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Trends in fatal motor vehicle crashes before and after marijuana commercialization in Colorado☆

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ABSTRACT

Background: Legal medical marijuana has been commercially available on a widespread basis in Colorado since mid-2009; however, there is a dearth of information about the impact of marijuana commercialization on impaired driving. This study examined if the proportions of drivers in a fatal motor vehicle crash who were marijuana-positive and alcohol-impaired, respectively, have changed in Colorado before and after mid-2009 and then compared changes in Colorado with 34 non-medical marijuana states (NMMS).
Methods: Thirty-six 6-month intervals (1994–2011) from the Fatality Analysis Reporting System were used to examine temporal changes in the proportions of drivers in a fatal motor vehicle crash who were alcohol-impaired (≥ 0.08 g/dl) and marijuana-positive, respectively. The pre-commercial marijuana time period in Colorado was defined as 1994–June 2009 while July 2009–2011 represented the post-commercialization period.
Results: In Colorado, since mid-2009 when medical marijuana became commercially available and prevalent, the trend became positive in the proportion of drivers in a fatal motor vehicle crash who were marijuana-positive (change in trend, 2.16 (0.45), $p < 0.0001$); in contrast, no significant changes were seen in NMMS. For both Colorado and NMMS, no significant changes were seen in the proportion of drivers in a fatal motor vehicle crash who were alcohol-impaired.
Conclusions: Prevention efforts and policy changes in Colorado are needed to address this concerning trend in marijuana-positive drivers. In addition, education on the risks of marijuana-positive driving needs to be implemented.

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1. Introduction

Traffic fatalities are a major public health issue; 32,367 individuals died in motor vehicle crashes in the United States in 2011 and 31% of these fatal accidents involved drivers who tested positive for alcohol (USDTNHTSA, 2013). Alcohol use has been associated with driving-related problems including: divided attention; drowsiness; vigilance; perception; visual functions; tracking; cognitive tasks; psychomotor skills; and choice reaction time (Moskowitz and Fiorentino, 2000). In a review by Moskowitz and Fiorentino (2000), the majority of studies found serious impairment due to alcohol by a blood alcohol concentration (BAC) of 0.08 g/dl.

Although in 2009 18% of all fatally injured drivers tested positive for drug involvement (USDTNHTSA, 2010), far less research has been conducted on marijuana compared with alcohol. According to a recent review, drivers who used marijuana compensate by driving slower; however, their control deteriorates with increasing task complexity (Hartman and Huestis, 2013). Marijuana use increases lane weaving, decreases mean speed, increases mean and variability in headways, and impairs cognitive function, critical tracking tests, reaction times, divided attention tasks, expected practice effects, and lane position variability (Anderson et al., 2010; Downey et al., 2013; Hartman and Huestis, 2013; Lenne et al., 2010). The increased risk of impaired driving skills occurs for both lower and higher levels of delta-9-tetrahydrocannabinol (THC) concentrations (Bramness et al., 2010). A double-blind, placebo-controlled, randomized, three-way crossover study administered placebo and

dronabinol (10 mg and 20 mg; medical tetrahydrocannabinol) to current marijuana users. The researchers found that dronabinol impairs driving performance in a dose dependent manner in both occasional and heavy marijuana users but to a lesser degree in heavy users (Bosker et al., 2012). Therefore, substantial scientific evidence demonstrates that THC use impairs driving-related skills. Although the link between marijuana use and driving impairment is less well studied, Li et al. (2013) recently concluded that drivers involved in a fatal motor vehicle crash were 1.83 times more likely to be positive for marijuana than drivers not involved in a fatal motor vehicle crash.

Policies and cultural or attitudinal shifts can affect rates of substance-impaired driving (Fell and Voas, 2006). In recent years, Colorado has undergone a sharp policy shift in its approach to marijuana. Colorado voters approved Amendment 20 to legalize medical marijuana in 2000; however, very few medical marijuana applications were submitted until 2009. In March of that year, federal policy shifted, ending raids on distributors of medical marijuana in states where it was legal (Johnston and Lewis, 2009). In October, 2009, the U.S. Department of Justice distributed a memo stating that federal resources should not focus on prosecuting medical marijuana patients and caregivers who were operating in "clear and unambiguous compliance with existing state laws" (Ogden, 2009). Perhaps most relevant to this manuscript, in July 2009, the Colorado Board of Health rejected a limit on the number of patients a caregiver could aid, which greatly loosened restrictions on who could cultivate and distribute medical marijuana. This decision opened the door for large scale retail medical marijuana dispensaries (Ingold, 2009; Sensible Colorado, 2013). Therefore, this study uses mid-2009 as the beginning of the large scale marijuana commercialization in Colorado.

Fig. 1 graphically displays the increase of registered medical marijuana users from 2009 through 2011. As of January 31st, 2009, only 5051 people were registered medical marijuana users (The Colorado Medical Marijuana Registry, 2009b) but by the end of July, the number more than doubled to 11,094 (The Colorado Medical Marijuana Registry, 2009c). By the end of 2009, the number of licensed registered medical marijuana users increased to 41,039 (The Colorado Medical Marijuana Registry, 2009a).

There has been much debate about the impact of marijuana commercialization on both marijuana-positive and alcohol-impaired driving; however, there is a dearth of empirical research. This study addressed two research questions: (1) Has the proportion of drivers in a fatal motor vehicle crash who were marijuana-positive changed in Colorado since mid-2009 and how do these changes compare with non-medical marijuana states (NMMS)? and (2) Has the proportion of drivers in a fatal motor vehicle crash who were alcohol-impaired (BAC ≥ 0.08%) changed during this same time in Colorado and how do these changes compare with NMMS?

2. Methods

This study is based on data from the 1994 to 2011 Fatality Analysis Reporting System (FARS), which has documented all qualifying fatalities occurring within the 50 United States, the District of Columbia, and Puerto Rico since 1975 (USDTNHTSA, 2012a). FARS requires that the crash involves a motor vehicle driving on a road open to the public and that the crash-related fatality occurs within 30 days (720 h) of the crash (USDTNHTSA, 2012a). State agencies provide information to the National Highway Traffic Safety Administration (NHTSA) on all qualifying fatal crashes identified in various documents, such as police accident reports, death certificates, state vehicle registration files, coroner/medical examiner reports, state driver licensing files, hospital medical reports, state highway department data, emergency medical service reports, and vital statistics (USDTNHTSA, 2012a). FARS analysts have
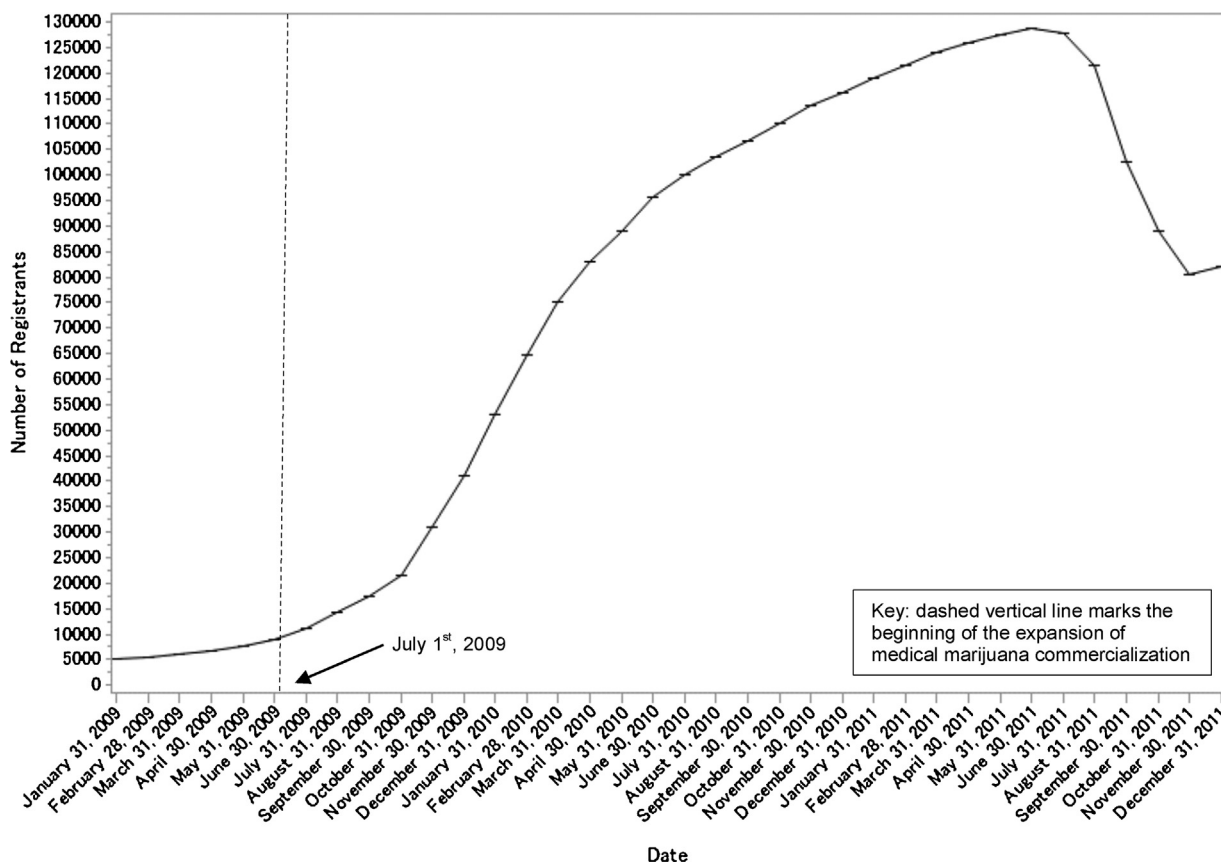

Fig. 1. Number of medical marijuana registered users from 2009 to 2011.