Shift in Drug vs Alcohol Prevalence in Milwaukee County Motor Vehicle Decedents, 2010–2016

Kiran A. Faryar, MD, MPH; Sara A. Kohlbeck, MPH; Sara J. Schreiber, BS

ABSTRACT

Objective: The purpose of this study is to examine the prevalence of alcohol and nonalcohol drugs in motor vehicle crash (MVC) decedents in Milwaukee County, Wisconsin.

Methods: A retrospective review of MVC decedents in Milwaukee County from 2010 to 2016 was performed. Substances were divided into 5 categories based on chemical composition and clinical effects: alcohol, cocaine and its metabolite benzoylecgonine, opioids, cannabinoids, amphetamines and methamphetamines. Decedents were determined to be positive if any of these substances were detected on blood toxicology analysis.

Results: Sixty-five percent (n = 113) of MVC decedents tested positive for 1 substance, while polysubstance use (≥ 2 substances) was seen in 27% (n = 47). Alcohol was the most prevalent substance (n = 77, 44%), while cannabinoids were the second most prevalent (n = 50, 29%), and opioids were third most prevalent (n = 24, 14%). There was a statistically significant increase in the number of MVC decedents who tested positive for opioids from 2010 to 2016 (slope = 3.9, $P < 0.01$). The number of decedents who tested positive for alcohol only from 2010 to 2016 decreased significantly (slope = -3.9, $P < 0.05$), and 2016 was the first year in which the number of drug-positive decedents exceeded the number of alcohol-positive decedents.

Conclusion: The prevalence of drugs exceeded that of alcohol in decedents for the first time in 2016 in Milwaukee County. While continued efforts to reduce alcohol-positive driving are encouraged, increased attention to drugged driving is needed to prevent further drug-positive fatalities.

INTRODUCTION

Drugged driving, defined as driving under the influence of illicit drugs or misuse of prescription drugs,[1] is a federal research priority. Multiple organizations such as the Office of National Drug Control Policy, the US Drug Enforcement Administration, and the National Highway Traffic and Safety Administration (NHTSA), have declared drugged driving a public health concern that warrants further research and community interventions.[2-4] Conversations regarding the current opioid epidemic led to questions about drugged driving prevalence.[5] With rates of opioid and heroin use on the rise, so too is the number of drivers testing positive for these substances.[5] While the effects of driving under the influence of alcohol (termed "drunk driving") have been well studied, the effects of drug-positive driving are less clear.[6-8]

Few studies have examined drug prevalence in fatally injured drivers. One Canadian study of national road safety data found drug prevalence among decedents increased slightly (16.9% increase) from 2000 to 2012.[8] National variations in both rates of drug prevalence in drivers and types of substance present make this data less representative of US drug trends.[7,8] Several US studies examined NHTSA Fatality Analysis Reporting System (FARS) data to delineate the type and prevalence of substance present.[5,7,9] Romano and Pollini found alcohol prevalence (45.1%) exceeded drug prevalence (25.9%) among fatally injured drivers in the FARS database between 1998 and 2010. Among these fatally injured drug-positive drivers, stimulants and cannabinoids were most prevalent.[7] Most recently, Chihuri and Li examined the prevalence of prescription opioids alone in fatally injured drivers in 6 states using the FARS database (1995-2015).[5] The authors found increased prevalence of prescription opioids in drivers tested within 1 hour of death—a 620% increase.[5] This study delineated prescription opioids from other nonalcohol drugs in primary analysis.[5] No studies examining the prevalence of drug-

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Author Affiliations: Injury Research Center, Medical College of Wisconsin, Milwaukee, Wis (Faryar, Kohlbeck); Milwaukee County Medical Examiner Office, Milwaukee County, Milwaukee, Wis (Schreiber).

Corresponding Author: Kiran Faryar, MD, MPH, Department of Emergency Medicine, University of Cincinnati, College of Medicine, 231 Albert Sabin Way, Cincinnati, Ohio 45267-0769; phone 513.884.6269; fax 513.558.4599; email faryarka@ucmail.uc.edu.

positive driving (both opioids and other nonalcohol drugs) in fatally injured drivers have been conducted in the United States within the last 5 years. Given the rapidly evolving nature of drug trends, it is unclear if the same substances remain prevalent today.

Milwaukee County is an ideal setting to examine substance prevalence in drivers, as it is the most populous county in Wisconsin and it has a mixture of urban, suburban, and rural areas.[10,11] The goal of this study was to determine which substances (alcohol, cocaine, opioids, amphetamines, or cannabis) were most prevalent in fatally injured drivers. The authors hypothesize opioid prevalence in motor vehicle decedents is increasing at a faster rate than other substances given its increased incidence nationwide.

METHODS

Study Design and Population

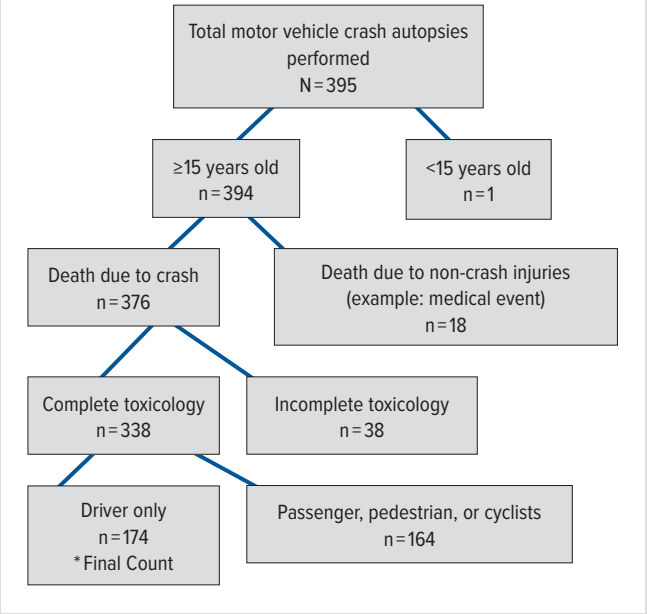
A retrospective review of motor vehicle crash (MVC) decedents in Milwaukee County, Wisconsin from 2010 to 2016 was performed. A list of MVC autopsies was obtained from the Milwaukee County Medical Examiner's Office. Inclusion criteria were adolescents and adults ≥15 years old who expired due to acute crash-related injuries. Subjects were excluded if whole blood specimens were not available for complete toxicology analysis (N = 38) and if subjects were passengers, pedestrians, or cyclists (N = 164) (Figure 1).

Per county protocol, blood samples from each decedent are qualitatively screened (positive/negative) by enzyme-linked immunoassay for the following substances: benzodiazepines, cocaine and its metabolite benzoylecgonine, tetrahydrocannabinol (THC), amphetamines, methamphetamines, opiates, oxycodone, fentanyl, buprenorphine, and methadone. If a positive qualitative blood screen is obtained, the blood sample is confirmed by gas chromatography/mass spectrometry with the exception of THC. Decedents were determined to be negative if no substance was present or if the substance detected was administered after the crash (such as by emergency medical services or in the hospital) per the medical examiner report. Only blood samples were used for toxicology results due to the temporal unreliability of urine samples. Institutional Review Board approval was obtained through the Medical College of Wisconsin. Consent was obtained from the Milwaukee County Medical Examiner's Office.

Demographic, Crash, and Substance Variables

Demographic variables including age, race, and sex were collected for each subject. Crash related variables included rollover (yes/no), ejected (yes/no), seatbelt use (yes/no), helmet use (yes/no), airbag deployment (yes/no), speed (in miles per hour), and evidence of pre-impact braking on scene (yes/no). Quantitative blood toxicology results were only available for the following substances: alcohol, cocaine, benzoylecgonine, oxycodone, methadone, morphine, fentanyl, oxymorphone, codeine, hydrocodone, and 6-monoacetylmorphine. If these levels were > 0.00, they were considered positive. The remaining substances (buprenorphine, THC, amphetamines, methamphetamines, and opiates) were marked as either present or absent per blood immunoassay screen. Benzodiazepines were excluded from analysis because the majority were administered after the crash by emergency medical services or hospital providers.

Figure 1. Data Collection Algorithm Of Motor Vehicle Decedents in Milwaukee County From 2010-2016



Statistical Analysis

Descriptive analysis of autopsied decedent demographic characteristics, crash characteristics, and substance prevalence was performed. The substances were divided into 5 major categories based on their chemical composition and clinical effects: alcohol; cocaine and its metabolite benzoylecgonine; cannabinoids; opioids (including opiates, oxycodone, methadone, buprenorphine, norbuprenorphine, fentanyl, oxymorphone, codeine, morphine, hydrocodone, and 6-monoacetylmorphine); amphetamines and methamphetamines. Chi-square analysis was performed between each substance category and demographic and crash characteristic. Linear regression analysis was performed to determine trends in substance prevalence during the study period. IBM SPSS Statistics Version 21 was used for statistical analysis.

RESULTS

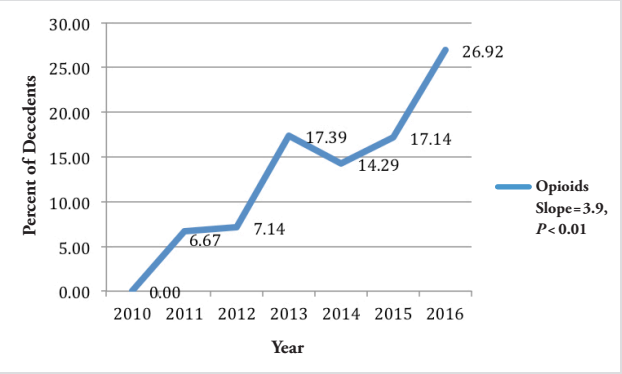
Demographic and Crash Characteristics

From 2010 to 2016, 174 decedents met the study criteria, 83% were male, and 17% were female. In comparison, according to US Census data from 2015, 51.7% of Milwaukee County residents identified as female and 48.3% as male.[12] The average age of study

Table 1. Demographics of Motor Vehicle Crash Decedents, N=174

Characteristic		n	%
Sex	Male	144	83
	Female	30	17
Race	White	82	47
	Black	69	40
	Hispanic	20	11
	Asian	3	2
Mechanism of Injury	Single car	60	34
	2 car	50	29
	Multicar	7	4
	Single motorcycle	20	12
	Motorcycle vs auto	35	20
	Bicycle vs auto	2	1
Seatbelt	No	101	58
	Yes	38	22
	Unknown	35	20
Any substance detected	Negative	61	35
	Positive	113	65
Alcohol	Negative	97	56
	Positive	77	44
Cocaine	Negative	160	92
	Positive	14	8
Opioids	Negative	150	86
	Positive	24	14
Cannabinoids	Negative	124	71
	Positive	50	29
Amphetamines and methamphetamines	Negative	171	98
	Positive	3	2

Figure 2. Analysis of Motor Vehicle Crash Decedents Who Tested Positive for Opioids, 2010-2016



decedents was 40 years old; 47% were white, 40% were black, 11% were Hispanic, and 2% were Asian (Table 1). In comparison, 27.1% of Milwaukee County residents were black, according to 2015 US Census data.[12]

Two-thirds of the car crashes involved 1 or more automobiles (67%), while almost one-third of the fatalities involved motorcycles (32%). The majority of decedents did not wear their seatbelt (58%). Seatbelts were worn in 22% of crashes; seatbelt use was unknown in 20% of crashes per investigation reports (Table 1).

Substance Use

Sixty-five percent (n = 113) of decedents tested positive for at least 1 substance, and polysubstance use (≥ 2 substances) was seen in 27.0% (n = 47) of crash decedents. Alcohol (> 0.00 grams per deciliter) was the most prevalent substance detected (n = 77, 44%), while cannabinoids were the second most prevalent substance (n = 50, 29%), and opioids the third most prevalent (n = 24, 14%). From 2010 to 2015, the percent of decedents who tested positive for alcohol alone exceeded the percent of decedents who tested positive for all nonalcohol drugs (cocaine, opioids, amphetamines, methamphetamines, and cannabinoids). In 2016, more decedents tested positive for drugs (19.2%) as compared to alcohol (3.8%). Specifically, isolated cannabis (11.5%) and opioids (7.7%) were more prevalent in decedents than alcohol alone. 2016 was the first year in which the number of decedents who tested positive for drugs exceeded those who tested positive for alcohol.

Statistical analysis

White drivers were 2.1 times (95% CI, 1.1–4.1) less likely to test positive for any substance as opposed to nonwhite drivers ($P = 0.021$). There was no association between substance-positive drivers and sex, type of vehicle driven (car vs motorcycle), or single vs multi-vehicle collisions. For decedents who tested positive for alcohol, the risk of being in a single vehicle crash was 1.84 times (95% CI, 1.3–2.6) that of decedents involved in a multivehicle crash ($P < 0.01$). There was no relationship between alcohol-positive decedents and sex, race, type of vehicle driven (car vs motorcycle), or presence of seatbelt. The presence of opioids and cocaine was not associated with sex, race, type of vehicle driven (car vs motorcycle), single vs multivehicle collision, or presence of seatbelt. There was an association between decedents who tested positive for cannabis and race; white decedents were 4.1 times (95% CI, 1.9–8.6) less likely to test positive for cannabis as opposed to nonwhite decedents ($P < 0.01$).

There was a statistically significant increase in the number of MVC decedents who tested positive for opioids from 2010 to 2016 (slope = 3.9, $P < 0.01$) (Figure 2). The downward trend in the number of MVC decedents who tested positive for alcohol only from 2010 to 2016 was also statistically significant (slope = -3.9, $P = 0.011$) (Figure 3). Linear regression analyses were not statistically significant for the remaining substance categories.

LIMITATIONS

This study cannot declare a causal relationship between substance use and motor vehicle crashes. The findings are associative. The effect of illegal drugs and prescription medications on each individual driver is dependent on multiple factors such as rate of absorption, distribution, mechanism of action, elimination, and tolerance. These factors are difficult to predict and quantify. The presence of substances in

blood samples is more temporally and pharmacologically accurate than urine samples, therefore toxicology results were based on blood samples exclusively in this study. For drivers with polysubstance use, it is unclear what role each drug played in the motor vehicle crash. By examining only fatal crashes, the true prevalence of drug use in MVC drivers in this county is unknown. The medical examiner system in Wisconsin is decentralized; therefore only 1 county was examined. It is unclear if these results are applicable to all counties in the state or nationwide.

DISCUSSION

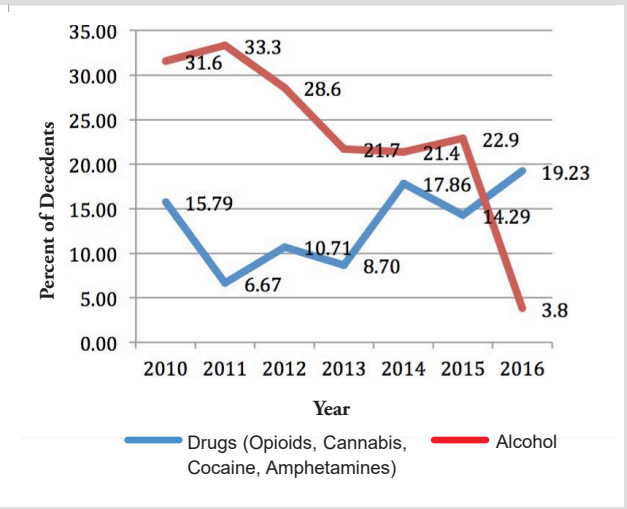
This study sought to determine the prevalence of drug-positive drivers in Milwaukee County MVC decedents from 2010 to 2016. The findings disclosed an increasing trend in the presence of opioids among motor vehicle decedents over time. Two unexpected trends were observed during analysis; the number of fatally injured drivers who tested positive for alcohol alone decreased significantly, and the number of drug-positive decedents exceeded alcohol-positive decedents for the first time in 2016. National organizations such as the Office of National Drug Control Policy [3] and the National Institutes of Health have defined drugged driving as driving after drug use; therefore, our findings indicate that in 2016 drugged driving exceeded drunk driving for the first time during the study period.

The rise in opioid-positive drivers highlights an urgent need to address drugged driving with current opioid users. Opioids are known to cause drowsiness and hinder reaction time, attention, and concentration while driving.[1,5] In a study of heroin users, perceived risk of driving after use was low.[13] Interviewed heroin users stated they attempted to reduce driving risk by limiting drug use to tolerable levels prior to driving and waiting until they no longer felt "high" before driving.[13] McIntosh et al concluded that drugged driving educational campaigns would be ineffective because users believe they can mitigate these effects.[13] They hypothesized drugged driving interventions would be most useful while users are in treatment facilities.[13]

Interventions immediately after a motor vehicle crash, such as in the emergency department, could prove advantageous since users would be faced with the negative consequences of their drug use in real-time. Such real-time interventions were performed in a population of alcohol abusers.[14] Trauma surgeons in a Level 1 trauma center performed brief interventions in a population of patients who screened positive for alcohol abuse. Patients in the intervention group were found to have decreased rates of alcohol intake and trauma recidivism at 12-month follow-up.[14]

The dramatic decrease in the number of drivers who tested positive for alcohol alone is especially interesting given Wisconsin has a higher rate of binge-drinking and alcohol consumption than other US states.[15,16] The rate of alcohol-positive crash fatalities in

Figure 3. Analysis of Motor Vehicle Crash Decedents Who Tested Positive for Alcohol and Nonalcohol Drugs, 2010-2016



Wisconsin (6.7 fatalities per 100,000) exceeds the national average (5.7 per 100,000).[15] In comparison, national rates of alcohol-positive driving in nonfatal and fatal crashes are decreasing.[16,17] Our alcohol-positive driving trends in Milwaukee County parallel national trends. According to 2013-2014 NHTSA survey data, the percent of US drivers of nonfatal crashes who tested positive for alcohol has decreased over time from 12.4% in 2007 to 8.3% in 2014—a 33% reduction.[16,18] Among national MVC fatalities in 2014, the percent of alcohol-positive (> 0.08 grams per deciliter) drivers decreased slightly compared to 2012, from 20% to 19.8%, a 1% reduction.[19] This trend is likely multifactorial and can be attributed to extensive drunk driving media campaigns, school-based education programs, and ride share programs.[8,15,16,18]

Surprisingly, in 2016 the presence of nonalcohol drugs exceeded alcohol in decedents. This is consistent with a report by the Governors Highway Safety Association (GHSA) in April 2017 that found more fatally injured drivers tested positive for drugs than alcohol.[20] The GHSA report used 2015 FARS data, the most recent data available.[20] A few years prior, using the same database, Romano and Pollini reported that alcohol-positive crashes still exceeded drug-positive crashes among fatally injured drivers.[7] This indicates the predominance of drug-positive driving over alcohol-positive driving is a relatively new trend.

The etiology of this new trend can be attributed to several factors. The proportion of drivers who test positive for drugs is increasing nationally while alcohol-positive drivers are decreasing.[8,21] According to a 2013-2014 NHTSA survey, drug-positive drivers of nonfatal crashes increased from 16.3% in 2007 to 20% in 2013-2014. With more surveyed drivers admitting to drug use, drug-positive crash risk also increases. Medical and recreational legalization of marijuana also contributed to the increased preva-

lence of drug-positive drivers. Several states such as Colorado, California, and Washington witnessed a rise in fatally injured marijuana-positive drivers after legalization.[22-24] Similar to heroin users, marijuana users admit to use prior to driving and indicate a lack of self-awareness as to the harmful effects of marijuana on driving performance, such as slower reaction time and decreased ability to perform complex tasks.[9,25] Given the trajectory of increased drug use and a lack of awareness as to its effects on driving performance, it is logical that drug-positive driving surpassed alcohol-positive driving.

CONCLUSIONS

Between 2010 and 2016, the number of fatally injured opioid-positive drivers disclosed a statistically significant increasing trend in Milwaukee County. In contrast, the number of fatally injured drivers who tested positive for alcohol alone decreased significantly. 2016 was the first year wherein drug-positive driving exceeded alcohol-positive driving. This data, coupled with driving perceptions of current and former drug users, can guide more effective educational campaigns and real-time interventions.

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