

Original article

Role of alcohol and marijuana use in the initiation of fatal two-vehicle crashes

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ABSTRACT

Purpose: To assess individual and joint effects of alcohol and marijuana on the initiation of fatal two-vehicle crashes.**Methods:** Data on 14,742 culpable drivers (initiators) and 14,742 nonculpable drivers (noninitiators) involved in the same fatal two-vehicle crashes between 1993 and 2014 were obtained from the Fatality Analysis Reporting System. Multivariable conditional logistic regression models were used to assess the association of driver use of alcohol, marijuana, or both with fatal crash initiation with adjustment for demographic variables.**Results:** Initiators were significantly more likely than non-initiators to test positive for alcohol (28.3% vs. 9.6%, $P < .0001$), marijuana (10.4% vs. 6.0%, $P < .0001$), and both substances (4.4% vs. 1.1%, $P < .0001$). Relative to drivers testing negative for both alcohol and marijuana, the adjusted odds ratios of fatal crash initiation were 5.37 (95% confidence interval [CI]: 4.88 to 5.92) for those testing positive for alcohol and negative for marijuana, 1.62 (95% CI: 1.43 to 1.84) for those testing positive for marijuana and negative for alcohol, and 6.39 (95% CI: 5.19 to 7.88) for those testing positive for both alcohol and marijuana.**Conclusions:** Alcohol and marijuana each play a significant role in fatal crash initiation. When used in combination, alcohol and marijuana appear to have a positive interaction effect on the risk of fatal crash initiation on the additive scale.

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Introduction

Drugged driving has become a serious public safety concern in the United States and in many other countries around the world [1–4]. Marijuana is the most commonly used nonalcohol drug in the general driver population and in drivers involved in crashes [5–13]. The prevalence of marijuana detected in fatally injured drivers in the United States increased from 4.2% in 1999 to 12.2% in 2010 [7]. Epidemiologic studies indicate that marijuana use, particularly in the last few hours or presence of delta-9-tetrahydrocannabinol in the blood, increases the risk of crash involvement and crash culpability [2,14–16]. Experimental studies have reported that marijuana use impairs psychomotor skills and driving performance [17,18]. Recent meta-analyses have confirmed that marijuana use is a significant risk factor for motor vehicle

crashes although the extent to which the role marijuana plays in crash causation remains to be determined [2,19,20]. Concurrent use of alcohol and marijuana is the most frequently detected polydrug combination among drivers involved in fatal and nonfatal crashes [6,13].

As of November 9, 2016, 28 states and the District of Columbia have decriminalized marijuana for medical use and eight states have further decriminalized marijuana possession for recreational use among adults [21]. Among these, Washington and Colorado have experienced an increase in the proportion of drivers in fatal crashes who tested positive for marijuana since marijuana laws became effective [22,23]. Studies assessing the combined effects of alcohol and marijuana on crash involvement have produced different results with some indicating an additive effect [10,15,18,24–26], a likely synergistic effect [18,27–30], or no additive effect [16,31,32]. Experimental studies have mostly shown an additive effect and synergistic effect on cognitive performance at high concentrations of both marijuana and alcohol [17,18,32]. Inconsistent results are due in part to differences in study designs

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and exposure and outcome measures. For example, differences between comparison groups in spatiotemporal crash circumstances such as weather and road conditions may lead to biased risk estimates. In case-control studies, high refusal rates for drug testing in controls recruited through roadside surveys may introduce severe bias to the estimated odds ratios (ORs) [33]. By contrast, in pair-matched culpability or quasi-induced exposure studies, the two drivers in each pair are from the same two-vehicle crash [34,35]. Therefore, culpable drivers and nonculpable drivers are pair-matched on important temporspatial factors, such as weather and traffic conditions, making it possible to accurately estimate the crash initiation risk associated with alcohol and marijuana use. Although numerous studies have used the quasi-induced exposure design, few have evaluated joint effects of marijuana and alcohol on crash culpability based on pair-matched analysis [34]. In the present study, we performed a pair-matched analysis using data for drivers involved in fatal two-vehicle crashes to assess the individual

and joint effects of alcohol and marijuana on crash initiation as determined by driving error that led to the crash.

Methods

Data

Data for this study came from the Fatality Analysis Reporting System (FARS) compiled by the National Center for Statistics and Analysis of the National Highway Traffic Safety Administration. The FARS database contains investigation data for all crashes that resulted in at least one fatality within 30 days and that occurred on public roads in the United States [36]. These data elements are acquired from police reports, medical records, state administrative files, and coroner reports. FARS includes driver characteristics (e.g., age, sex, alcohol, and drug test results, history of driving while intoxicated [DWI] conviction in the past 3 y), vehicle characteristics

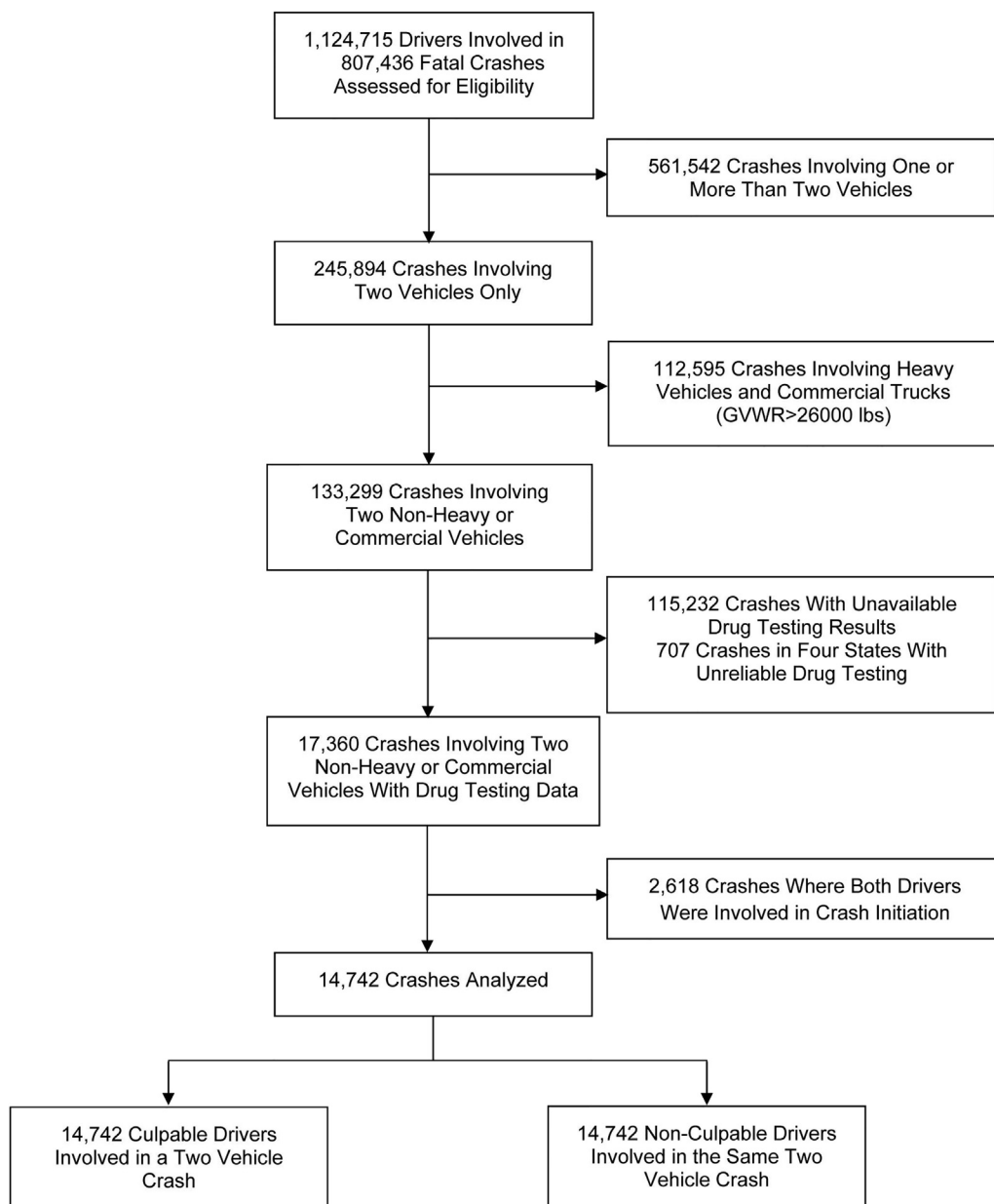


Fig. 1. Flow diagram of selection of drivers involved in two-vehicle crashes 1993–2014, Fatality Analysis Reporting System.

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