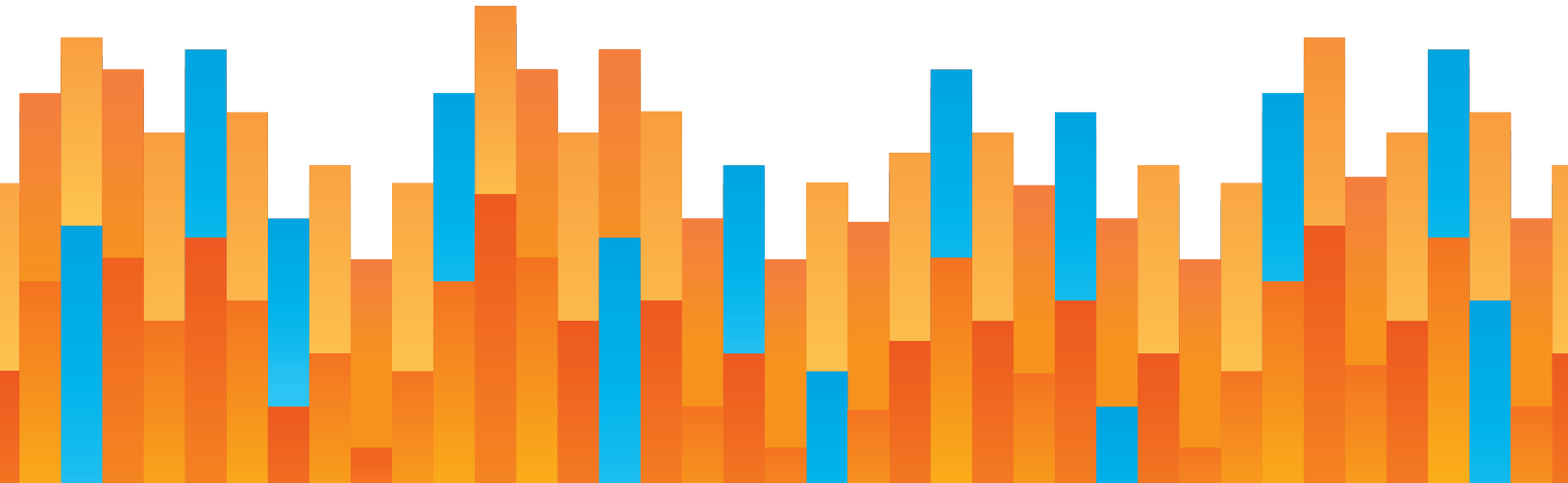
reason
FOUNDATION

DOES MARIJUANA LEGALIZATION INCREASE TRAFFIC ACCIDENTS?

by Spence Purnell and Allie Howell
September 2018



Reason Foundation's mission is to advance a free society by developing, applying and promoting libertarian principles, including individual liberty, free markets and the rule of law. We use journalism and public policy research to influence the frameworks and actions of policymakers, journalists and opinion leaders.

Reason Foundation's nonpartisan public policy research promotes choice, competition and a dynamic market economy as the foundation for human dignity and progress. Reason produces rigorous, peer-reviewed research and directly engages the policy process, seeking strategies that emphasize cooperation, flexibility, local knowledge and results. Through practical and innovative approaches to complex problems, Reason seeks to change the way people think about issues, and promote policies that allow and encourage individuals and voluntary institutions to flourish.

Reason Foundation is a tax-exempt research and education organization as defined under IRS code 501(c)(3). Reason Foundation is supported by voluntary contributions from individuals, foundations and corporations. The views are those of the author, not necessarily those of Reason Foundation or its trustees.

TABLE OF CONTENTS

INTRODUCTION

The legalization and decriminalization of marijuana across the U.S. has prompted policy debates about its risks to public health and safety. This brief focuses on the potential effect of legalizing recreational marijuana on the incidence of traffic accidents and associated fatalities.

PART 1

HOW DOES MARIJUANA AFFECT DRIVING ABILITY?

Unlike alcohol, the effects of marijuana on driving performance are not well documented or predictable. Simulator studies have found that drivers affected by THC may suffer from slower reaction time, swerving in the lane, impaired cognitive performance, impaired route planning, and risk-taking.[1] Yet other studies have found no adverse effects on sign detection, sudden lane change, or response to sudden hazards.[2]

A 2015 study produced by the National Institute on Drug Abuse (NIDA) used a driving simulator to assess how marijuana and alcohol affect driving performance.[3] While both THC

1 Ibid.

2 Sewell, R. Andrew, James Poling, and Mehmet Sofuoglu. "The Effect of Cannabis Compared With Alcohol on Driving." *The American Journal on Addictions*. Vol 18 (3): 185–193. 2009. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2722956/

3 NIDA "Effects of Marijuana – With and Without Alcohol – on Driving Performance." *National Institute on Drug Abuse*. June 23, 2015. https://www.drugabuse.gov/news-events/news-releases/2015/06/effects-marijuana-without-alcohol-driving-performance

and alcohol caused subjects to increase in-lane weaving,[4] the NIDA study found that only alcohol increased the number of the times the driver left the lane when weaving and the speed of weaving.[5] One explanation is that, unlike drivers under the influence of alcohol, drivers who have used marijuana tend to overestimate their impairment and may try to compensate by driving more slowly and increasing following distance.[6]

The NIDA study also found that drinking alcohol and smoking marijuana together resulted in weaving even if blood THC content and BAC were lower than the per se impairment thresholds for using either substance alone. Even low amounts of alcohol created a synergistic effect with cannabis which increased impairment.[7] Yet, a 2016 study conducted on the same driving simulator found that marijuana actually mitigated some of the effects of alcohol by reducing the time spent above the speed limit.[8]

While simulator studies can provide valuable insight into how marijuana affects key cognitive functions necessary for driving, such as the ability to respond to sudden changes, they may only show what drivers are capable of—not how they actually perform when driving.[9] However, as noted later in the paper, analyzing crash data to determine the effect of cannabis legalization on road safety is a practically and empirically difficult task.

4 Hartman, Rebecca L., et al. "Cannabis Effects on Driving Lateral Control With and Without Alcohol." *Drug and Alcohol Dependence*. Vol 154: 25-37. September 2015. https://www.sciencedirect.com/science/article/pii/S0376871615003142

5 NIDA "Effects of Marijuana—With and Without Alcohol—on Driving Performance." June 23, 2015.

6 Sewell, Poling and Sofuoglu. "The Effect of Cannabis Compared with Alcohol on Driving."

7 "Effects of Marijuana—With and Without Alcohol—on Driving Performance." June 23, 2015.

8 Hartman, R.L., et al. "Cannabis Effects on Driving Longitudinal Control With and Without Alcohol." *Journal of Applied Toxicology*. Vol 36 (11): 1418-29. Nov. 2016. https://www.ncbi.nlm.nih.gov/pubmed/26889769

9 Sewell, Poling and Sofuoglu. "The Effect of Cannabis Compared with Alcohol on Driving."

PART 2

DOES MARIJUANA LEGALIZATION INCREASE THE NUMBER OF IMPAIRED DRIVERS AND DUIS?

Studies suggest that the number of drivers with detectable levels of delta-9-tetrahydrocannabinol (THC), the main psychoactive component of marijuana, in their blood plasma tends to increase following legalization of marijuana either for medical or recreational use. However, cannabis's chemical compounds being present in a blood test does not mean a driver was *impaired* by cannabis at the time of the incident. THC can be present in blood plasma as much as a month after marijuana has been consumed, whereas impairment tends to peak relatively soon after consumption. Thus, the prevalence of THC in the blood plasma of drivers does not provide useful information about the prevalence of marijuana impairment. In fact, the National Highway Traffic Safety Administration (NHTSA) concluded recently that "there are currently no evidence-based methods to detect

marijuana-impaired driving" and as a result, "the scope and magnitude of the marijuana-impaired driving problem in this country cannot be clearly specified at this time."[10]

Placing this glaring data issue aside and assuming that every DUI recorded represents an impaired driver, there is still no statistical relationship between DUI arrests for cannabis and legalization. Colorado has witnessed an overall decrease since legalization, while Washington State has seen some increases.[11] Other states have not had enough time since legalization to make meaningful observations from their data. However, as the first fully recreational cannabis state in the country, Colorado would be expected to have more cannabis DUIs—the opposite of what we can observe with data. Thus, even assuming that presence equals impairment, and that police are arresting DUI drivers at the same rate such that DUI arrests actually track the number of impaired drivers on the road, these data do not prove that legalization increases the number of impaired drivers on the road.

In summary, it is far too early in the history of legalization to make determinations about whether legalization increases the number of impaired drivers, but for the time being it appears there is no relationship between the two.

[10] Compton, Richard P. "Marijuana-Impaired Driving: A Report to Congress." NHTSA DOTHS 812 440. U.S. Department of Transportation: Washington, D.C. July 2017. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/812440-marijuana-impaired-driving-report-to-congress.pdf

[11] Dr. Fiona Couper, State Toxicologist, Washington State. DUI Toxicology Reports. https://media.npr.org/assets/news/2015/08/THC-1.pdf
Abrams, Abigail. "Colorado's Marijuana DUIs Are Down 33%." *Time Magazine*. April 21st, 2017. http://time.com/4749802/colorado-marijuana-dui-drop-33-percent-2017/

PART 3

MEDICAL MARIJUANA AND CRASH PREVALENCE

Alcohol use is an especially important factor to consider when evaluating accident fatalities in medical marijuana states. A study in the *Journal of Law and Economics* looked at traffic fatalities from 1990 to 2010. During this time period, 14 states and Washington D.C. enacted medical marijuana legalization (MML). The authors found that traffic fatalities fell by between 8% and 11% in the first year after the passage of MML laws and continued to fall for a further three years. Interestingly, despite most medical marijuana users being 40 or older, the reduction in fatal accidents is largest among those aged 20–39. Moreover, the reduction in fatalities is almost entirely attributable to a reduction in the number of accidents involving individuals with high blood alcohol content. The authors suggest that the most likely explanation is that medical marijuana is serving as an alcohol substitute. Alternatively, the reduction in alcohol-related accidents might have occurred because it is illegal to consume marijuana in public places, whereas alcohol may be consumed in bars. Consuming marijuana in one's own home, even if alcohol is also being consumed, dramatically reduces the likelihood of driving while impaired.[12]

[12] Anderson, D. Mark et al. "Medical Marijuana Laws, Traffic Fatalities, and Alcohol Consumption." *The Journal of Law and Economics*. Vol. 56 (2): 333-369. 2013. https://www.journals.uchicago.edu/doi/abs/10.1086/668812

A study published by the National Bureau of Economic Research (NBER) replicated parts of the above study using a slightly different methodology and time period (1990–2009). It came to similar conclusions, finding that alcohol-related traffic fatalities dropped in states that had introduced MML, especially among those aged under 21. But curiously they found that the presence of marijuana dispensaries in states with MML seemed to negate this effect. The authors suggest that this might be due to the more recreational use of marijuana in states with dispensaries.[13]

A final study, published in the *American Journal of Public Health*, explored the same relationships as the NBER paper but using a longer time period (1985–2014), during which more states had enacted medical marijuana laws. This study also added the condition that dispensaries were operational. Again, the authors found that states with MML laws had lower traffic fatality rates. On average, traffic fatalities decreased by 10.8% following the enactment of MML. However, the effect varied considerably from state to state: seven states experienced fatality decreases while in two states (Rhode Island and Connecticut) MML laws were associated with an increase in fatalities. Meanwhile, contrary to the findings of the previous NBER study, the presence of *operational* dispensaries was associated with a *decrease* in accident fatalities.[14]

[13] Pacula, Rosalie Liccardo et al. "Assessing The Effects Of Medical Marijuana Laws On Marijuana And Alcohol Use: The Devil Is In The Details" NBER Working Paper 19302. 2013. http://www.nber.org/papers/w19302.pdf

[14] Santaella-Tenorio, Julian et al. "US Traffic Fatalities, 1985–2014, and Their Relationship to Medical Marijuana Laws." *American Journal of Public Health*. Vol 107 (2): 336–342. February 2017. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5227945/

PART 4

RECREATIONAL MARIJUANA AND CRASH PREVALENCE

Numerous studies demonstrate conflicting evidence on the relationship between cannabis legalization and auto accidents, though many are riddled with data and methodological issues.

An analysis from 1990–2010 found that auto accidents related to marijuana have steadily increased following both medical and recreational legalization but had no control variables.[15] A study conducted by NHTSA in Virginia Beach found that THC was the drug most frequently detected in the oral fluid or blood of drivers. THC was found in 7.6% of drivers involved in a crash but only 6.1% of control drivers, implying a 25% increase in crash likelihood for those with THC in their blood. When demographic factors are taken into consideration, however, the presence of THC had no statistically significant effect on crash likelihood.[16]

[15] Brady, Joann. Li, Gouhua. "Trends in Alcohol and Other Drugs Detected in Fatally Injured Drivers in the United States, 1990-2010." *American Journal of Epidemiology*. 2014.

[16] Compton. "Marijuana-Impaired Driving."

Similarly, a study looking at car crashes in Auckland, New Zealand where at least one occupant was hospitalized or killed found that acute marijuana use was significantly associated with crash injury after controlling for some factors such as age, gender, and time of day with an odds ratio of 3.9. However, after also controlling for risky behavior such as BAC, seat-belt use, sleepiness score, and speed, the effect of marijuana intake on car crash likelihood was no longer statistically significant.[17] However, the effect re-appeared for habitual users who used marijuana acutely before driving.

One study found that "marijuana-related" traffic deaths increased 66% in Colorado when comparing the average of post-legalization 2013–2016 to pre-legalization 2009–2012.[18] However, looking at total "marijuana related" deaths without accounting for other factors highly distorts the true impact of legalization. Moreover, these studies equated marijuana presence with not only impairment but causality, regardless of whether alcohol was present.

Two studies released in the same week in 2017 came to apparently opposite conclusions about the impact of legalization, due in part to a major methodological difference.[19] One, conducted by the Insurance Institute for Highway Safety found that collision claims were on average 3% higher in Colorado, Washington, and Oregon than in neighboring states where marijuana was still illegal.[20] The second study, published in the *American Journal of Public Health*, found that the annual changes in vehicle crash fatality rates in Colorado and Washington did not differ from control states.[21] The methodology used by the authors of

17 Blows, Stephanie, et al. "Marijuana Use and Car Crash Injury." *Addiction*. Vol 100 (5): 605-611. May 2005. https://www.ncbi.nlm.nih.gov/pubmed/15847617

18 Rocky Mountain High Intensity Drug Trafficking Area Strategic Intelligence Unit. "The Legalization of Marijuana in Colorado: The Impact." Vol 5. Oct. 2017. http://www.rmhidta.org/html/FINAL%202017%20Legalization%20of%20Marijuana%20in%20Colorado%20The%20Impact.pdf

19 Ingraham, Christopher. "What Marijuana Legalization Did to Car Accident Rates." *The Washington Post*. June 26, 2017. https://www.washingtonpost.com/news/wonk/wp/2017/06/26/what-marijuana-legalization-did-to-car-accident-rates/?utm_term=.bad97aabdf5b

20 "Legalizing Recreational Marijuana is Linked to Increased Crashes." *Insurance Institute for Highway Safety Highway Loss Data Institute*. June 22, 2017. http://www.iihs.org/iihs/news/desktopnews/legalizing-recreational-marijuana-is-linked-to-increased-crashes

21 Aydelotte, Jayson D. et al. "Crash Fatality Rates After Recreational Marijuana Legalization in Washington and Colorado." *American Journal of Public Health*. Vol 107 (8): 1329-1331. Aug. 1, 2017. https://ajph.aphapublications.org/doi/10.2105/AJPH.2017.303848

the second study is generally more robust than that used in the first, since it was able to take into account a wider range of factors that might have led to the differences in crashes between the states—such as differences in economic activity, age, and more. Every analysis that has used controls has found no relationship between legalization and auto accidents and fatalities, including our own.

For example, from our own analysis in Colorado: the chart below shows total Vehicle Miles Traveled (VMT), Total Fatalities per VMT, and Marijuana Related Fatalities per VMT.

FIGURE 1: VEHICLE-MILES TRAVELED, AUTO FATALITIES AND MARIJUANA IN COLORADO, 2006–2016

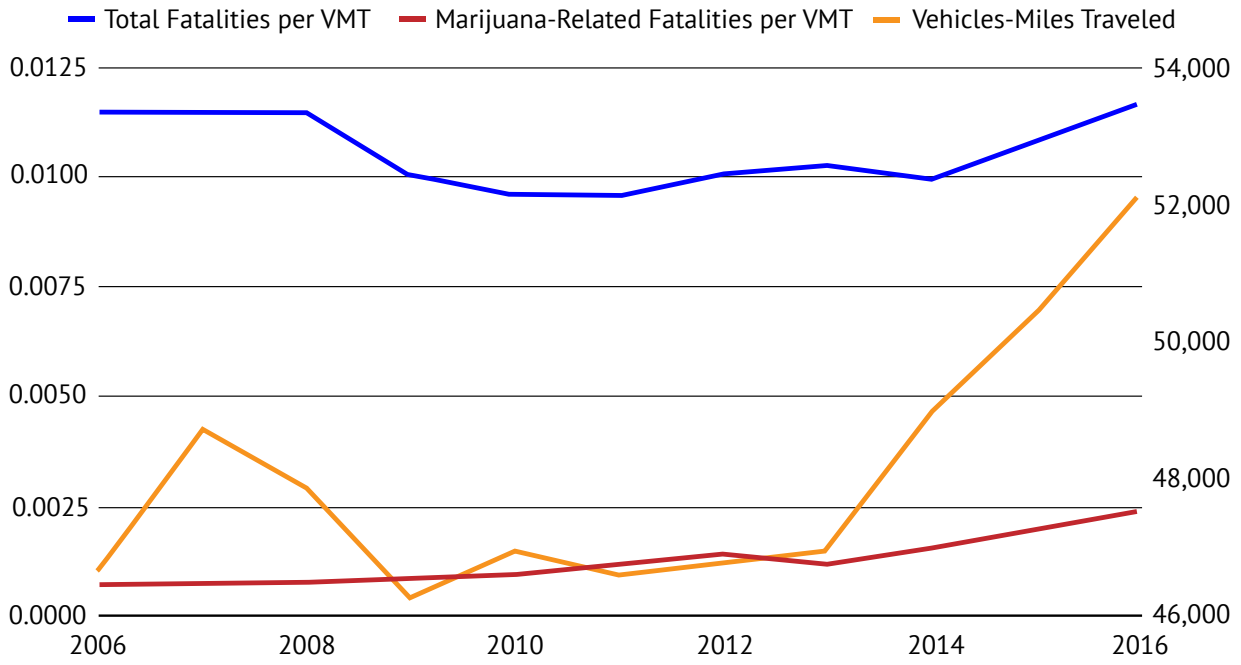
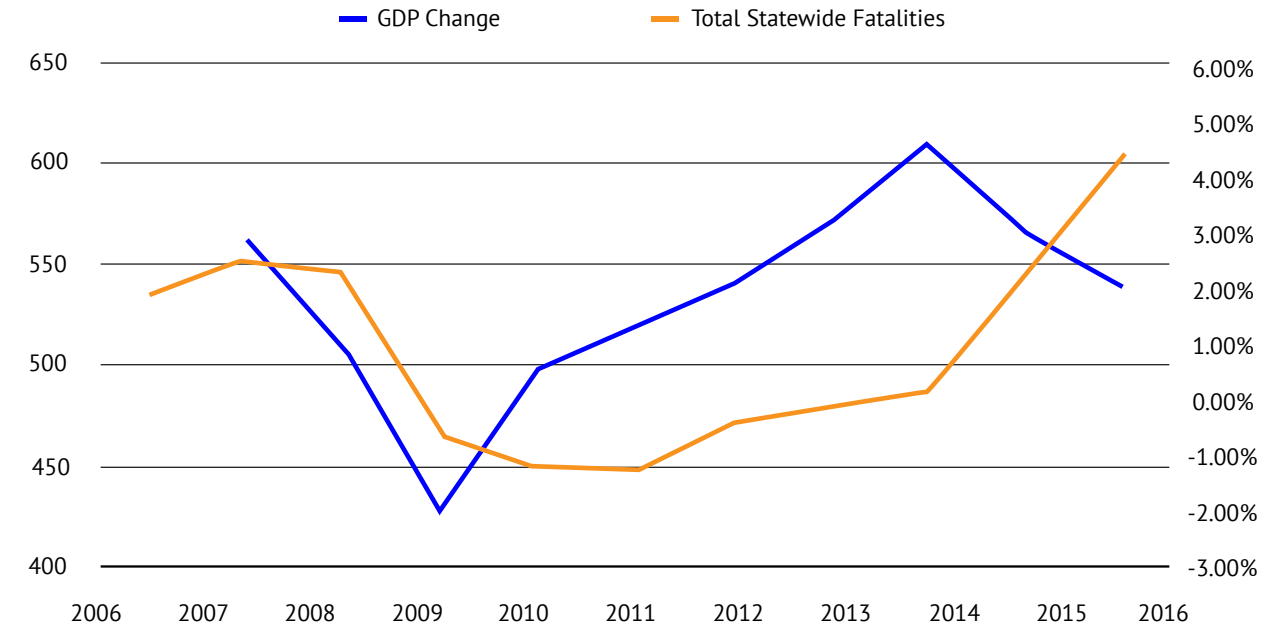


Figure 1 appears to show a correlation between cannabis legalization and auto fatalities, but the relationship is more complex. Total fatalities per VMT had been going down in Colorado until what looks like a causal increase from legalization jumps the number up in 2014. However, a closer inspection shows cannabis may not be entirely to blame. It appears the entire nation witnessed a similar phenomenon in 2014–2015.

FIGURE 2: TRAFFIC FATALITIES AND GDP CHANGE IN COLORADO



Source: Rocky Mountain High Intensity Drug Trafficking Area Strategic Intelligence Unit. "The Legalization of Marijuana in Colorado: The Impact." Vol 5. Oct. 2017.

The two above charts demonstrate a complex relationship between auto fatalities and cannabis. Figure 2 is fairly easy to interpret and shows that traffic fatalities often correlate with GDP. This can occur for a variety of reasons but is generally attributed to more population, more vehicle miles traveled, wear and tear on highways, etc. that end up increasing total fatalities. Conflating the statistics about cannabis fatalities is the fact that Colorado's population has been growing rapidly over the last 10 years.

FIGURE 3: U.S. MOTOR VEHICLE DEATHS PER VMT, DEATHS PER CAPITA, TOTAL DEATHS, VMT AND POPULATION

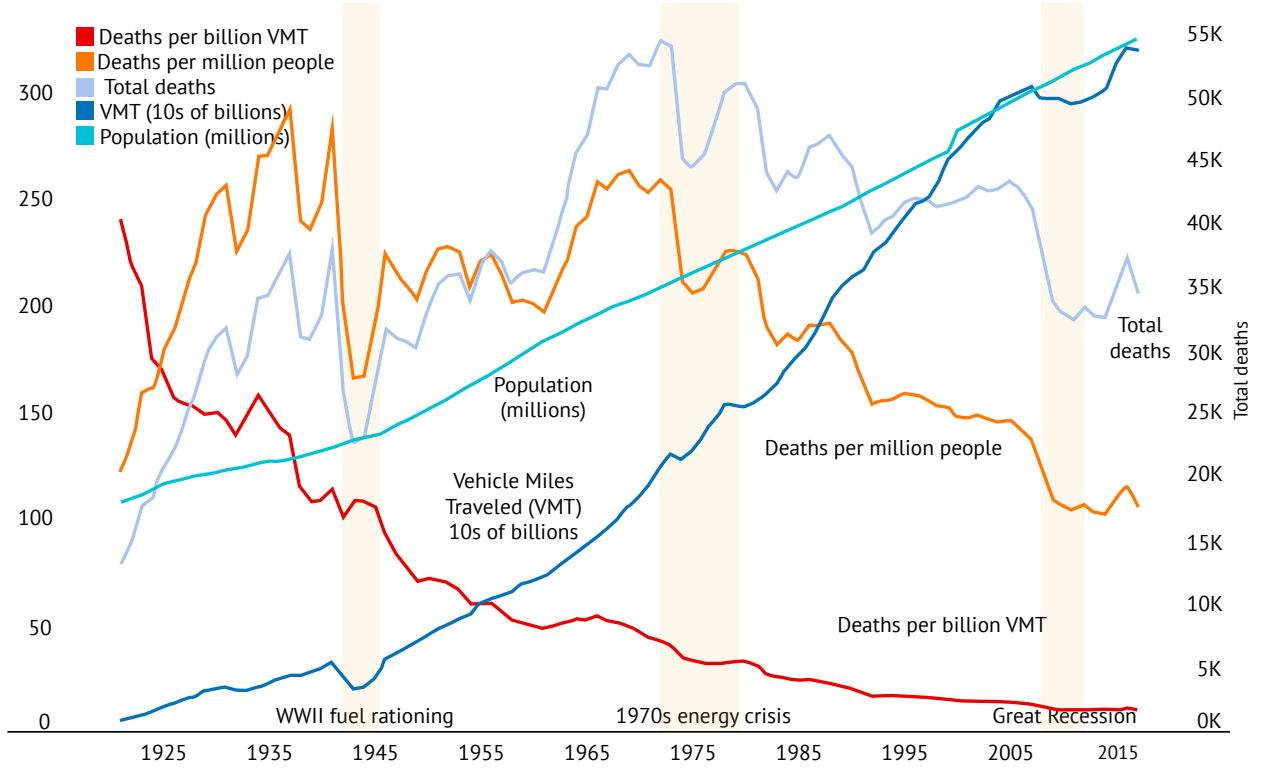


Figure 3 shows that 2014-15 jump in deaths per VMT for the entire nation, which goes against a 30-year trend of VMT increasing while fatalities per VMT decreases. There is no apparent explanation for the national increase. Therefore, it is highly unlikely that cannabis legalization is responsible for the jump in deaths per VMT in Colorado given that the trend is matched across the nation, whose states obviously differ in cannabis laws. This nationwide comparison confirms other analyses that use control variables to compare legalization states to prohibition states, finding no clear patterns in road safety. Cannabis-related fatalities have slowly and steadily increased in Colorado since 2006, but at no greater rate than the nation, suggesting there is no relationship to legalization. Whatever is happening in Colorado might be specific to Colorado, could be a general trend unrelated to cannabis, or could be the result of increased testing, which we discuss more below.

Some observers have suggested that rising insurance premiums in Colorado and other states that have legalized recreational marijuana are an indicator of the potential for increased crash risks associated with marijuana.[22] However, there are many other possible explanations—ranging from hail storms and low gasoline prices to distracted driving—and no study has yet adequately assessed the relative contribution of recreational marijuana legalization to the rise in premiums.

[22] Svaldi, Aldo. "Colorado is No. 3 in the Country for Rising Car Insurance Premiums. Here's Why." *The Denver Post*. Feb. 27, 2018. https://www.denverpost.com/2018/02/27/colorado-car-insurance-premiums-rise/

PART 5

STRUCTURAL RESEARCH AND DATA ISSUES THAT IMPACT RESEARCH ON CANNABIS

The entire debate around cannabis and auto safety is marred by several major data and research-related issues. First, there is the issue of impairment vs THC presence in blood and saliva. As discussed, THC presence is not directly associated with impairment. Thus any study or toxicology lab that uses blood testing and then reports that an accident or DUI is related to cannabis could overestimate the number of truly cannabis-impaired drivers on the road. Future developments will require accurately assessing impairment at the time of incident versus testing for traces of cannabis which can last days or weeks.

Second, further complicating the data is the fact that some states do not expend the time and resources to delineate accident and DUI data into specifically what drugs or alcohol were present at the time of arrest and/or accident. Therefore, trace cannabis presence could be tagged alongside DUI charges where THC was not contributing to impairment, but alcohol and/or other drugs were. States should test for all drugs and publish the delineated data so that cannabis-only incidents can be analyzed and understood better. This would

help remove the conflation between cannabis and alcohol in the statistics—a significant issue.

The 2013–2014 National Roadside Survey of Drug and Alcohol Use by Drivers found that 59% of all drug-positive drivers also had a positive BAC. The use of both alcohol and marijuana can make it difficult to accurately assess crash risk.[23] As summarized by the authors of the study: "[I]t is essential that alcohol be taken into account since very often (more than one in two times, according to our data) the consumption of cannabis is accompanied by consumption of alcohol. Put another way, a study that does not consider alcohol has every chance of overestimating the effect of cannabis, since the effect of cannabis on driving is going to be, for around half of drivers, the reflection of alcohol consumption, which itself is linked to a strongly heightened risk of accident responsibility."[24]

In a pure comparison between the impairing effects of alcohol against cannabis directly in driving scenarios, one study found that "…cannabis-impaired driving appears to present less risk to the public than alcohol-impaired driving. Based on experiments with impaired drivers, NHTSA's Drug and Alcohol Crash Risk study assigns alcohol-impaired drivers a roughly two to four times higher crash risk (reflecting .05% BAC to .08% BAC) compared to sober drivers. The same study assigns cannabis-impaired drivers a 1.25 times higher increased crash risk compared to sober drivers (1.00 represents the same crash risk as sober drivers)."[25]

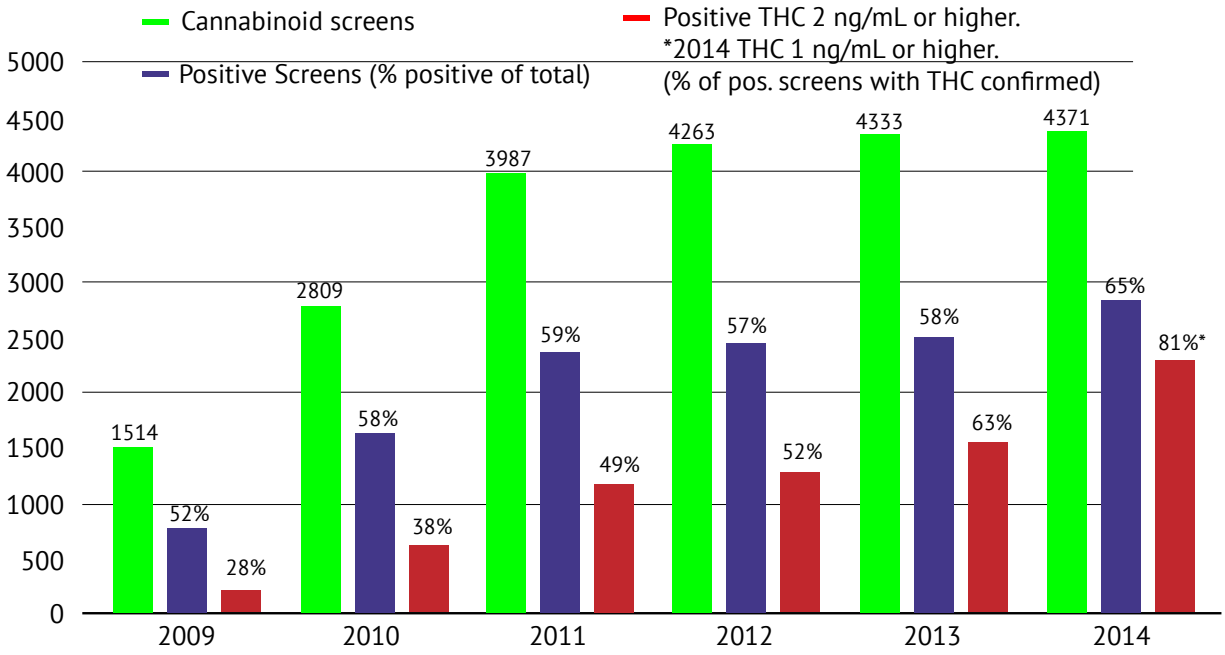
A third factor, contributing to the apparent rise in cannabis-related auto accidents is the fact that states like Colorado are testing for it more.

[23] Compton. "Marijuana-Impaired Driving."

[24] Ibid.

[25] Logan, Barry. et. al. "An Evaluation of Data from Drivers Arrested for Driving Under the Influence in Relation to Per Se Cannabis Limits." *AAA Foundation For Traffic Safety*. May 2016.

FIGURE 4: TRENDS IN CANNABINOID SCREENS AND THC CONFIRMATION IN COLORADO, 2009–2014



NOTE: Data from ChemaTox Laboratory was merged with data supplied by Colorado Department of Public Health and Environment, Toxicology Laboratory for 2009–2013

*Due to a change in data collection the confirmation cutoff for Positive THC changed from 2 ng/mL (2009–2013) to 1 ng/mL (2014). Based on available data it is estimated ~18% of cases would fall between 1 and 2 ng/mL resulting in an estimated 67% Positive THC at or above 2 ng/mL in 2014.

Source: Sara Urfer, M.S., D-ABFT-FT; ChemaTox Laboratory

As one can see from the chart above, Colorado has almost tripled its annual screenings for cannabinoids from 2009–2014. Yet, the percentage of total positive tests during this time has hovered right around 58%. The chart attempts to show that positive tests for 2ng/mL have increased from 28% to 81%, but this masks a change in a "positive" test switching from 2 ng/mL to 1ng/ML. For reference, although there is no scientific basis to determine if these levels represent impairment, many have pointed to 5ng/mL as an acceptable level. Testing for 1 or 2 ng/mL could report positives from people who haven't consumed cannabis in over a week. Even with legalization occurring in 2012, there is no statistically significant increase in positive tests. And with presumably more people experimenting with cannabis after legalization, it's intuitive that testing for incredibly low level traces of THC will appear more in tests the more of them that occur over time. Simply put, if you test more than before, you increase the odds of positive hits. By ramping up testing in 2011 and

2012, Colorado was bound to find more cannabis-related incidents. This could contaminate all data related to cannabis, ranging from DUI to auto fatalities, and could help explain the apparent rise in marijuana-related incidents.

CONCLUSION

There are few convincing conclusions to be drawn concerning the risk of traffic accident fatalities from marijuana legalization. Studies looking at the prevalence of drivers impaired by THC are prone to overestimate crash risk because of other risk factors, such as age and the great difficulty of measuring impairment from THC. Further, alcohol use could inflate data if a driver has both a positive BAC and THC in their system. Increased testing for THC, especially for trace amounts, could also be contributing to the "rise" of so-called "marijuana-related" incidents. Some studies, especially concerning medical marijuana, suggest that marijuana legalization might actually reduce fatalities by reducing drunk driving. All in all, no conclusive or definitive patterns related to cannabis legalization have appeared in the data or research to this point.

ABOUT THE AUTHORS

Spence Purnell is a policy analyst at the Reason Foundation, where he works on pension reform, Florida policy issues and economic development.

Prior to joining Reason, Spence worked as director of business development at Florida startup Dealers United and as an analyst for the state of Florida's Executive Office of the Governor (Florida Gubernatorial Fellowship).

Spence graduated from Stetson University with a bachelor's degree in political science and is working on an MPA at Florida State, where his research has focused on database infrastructure and analytics, economic development, and policy evaluation methods.

Spence Purnell is based in Florida.

Allie Howell is a research intern at Reason. Previously, she was a Burton C. Gray Memorial intern at Reason and an economic policy intern at the Manhattan Institute. Allie has been published on Economics21.org, the Foundation for Economic Education, and Reason. She is a recent graduate of Hillsdale College where she majored in economics and mathematics. Allie will be attending Notre Dame Law School in the fall.