

# Association between Marijuana Laws in the United States and Suicide Mortality Risk During Adolescence and Young Adulthood

Christopher J Hammond MD PhD<sup>1\*</sup>; Danielle L Steelesmith PhD<sup>2</sup>; Madison Hyer PhD<sup>2</sup>; Guy Brock PhD<sup>3</sup>; Ankit Chalia MD<sup>4</sup>; Alene Kennedy-Hendricks PhD<sup>5</sup>; Mary A Fristad PhD<sup>2,6</sup>; Cynthia A Fontanella PhD<sup>2\*</sup>

<sup>1</sup>Department of Psychiatry, Johns Hopkins University School of Medicine, Baltimore, MD; <sup>2</sup>Department of Psychiatry, The Ohio State University Wexner Medical Center, Columbus, OH; <sup>3</sup>Department of Biomedical Informatics, The Ohio State University, Columbus, OH; <sup>4</sup>Department of Psychiatry, West Virginia University School of Medicine, Morgantown, WV; <sup>5</sup>Center for Mental Health and Addiction Policy, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; <sup>6</sup>Big Lots Behavioral Health Services, Nationwide Children's Hospital, Columbus, OH. \*presenting authors

Conflicts of Interest Disclosures: The authors report no financial or other relationship relevant to the subject of this research.



THE OHIO STATE UNIVERSITY

WEXNER MEDICAL CENTER

## Synopsis

Marijuana laws, both recreational (RML) and medical (MML) are changing rapidly, and are not informed by evidence. From 2000-2018, 23 states passed MML and 10 states passed RML. We examined the impact on rates of suicide in adolescents (12-17) and young adults (18-25: AYA). Both MML and RML are associated with increased suicide in females aged 12-25; girls aged 12-14 had higher suicide in RML compared to MML states. RML (vs. no law or MML) is linked to higher suicide in males aged 14-16. This is the first study to show increased risk of suicide among AYA with the passage of marijuana laws.

## Background

Little is known about the relationship between MML and RML and suicide in youth and young adults. While cannabis use has been associated with increased suicidal ideation, suicide attempts, and death by suicide in youth and adults, limited studies are available to examine how marijuana laws relate to these outcomes. At least three studies exist that examine these relationships, but they do not focus specifically on adolescents and young adults.

Anderson et al<sup>1</sup> examined the association between MML and year-to-year changes in adult suicide rates using data from the 1990-2007 National Vital Statistics System. Overall, there was no significant association between MML and suicide; however, legalization was associated with a 10.8% reduction in the suicide rate for males aged 20-39 years. Bartos et al<sup>2</sup> looked specifically at California compared to other states without MML laws and found that the enactment of California's law resulted in a reduction of overall and firearm suicide deaths. However, one study by Grucza et al<sup>3</sup> found no relationship between MML and suicide risk when examining all suicides in those 15 and older.

To our knowledge, no studies have examined the relationship between RML and suicide, nor have they examined how these laws relate to suicide in adolescents and young adults specifically.

## Methods

### Design:

- Difference in Difference with individual- and state-level covariates

### Population:

- Ages 12-25 years
- Death between Jan 1 2000 and Dec 31 2018
- Death by suicide (ICD 10 cause of death codes: X60-X84, Y87.0, \*U03)

### Data Sources:

- CDC's National Center for Health Statistics Detailed Mortality File
- Area Health Resource File
- American Community Survey
- Giffords Law Center (gun laws)
- Alcohol Policy Information System
- State Tobacco Activities Tracking and Evaluation System
- National Conference of State Legislatures, Ballotpedia, Britannica ProCon.org (MML and RML)

### Individual-Level Factors:

- Age
- Gender
- Race/Ethnicity

### State-Level Factors:

- MML and RML
- Gun laws
- Smoking laws
- Cigarette tax
- Blood alcohol content laws
- Community mental health centers
- Provider availability per 100,000 persons (child psychiatrist, psychiatrist, pediatricians, and primary care providers)
- State sociodemographics (percent male, percent white, percent black, percent Hispanic, percent aged 15-24, per capita income, unemployment rate, poverty rate, percent uninsured)

### Outcome Variable:

- Suicide rate per 100,000 persons

### Statistical Analysis:

- Negative binomial regression with a log link and log(population) offset, adjusted for all variables listed
- Rates by age smoothed with LOESS curves
- SAS 9.4

## Results

Figure 1. State MML and RML enactment

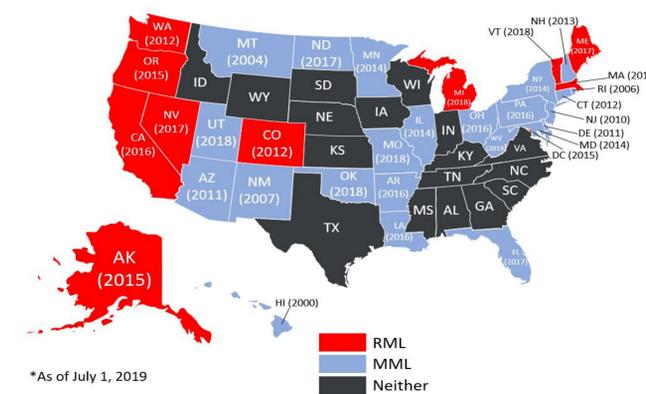


Figure 2. Suicide Rates by Age, no laws, MML, and RML, 2000-2018

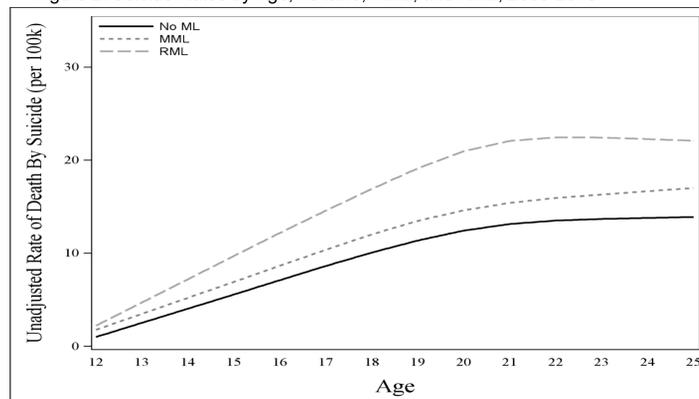


Figure 3. Female Suicide Rates by Age, no laws, MML, and RML, 2000-2018

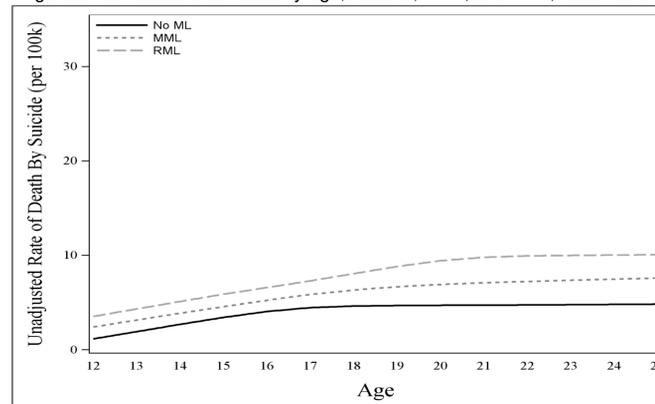
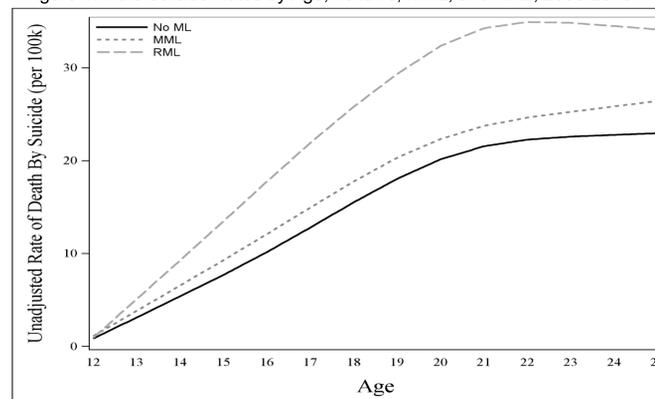


Figure 4. Male Suicide Rates by Age, no laws, MML, and RML, 2000-2018



## Summary of Findings

### Overall Suicide Rates

- Increased from 9.2/100,000 in 2000 to 15.2 /100,000 in 2018
- Higher among 18-25 yr olds: 13.0 /100K than 12-17 yrs: 4.5 /100K
- Higher among males than females (15.0 vs 3.6/100K)

### Suicide Rates by Marijuana Laws, Age, Sex (see figures)

- Highest among states with RML
- Lowest among states with no laws
- Age 19, RML: Overall 18.63, females 6.61, males 30.66
- Age 19, MML: Overall 14.09, females 5.87, males 22.31
- Age 19, no law: Overall 11.68, females 4.82, males 18.55

### Adjusted Incidence Rate Ratios

- All female age groups have increased suicide rates when comparing MML to no laws and RML to no laws. 12-13 yrs had increased suicide rates in RML vs MML states.

	MML vs no law	RML vs no law	RML vs MML
Females	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
12-13	1.21 (1.04-1.40)	1.84 (1.43-2.39)	1.54 (1.16-2.00)
14-16	1.22 (1.13-1.32)	1.34 (1.16-1.56)	1.10 (0.95-1.28)
17-19	1.17 (1.09-1.26)	1.26 (1.10-1.45)	1.08 (0.93-1.23)
20-22	1.22 (1.15-1.31)	1.36 (1.20-1.54)	1.11 (0.98-1.25)
23-24	1.17 (1.09-1.24)	1.23 (1.09-1.39)	1.05 (0.93-1.19)

- Males aged 14-16 have increased suicide rates in RML vs no law states (IRR = 1.23, 95% CI = 1.11-1.37) and RML to MML (IRR = 1.25, 95% CI = 1.14 - 1.39).
- Males aged 17-19 have decreased suicide rates when comparing MML to no laws (IRR = 0.95, 95% CI = 0.91-0.99)

## Strengths and Limitations

### Strengths:

- Large population sample of all suicide deaths in the US
- Controlled for large number of state-level covariates as well as age, sex, and race/ethnicity

### Limitations:

- Cannot draw conclusions about individuals

## Conclusions

- States with RML had highest suicide rates, followed by states with MML; those with no laws had lowest suicide rates
- Females of all ages had higher suicide rates for RML compared to no law and MML compared to no law. Young females (aged 12-13) also had higher suicide rates for RML compared to MML.
- Males aged 14 to 16 had higher suicide rates for RML compared to no laws and RML compared to MML.
- Only one comparison out of 30 (17-19 yr old males) showed decreased suicide rates associated with marijuana (MML < no law)
- Findings are consistent with prior individual studies that have shown associations between cannabis use and increased risk for suicide.

### References

1. Anderson DM, Rees DI, Sabia JJ. Medical marijuana laws and suicides by gender and age. *Am J Public Health.* 2014;104(12):2369-2376. doi:10.2105/AJPH.2013.301612
2. Bartos BJ, Kubrin CE, Newark C, McCleary R. Medical Marijuana Laws and Suicide. *Arch Suicide Res.* 2020 Apr-Jun;24(2):204-217. doi:10.1080/13811118.2019.1612803. Epub 2019 Jun 14. PMID: 31079575.
3. Grucza RA, Hu H, Agrawal A, Krauss MJ, Plunk AD, Cavazos-Rehg PA, Chaloupka FJ, Bierut LJ. A reexamination of medical marijuana policies in relation to suicide risk. *Drug Alcohol Depend.* 2015 Jul 1;152:68-72. doi: 10.1016/j.drugalcdep.2015.04.014. Epub 2015 Apr 30. PMID: 25979644; PMCID: PMC4459507.