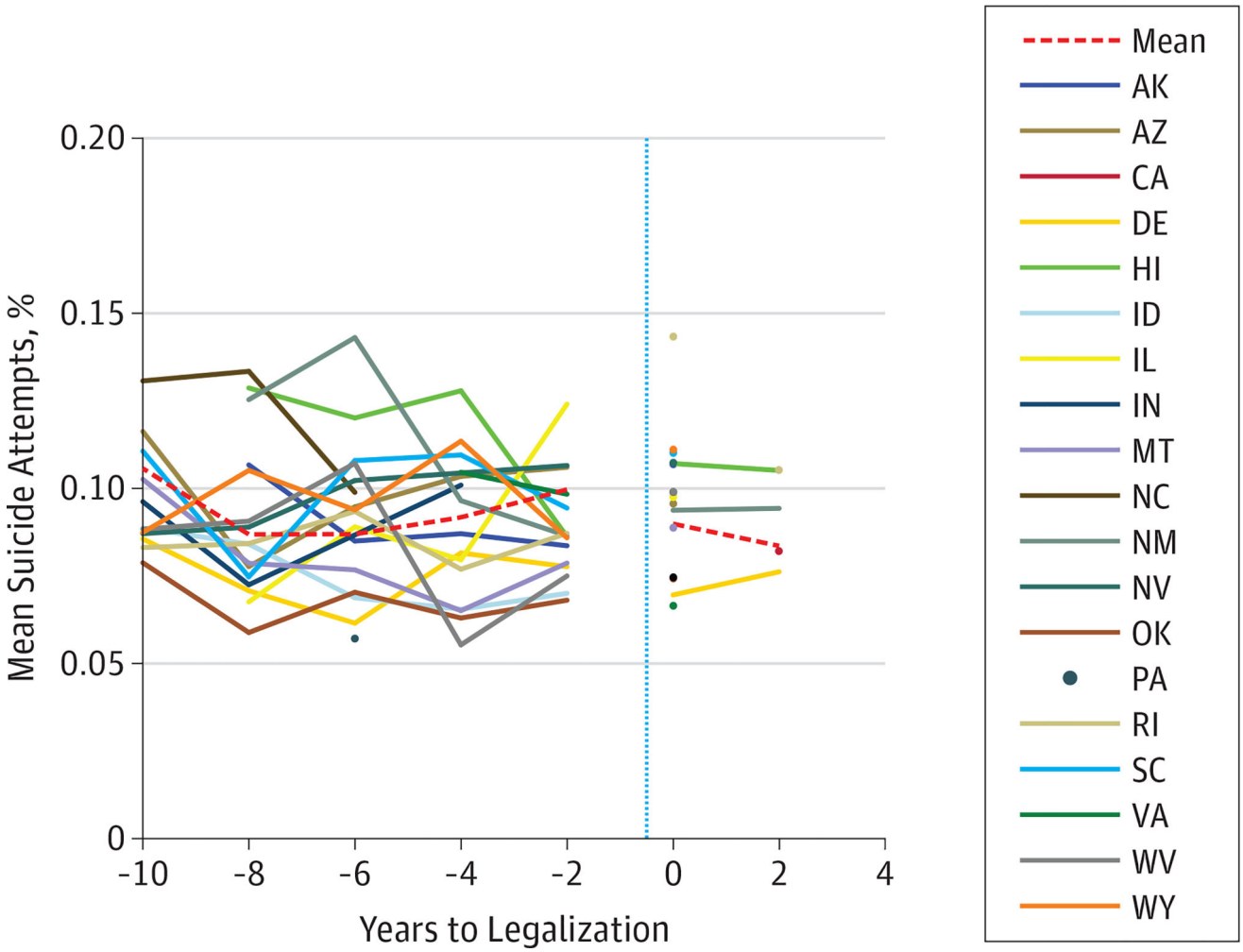

Figure 3. Suicide Attempts by Years Relative to Implementation of Same-Sex Marriage Policies in States Implementing Same-Sex Marriage Policies in 2013 or 2014

Year 0 reflects the first Youth Risk Behavior Surveillance System (YRBSS) data collection period after same-sex marriage policies were implemented. The vertical line marks the beginning of year 0. The 2-year increments on the x-axis reflect the 2-year increments of YRBSS data collection. Point estimates in Table 2 reflect the mean of the period after implementation of same-sex marriage policies relative to the mean of the period before implementation of such policies. Time trends depicted in the graph suggest that the proportion of students attempting suicide declined following implementation of same-sex marriage policies.

Table 1

Participant Characteristics Across All Years of the Youth Risk Behavior Surveillance System (1999–2015)

Characteristic	Value[a] Same-Sex Marriage Policies (n = 546 276)[b]	No Same-Sex Marriage Policies (n = 216 402)[c]	*P* Value
Age, mean (SD), y	15.9 (1.2)	16.0 (1.2)	<.001
Sex			
Male	262 808 (49.7)	103 255 (49.6)	.48
Female	283 468 (50.3)	113 147 (50.4)	.48
Race/ethnicity			
White	296 334 (58.4)	119 730 (55.0)	.03
Hispanic	53 060 (11.3)	34 048 (16.1)	<.001
African American	78 139 (14.3)	25 519 (18.6)	<.001
Other race/ethnicity	118 734 (16.0)	37 105 (10.3)	<.001

[a] All numbers are unweighted while percentages are weighted to be representative of the state population of high school students by student sex, grade, and race/ethnicity. Sex, age, and race/ethnicity are based on participant self-report.

[b] Data from 32 states.

[c] Data from 15 states.

Table 2

Changes in High School Student Suicide Attempts in States With Same-Sex Marriage Policies Relative to States Without Same-Sex Marriage Policies[a]

Students	Students Reporting a Suicide Attempt in the Past Year Before Same-Sex Marriage Policies, %[b]	Net Change in Suicide Attempts After Same-Sex Marriage Policies Implemented, Percentage Points	95% CI
All students (n = 762 678)	8.6	−0.6[c]	−1.2 to −0.1
Students identifying as sexual minorities (n = 231 413)[d]	28.5	−4.0[e]	−6.9 to −1.2

[a] In each linear regression, we controlled for sex, age, and race/ethnicity. We included fixed effects for state and year and clustered standard errors by school and by classroom. We included the full regression tables for each analysis in eTables 3 and 4 in the Supplement.

[b] Percentages are weighted to be representative of the state population of high school students by student sex, grade, and race/ethnicity.

[c] $P < .05$.

[d] The sample size includes students who identified as straight as well as those who identified as sexual minorities in states that collected data on sexual orientation. The analysis of sexual minority adolescents was based on interacting a term for state same-sex marriage implementation and adolescents identifying as sexual minorities. The full results can be found in eTable 4 in the Supplement.

[e] $P < .01$.