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Alcohol- or drug-use disorders and motor vehicle accident mortality: A retrospective cohort study

Russell C. Callaghan[a,b,c,*], Jodi M. Gatley[b,d], Scott Veldhuizen[b], Shaul Lev-Ran[f,g], Robert Mann[b], Mark Asbridge[e]

[a] Northern Medical Program, University of Northern British Columbia, 3333 University Way, Prince George, British Columbia, V2N 4Z9, Canada
[b] Centre for Addiction and Mental Health, Social, Epidemiological Research Department, 33 Russell St., Toronto, Ontario, M5S 2S1, Canada
[c] Dalla Lana School of Public Health, University of Toronto, 155 College St., Health Science Building, Toronto, Ontario, M5T 3M7, Canada
[d] University of Toronto (Scarborough Campus), Department of Biological Sciences, 1265 Military Trail, Toronto, Ontario, M1C 1A4, Canada
[e] Department of Community Health and Epidemiology, Dalhousie University, 5790 University Ave., Halifax, Nova Scotia, B3H 1V7, Canada
[f] Social Aetiology of Mental Illness (SAMI) CIHR Fellow, Centre for Addiction and Mental Health, University of Toronto, 455 Spadina Ave., Suite 300, Toronto, Ontario, M5S 2G8, Canada
[g] Addiction Psychiatry Program, Centre for Addiction and Mental Health, University of Toronto, 33 Russell St., Toronto, Ontario, M5S 2S1, Canada

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ABSTRACT

A large body of research has linked alcohol consumption and motor vehicle accidents (MVAs), but far fewer studies have estimated the risk of MVA fatality among drug users. Our study addresses this gap. We identified cohorts of individuals hospitalized in California from 1990 to 2005 with ICD-9 diagnoses of methamphetamine- (n = 74,170), alcohol- (n = 592,406), opioids- (n = 68,066), cannabis- (n = 47,048), cocaine- (n = 48,949), or polydrug-related disorders (n = 411,175), and these groups were followed for up to 16 years. Age-, sex-, and race-adjusted standardized mortality rates (SMRs) for deaths due to MVAs were generated in relation to the California general population. Standardized MVA mortality ratios were elevated across all drug cohorts: alcohol (4.5, 95% CI, 4.1–4.9), cocaine (3.8, 95% CI, 2.3–5.3), opioids (2.8, 95% CI, 2.1–3.5), methamphetamine (2.6, 95% CI, 2–3.1), cannabis (2.3, 95% CI, 1.5–3.2) and polydrug (2.6, 95% CI, 2.4–2.9). Males and females had similar MVA SMRs. Our large, population-based study found elevated risk of MVA mortality across all cohorts of individuals with alcohol- or drug-use disorders. Given that illicit drug users are often unaware of or misperceive the impacts of drug use on safe driving, it may be important for health-service or public-health interventions to address such biases and improve road safety.

1. Introduction

While a large body of research has linked alcohol consumption and motor vehicle accidents (MVAs), comparatively fewer studies have assessed the MVA risk posed by illicit drug use, with the exception of cannabis (Asbridge et al., 2012; Li et al., 2012). Approximately 4.2% of the US general population (10.6 million people) has reported driving after drug use in the previous 12 months (Substance Abuse and Mental Health Services Administration, 2011), but this pattern of drug-impaired driving rises dramatically in other subpopulations, such as young drivers (Asbridge et al., 2005; O'Malley and Johnston, 2007; Paglia-Boak et al., 2011), injection drug users, and community-based/treatment-seeking drug users (Albery et al., 2000; Darke et al., 2004; Macdonald et al., 2005).

Population-based toxicological examinations of MVA-related injuries and deaths often detect the presence of illicit drugs or prescription medications, with cannabis being most frequently identified (in 2–32%), followed by benzodiazepines (in 2–15%), cocaine (in 0.4–11%), amphetamines (in 0.8–6%) and opioids (in 0.5–11.5%) (Brady and Li, 2012; Brault et al., 2004; Costa et al., 2012; Darke et al., 2007; Gjerde et al., 2011; Jones et al., 2009; Kelly et al., 2004; Mercer and Jeffery, 1995; Movig et al., 2004; Mravcik et al., 2007; Stoduto et al., 1993). Recent meta-analyses examining the crash risk associated with driving under the influence of drugs identified an increased risk of a fatal crash associated with prescription psychoactive drugs with sedative effects [e.g., benzodiazepines, tricyclic antidepressants, and opioids (Dassanayake et al., 2011; Rapoport et al., 2009)], amphetamines, and cocaine (Elvik, 2012). However, some meta-analytic work has also found no observed association between fatal crashes and use of cannabis or opioids (Elvik, 2012), while other meta-analyses have found significant associations between acute cannabis use and the risk of MVA (Asbridge et al., 2012; Li et al., 2012).

* Corresponding author at: Northern Medical Program, University of Northern British Columbia, 3333 University Way, Prince George, British Columbia, V2N 4Z9, Canada. Tel.: +1 250 960 5668.
E-mail address: Russ.Callaghan@UNBC.ca (R.C. Callaghan).

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The harms associated with impaired driving-related crashes are substantial and varied, and include direct and indirect costs such as property damage, acute and long-term injury, lost productivity, and death (Degenhardt and Hall, 2012). Mortality rate estimates resulting from drug-related MVAs remain quite limited, particularly in relation to those most at risk. The existing literature examining the impact of illicit drug use on MVA fatalities consists of 11 cohort studies (Benson and Holmberg, 1984; Dukes et al., 1992; Galli and Musicco, 1994; Gronbladh et al., 1990; Manfredi et al., 2006; Maxwell et al., 2005; Ojesjo et al., 1998; Oppenheimer et al., 1994; Oyefeso et al., 1999; Quaglio et al., 2001; Saieva et al., 2012). This body of research, however, suffers from a number of critical limitations that include: a lack of standard mortality ratios (SMRs) (in comparison to population controls); relatively imprecise MVA-related estimates due to few MVA deaths (less than 375 across all available cohort studies); a deficiency of gender-specific estimates (Darke et al., 2007); only a single cohort study occurring in a North American setting; and a large gap in evidence about MVA mortality risk in cohorts of cocaine, cannabis or methamphetamine users (Kelly et al., 2004; Ramaekers et al., 2012; Vingilis and Macdonald, 2002).

Our study can address each of the noted major limitations in the drug use and crash literature. For example, it adds to the current science by including: gender-specific standardized mortality estimates in relation to general-population controls; relatively precise mortality estimates based on more than 3300 MVA deaths across study cohorts; MVA fatality estimates in a US-based setting; and fatal crash estimates for large cohorts of cocaine, cannabis and methamphetamine groups. The current retrospective study aims to provide age-, sex-, and race-adjusted estimates of motor vehicle accident mortality over a 16-year period (1990–2005) among individuals admitted to California inpatient hospitals with an alcohol- or drug-use disorder.

2. Methods

2.1. Data sources

The current study, approved by the Research Ethics Board at the Center for Addiction and Mental Health (CAMH) and the State of California Committee for the Protection of Human Subjects, utilized California Office of Statewide Health Planning and Development (OSHPD) inpatient hospital admission data from January 1, 1990 until December 31, 2005 from the patient discharge database (PDD). The dataset consists of a record containing demographic information and up to 25 diagnoses, based on the International Classification of Diseases, 9th edition (ICD-9), for each inpatient discharged from a California licensed hospital. Licensed hospitals include general acute care, acute psychiatric care, chemical dependency recovery, and psychiatric health facilities. Inpatient data are screened by an automated data-entry and reporting system (Office of Statewide Health Planning and Development, 2010) and data fields with error rates of 0.1% or higher are returned to the hospitals for correction (Office of Statewide Health Planning and Development, 1995; Zach, 1990). Reabstraction studies comparing California Office of Statewide Health Planning and Development inpatient data files with original medical records found specificities for diagnoses ranging from 0.98 to 1.00, and sensitivities for diagnoses ranging from 0.88 to 1.00 (Office of Statewide Health Planning and Development, 1990, 1996).

2.2. Measurement of outcome

Death records from the California Vital Statistics Database (VSD; which captures all death records for the state) were linked to the patient discharge database inpatient data. The probabilistic matching algorithm linking California inpatient records to state death records has a linkage sensitivity and specificity of 0.9524 and 0.9998, respectively, and positive and negative predictive values of 0.994 and 0.998 (Anderson et al., 2001; Zingmond et al., 2004).

Primary underlying causes of death were coded according to ICD-9 from the start of our study until 1998 and according to ICD-10 thereafter. Identification of motor vehicle accidents used ICD-9 and ICD-10 crosswalk codes from the Centers for Disease Control categorization scheme (see Table 1) (Anderson et al., 2001).

2.3. Patient group assignment

We identified individuals aged 15 years or older who had one or more drug- or alcohol-related diagnoses (see Table 1) at any inpatient hospital stay. The first admission for each individual during the study period (1990–2005) which included an ICD-9 alcohol- or drug-use code became that individual's index admission. People whose recorded diagnoses throughout the 15-year study period reflected only a single substance were assigned to one of 5 substance-specific groups: cocaine, methamphetamine [see prior work for justification of this cohort name (Callaghan et al., 2012)], opioids, cannabis, or alcohol. People whose records reflected problems with multiple substances including at least one of these 5 were assigned to a sixth "polydrug" group.

To be assigned to the cocaine, methamphetamine, opioids, cannabis, or alcohol cohort, individuals must have been admitted to an inpatient hospital and had: (1) an ICD-9 diagnosis, in any of the diagnoses (up to 25) recorded in the their electronic diagnostic record in the administrative database, indicating a condition within only one single drug category (in Table 1), at index admission; (2) no indication in medical records of any alcohol- or drug-use diagnoses outside of their assigned alcohol or drug cohort as listed in Table 1; and (3) no ICD-9 indication of any other drug use disorders (304.1, 304.5, 304.6, 304.7, 304.8, 304.9, 305.3, 305.4, and 305.9). Thus, the cohort-assignment algorithm excluded individuals from a group who had any ICD-9 diagnostic codes within a medical record or across records indicative of drug use other than that designated by their drug group membership.

To be assigned to the polydrug cohort, individuals must have had: (1) an ICD-9 diagnosis indicating an alcohol or drug condition listed in Table 1, but who were disqualified from the alcohol or drug cohorts (defined above) because of indication of more than one kind of alcohol- or drug-use condition (listed in: Table 1, or 304.1, 304.5, 304.6, 304.7, 304.8, 304.9, 305.3, 305.4, 305.9) either within an inpatient episode or across inpatient episodes during the study period.

2.4. Validity of ICD-9 codes to identify individuals with alcohol- or drug-use disorders

Prior research has indicated that ICD-9 codes for alcohol- or drug-use disorders in hospital-based administrative data systems have very high specificity (~97–99%) (Kim et al., 2012; Quan et al., 2008), but relatively low-to-moderate sensitivity (~54–61%) (Kim et al., 2012; Quan et al., 2008) in relation to expert-panel review as the gold standard. Corresponding positive predictive values (PPVs) for ICD-9 alcohol-use-disorder codes ranged from 0.80 to 0.83, and PPVs for drug-use-disorder codes spanned from 0.70 to 0.74 (Kim et al., 2012; Quan et al., 2008). At least in our understanding, however, no available literature has specifically assessed the validity of alcohol- or drug-use codes in the California inpatient data system. It is also important to note that the validity of the ICD-9 alcohol and drug codes may have changed across the years of the study period (1990–2005).