Accident Analysis and Prevention 108 (2017) 37–43

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Cannabis and crash responsibility while driving below the alcohol per se legal limit

Eduardo Romano[a,*], Robert B. Voas[a], Bayliss Camp[b]

[a] PIRE, United States
[b] Research & Development California Department of Motor Vehicles, CA, United States

ARTICLE INFO

Keywords:
Cannabis
Alcohol
Crash responsibility
Fatal crashes
Low BAC

ABSTRACT

There is a growing interest in how extensively the use of marijuana by drivers relates to crash involvement. While cognitive, lab-based studies are consistent in showing that the use of cannabis impairs driving tasks, epidemiological, field-based studies have been inconclusive regarding whether cannabis use causes an increased risk of accidents. There is ample evidence that the presence of cannabis among drivers with a BAC ≥ 0.08 g/dL highly increases the likelihood of a motor vehicle crash. Less clear, however, is the contribution of cannabis to crash risk when drivers have consumed very little or no alcohol. This effort addresses this gap in knowledge. We took advantage of a unique database that merged fatal crashes in the California Statewide Integrated Traffic Records System (SWITRS) and the Fatality Analysis Reporting System (FARS), which allows for a precise identification of crash responsibility. To account for recent increase in lab testing, we restricted our sample to cover only the years 1993–2009. A total of 4294 drivers were included in the analyses. Descriptive analyses and logistic regressions were run to model the contribution of alcohol and drugs to the likelihood of being responsible in a fatal crash. We found evidence that compared with drivers negative for alcohol and cannabis, the presence of cannabis elevates crash responsibility in fatal crashes among drivers at zero BACs (OR = 1.89) and with 0 < BAC < 0.05 g/dL (OR = 3.42), suggesting that emphasis on curbing impaired driving should not be solely focused on heavy-drinking drivers. Data limitations however caution about the generalizability of study findings. Special efforts to understand the effect of cannabis on fatal crashes, in particular in the absence of alcohol, are needed.

1. Introduction

There is a growing interest in how extensively the use of marijuana by drivers relates to crash involvement (e.g., Dobbs, 2005; Sewell et al., 2009; Rogeberg and Elvik, 2016). Cognitive, lab-based studies are consistent in showing that the use of cannabis impairs driving tasks (Sewell et al., 2009). Epidemiological, field-based studies on the other hand have been inconclusive regarding whether cannabis use causes an increased risk of accidents. Recently, the European Driving Under the Influence of Drugs, Alcohol and Medicines (DRUID) study reported an unadjusted serious or fatal crash risk associated with marijuana use similar to that faced by drivers with a blood alcohol concentration (BAC) between 0.01 g/dL and 0.05 g/dL. These estimates however require some cautions, as difficulties in pooling data from different sources amounted to unavoidable contradictions (Hels et al., 2011). Using information from the 2007 National Roadside Survey to serve as "controls" for the fatal crashes reported in the Fatality Analysis Reporting System (FARS), Li and colleagues reported a crude odds ratio (OR) for marijuana relative to that by non-marijuana users of 1.83 (Li et al., 2013). More recently, Chihuri et al. (2017) also used the matched FARS-NRS databases to report a synergistic contribution of alcohol and cannabis to crash risk. Also, using similar databases, Romano et al. (2014) found that although cannabis was a significant contributor to crash risk when studied alone (OR = 1.55), once adjusted by the presence of alcohol, the crash risk associated with cannabis became non-significant. A recent review of previous research on the role of cannabis in motor vehicle crashes including an updated meta-analysis of 21 observational studies, further revealed the studies' heterogeneity of results (Rogeberg and Elvik, 2016). The authors also pointed that such heterogeneity is related to the quality of the data and approach applied in each study, with higher risk estimates usually associated with case–control studies, low study quality, limited control of confounders, medium quality use data, and failure to control for alcohol intoxication (Rogeberg and Elvik, 2016).

The previous discussion suggests that the noted inconsistencies regarding the role of cannabis on crash risk may be at least in part related

* Corresponding author at: Pacific Institute for Research and Evaluation (PIRE), 11720 Beltsville Drive, Suite 900, Calverton, MD 20705, United States.
E-mail addresses: romano@pire.org (E. Romano), voas@pire.org (R.B. Voas), Bayliss.Camp@dmv.ca.gov (B. Camp).

http://dx.doi.org/10.1016/j.aap.2017.08.003
Received 8 March 2017; Received in revised form 26 July 2017; Accepted 1 August 2017

to the quantity of alcohol consumed. There is ample evidence that the presence of cannabis among drivers with a BAC ≥ 0.08 g/dL highly increases the likelihood of a serious or fatal motor vehicle crash (e.g., Hels et al., 2011; Li et al., 2013; Romano et al., 2014). Less clear, however, is the contribution of cannabis to crash risk when drivers have consumed very little or no alcohol. Understanding this contribution is relevant to the design of policies targeting marijuana and driving under the influence of drugs (DUID).

Unlike driving under the influence (DUI) of alcohol, which is governed by a well-established legal framework that uses BAC as legal evidence of impaired driving, complexities involving cannabinoid pharmacokinetics, including how cannabinoids are disposed into biological fluids and tissues (Huestis, 2007), have made it difficult to design a legal framework for driving under the influence of marijuana comparable to that for alcohol. Nevertheless, concerns about marijuana and DUID have motivated the promotion of state laws to reduce drug-related crashes (DuPont et al., 2012; Withers, 2011). Five states have passed per se limits for tetrahydrocannabinol (THC), cannabis's main psychoactive constituent, and 12 states have passed zero-tolerance laws for DUID, establishing that a positive test for marijuana constitutes legal evidence of impaired driving (GHSA, 2016). It is unclear the extent to which these laws account for the complexity of the drug–crash relationship (Reisfield et al., 2012). It is also unclear if in the case of cannabis the deleterious impact of the drug takes place regardless of the level of alcohol consumed. Assessing the contribution of cannabis to crash risk in the absence of alcohol and/or at low BACs would be relevant to policymakers.

Acquiring information on cannabis's contribution to motor vehicle crashes at zero or low BACs not only would be relevant to the design of DUID laws, but also to DUI laws. For instance, if those who use alcohol and other drugs (such as marijuana) in combination were more likely to be involved in crashes for which they are culpable, such outcome would suggest the need for different penalties for alcohol + marijuana DUI drivers.

Currently, all U.S. jurisdictions have a 0.08 per se law in place, making it illegal for a driver to drive with a BAC ≥ 0.08 g/dL. There is, however, an ongoing policy debate over whether the legal BAC limit should be lowered to 0.05 g/dL (e.g., Chamberlain and Solomon, 2002; Fell and Voas, 2006). Relevant to this debate is the apparent reduction in crash risk (relative to zero BAC) at BACs between 0.01 g/dL and 0.03 g/dL. This reduction in risk was first reported by Borkenstein et al. (1974) (the "Grand Rapids Dip") and replicated in several other studies (e.g., Blomberg et al., 2005) and appeared to support the conclusion that drivers with small amounts of alcohol were safer drivers than sober drivers.

The validity of such an assertion was questioned by Allsop (1966), Hurst (1973), and Hurst et al. (1994), who argued that such a dip was an artifact—an example of the Simpson Paradox in which correlations within groups are reversed when the groups are combined. Also arguing against the concept of low BAC drivers being safer operators was Marowitz (1996), who examined the recidivism rate (a measure of crash risk) of 53,217 drivers convicted of impaired driving in California between January and June of 1993 and found that the risk of recidivism increased as the arrest BAC declined from 0.09 g/dL to 0.00 g/dL. Thus, drivers convicted of DUI at low BACs were more likely to be rearrested for the same offense than drivers with BACs as high as 0.09 g/dL. To some extent, this rise in recidivism at low BACs relates to the enforcement procedures implemented to apprehend impaired drivers in the United States, which begin with the detection of vehicle maneuvers associated with impaired driving (Stuster, 1997), followed by sobriety tests (Burns, 2003; Burns and Moskowitz, 1977; Stuster, 1997). Despite being stopped under the presumption of drinking and driving, an increasing number of DUI arrested drivers are found to have BACs below 0.08 when a breath test is conducted (Basich, 2015). Also of special interest, therefore, is what caused arrested drivers with low BACs to behave as impaired.

It could be argued that some of the low BAC cases may be due to the delay between arrest and transporting the suspect to the police station for breath testing during which the body eliminates alcohol at approximately 0.10 g/dL to 0.015 g/dL percent per hour (Jones, 2010). Alternatively, however, it is also possible that a non-negligible proportion of low BAC drivers include high-risk drivers for whom alcohol consumption is not the only risk factor. Thus, sources of crash risk other than alcohol would be responsible for the Grand Rapids Dip as well as for the relatively elevated number of arrestees at low BACs. One such unaccounted sources of risk could be drowsiness or fatigue (Corfitsen, 2003). Another possibility is Marowitz's (1996) contention that the zero BAC arrest cases are drug-impaired drivers. This possibility is currently receiving the greatest attention. With the recent surge in states enacting medical marijuana laws and/or legalizing recreational use of cannabis—as well as with the evidence from the 2007 National Roadside Survey (Lacey et al., 2007) that 14.4% of drivers on U.S. roads test positive for a drug—interest has increased in the number of drug-impaired drivers being arrested with current enforcement procedures (DuPont et al., 2012; Voas et al., 2013). The hypothesis that low or zero BAC cases among DUI offenders involve cannabis is at the center of this effort. Although there is some evidence in support of this hypothesis, the evidence is weak. Dubois et al. used the Fatality Analysis Reporting System (FARS) to report that even at BAC = .00 g/dL, the presence of cannabis contributes to crash culpability (Dubois et al., 2015). Unfortunately, by using a proxy for crash responsibility developed from the same database (rather than applying an independent measure of culpability); by excluding drivers younger than 21 years old, an age group with increasing rates of cannabis use (NIDA, 2016) and at elevated crash risk (Peck et al., 2008), and by lumping crashes that occurred all over the United States (failing to account for the severe state-based and annual-based limitations in drug reporting present in the FARS) (e.g., Berning and Smither, 2014; Pollini et al., 2015), the report casts some doubts on their findings.

As a result of a collaboration between the Pacific Institute for Research and Evaluation (PIRE) and the California Department of Motor Vehicles, we took advantage of a unique database merging fatal crashes in the California Statewide Integrated Traffic Records System (SWITRS, maintained by the California Highway Patrol) and the FARS. The merged SWITRS-FARS database allows for a precise identification of crash responsibility, while allowing for a control of the FARS's weaknesses in recording drug use information (Berning and Smither, 2014). By taking advantage of that database, our goal was to evaluate the hypothesis that cannabis use may help explain the relatively high incidence of low and zero BACs among arrested drivers, as well as the Grand Rapids Dip. The relevancy of this aim is apparent, as it should illuminate the role that cannabis plays in fatal crashes, in particular at zero or low BACs.

2. Methods

For this study, we drew extensively from Brar (2012) and took advantage of a unique database merging fatal crashes in the FARS and the SWITRS. The FARS contains data on crashes that resulted in the death of a vehicle occupant or non-motorist within 30 days of the crash. The FARS informs about the victims' actual BAC. In 1982, only 54% of the drivers in the database had been tested for alcohol. That figure climbed to 65% in 2004 (Hedlund et al., 2004). For those with no actual measure available, FARS provides BAC measures developed using a multiple imputation technique by Subramanian (2002). When the driver was not tested for alcohol, we used the imputed measure. Results from drug tests are codified and stored in FARS in three variables, each informing the outcome of the lab test. The following list shows the correspondence between these codes and drug classes in the FARS: 000 (Not Tested for Drugs); 001 (No Drugs Reported/Negative); 100–295 (Narcotics); 300–395 (Depressants); 400–495 (Stimulants); 500–595 (Hallucinogens); 600–695 (Cannabinoids); 700–795 (Phencyclidine/PCP);