Release from drinking-age restrictions is associated with increases in alcohol-related motor vehicle collisions among young drivers in Canada

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ABSTRACT

Background. Alcohol-related motor vehicle collisions (MVCs) are a key concern in current international debates about the effectiveness of minimum legal drinking age (MLDA) laws, but the majority of this literature is based on natural experiments involving MLDA changes occurring 2–4 decades ago.

Methods. A regression-discontinuity approach was used to estimate the relation between Canadian drinking-age laws and population-based alcohol-related MVCs ($n = 50,233$) among drivers aged 15–23 years in Canada.

Results. In comparison to male drivers slightly younger than the MLDA, those just older had immediate and abrupt increases in alcohol-related MVCs of 40.6% (95% CI 25.1%–56.6%; $P < 0.001$) in Ontario; 90.2% (95% CI 7.3%–171.2%; $P = 0.033$) in Manitoba; 21.6% (95% CI 8.5%–35.0%; $P = 0.001$) in British Columbia; and 27.3% (95% CI 10.9%–44.5%; $P = 0.001$) in Alberta; but also an unexpected significant decrease in the Northwest Territories of −102.2% (95% CI −120.7%–74.9%; $P < 0.001$). For females, release from MLDA restrictions was associated with increases in alcohol-related MVCs in Ontario [34.2% (95% CI 0.9%–68.0%; $P = 0.044$)] and Alberta [82.2% (95% CI 41.1%–125.1%; $P < 0.001$)]. Nationally, in comparison to male drivers slightly younger than the legislated MLDA, male drivers just older had significant increases immediately following the MLDA in alcohol-related severe MVCs [27.0% (95% CI 12.6%–41.7%, $P < 0.001$)] and alcohol-related fatal MVCs [53.4% (95% CI 2.4%–102.9%, $P = 0.04$)].

Conclusions. Release from Canadian drinking-age restrictions appears to be associated with immediate increases in alcohol-related fatal and non-fatal MVCs, especially among male drivers.

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1. Introduction

Alcohol use is the largest contributor to the global burden of morbidity and mortality among adolescents and young adults aged 10–24 years old (Gore et al., 2011; Lim et al., 2012; Institute for Health Metrics and Evaluation, 2015), and road traffic crashes represent the second leading cause of disability-adjusted life years lost (DALYs) in this age group (Gore et al., 2011). Given the prominent role of worldwide alcohol-related injuries among young people (The Management of Substance Abuse Team (MSB) in the Department of Mental Health and Substance Abuse (MSD) of the World Health Organization (WHO), 2011),

especially those due to motor vehicle collisions (MVCs) (World Health Organization, 2015), many countries have implemented minimum legal drinking age (MLDA) legislation.

Canadian MLDAs are under provincial jurisdiction, and almost all provinces set their current legislated drinking ages in the mid-to-late 1970s. The MLDA is 18 years of age in Alberta, Manitoba and Québec, and 19 years of age in the rest of Canada. Recently, the Canadian Public Health Association (Canadian Public Health Association, 2011) and an expert-panel of Canadian researchers and policymakers both have recommended raising the MLDA across all provinces to 19 years of age, with the expert panel also identifying 21 years as the ideal (Giesbrecht et al., 2013). Such calls for increasing age-based restrictions on alcohol run counter to broader alcohol policy developments in some provinces which aim to liberalize liquor access, to shift to greater privatization of alcohol sales (away from a government monopoly model), and to increase population-level alcohol sales and corresponding

taxation revenue (British Columbia Ministry of Justice, 2013; Government of Saskatchewan, 2013; Liquor and Gaming Regulatory Consultation Committee, 2012). In addition, some provincial political parties have made recent attempts to lower the provincial MLDA, or have intentionally retained an MLDA of 18 years (CBC News, 2013; Owen, 2014).

International debate is also ongoing about the effectiveness of MLDA laws (Giesbrecht et al., 2013; Craig, 2014; Belden, 2015; Bloom, 2015; Japan Today, 2015). A large majority of studies assessing the impacts of the MLDA on MVCs were conducted 20–40 years ago [for reviews, see (Wagenaar & Toomey, 2002; McCartt et al., 2010a)], as most research relied on natural experiments involving legislative changes in the United States in the 1980s (Wagenaar & Toomey, 2002). It is reasonable to argue that the impacts of MLDA laws observed 2–4 decades ago might be substantially attenuated in the contemporary context due, in large part, to advances in both road and vehicle safety (Kahane, 2004; Waller, 2002), introduction of provincial graduated driver licensing (GDL) legislation (Dee et al., 2005; McCartt et al., 2010b; Masten et al., 2011; Mayhew et al., 2005), declining prevalence of past year drinking and past month binge drinking among adolescents and young adults (1999–2013) (Boak et al., 2013), and increases in the severity of penalties for drinking and driving (Asbridge et al., 2009; Mann et al., 2001; Vingilis et al., 1988). Recent MLDA studies have focused primarily on assessing MLDA impacts on fatal collisions (Lovenheim & Slemrod, 2010; Ponicki et al., 2007; Keyes et al., 2015; Carpenter & Dobkin, 2009; Carpenter et al., 2014; Callaghan et al., 2014a; Fell et al., 2008; Lindo et al., 2016; Fell et al., 2009) in the United States or serious traffic collisions resulting in injury or hospital-based care (Lindo et al., 2016; Callaghan et al., 2013a; Callaghan et al., 2013b; Kypri et al., 2006). The current MLDA-MVC literature has a number of limitations, including: a lack of assessment of MVCs without severe injuries and property-damage-only (PDO) collisions, which usually comprise the majority of MVCs in population-based collision data systems; and, aside from studies from our lab (Callaghan et al., 2014a; Callaghan et al., 2013a; Callaghan et al., 2013b; Callaghan et al., 2016; Callaghan et al., 2014b), a general absence of analyses to examine potential MLDA-related gender differences.

Using population-based collision data from eight provinces/territories, representing almost all of the Canadian population, the current study can address these limitations in the field by using a broad, population-based MVC outcome variable capturing collisions with PDO and those resulting in minor-to-serious injury or death, as well as by assessing the association between MLDA release and collision patterns across gender. The current study builds upon and extends our earlier work on the impacts of MLDA laws on MVCs in Québec (Callaghan et al., 2014b) by including a more sophisticated application of regression-discontinuity analyses (i.e., local regression techniques) and a much more comprehensive set of provincial/territorial collision data. Given that our prior MLDA-MVC work (Callaghan et al., 2014b) found that release from drinking-age restrictions was associated with significant and abrupt MVC increases of approximately 6% among males and females, as well as an immediate 11.1% rise in nighttime MVCs (a proxy for alcohol-related collisions), we expected significant and immediate increases in alcohol-related collisions among male and female drivers immediately following release from MLDA restrictions in other provinces and territories across Canada.

2. Methods

2.1. Data sources

The current study used de-identified information from reports of MVCs in population-based provincial/territorial data systems from 8 provinces/territories: British Columbia (BC), Alberta (AB), Saskatchewan (SK), Manitoba (MB), Ontario (ON), Québec (QC), Nova Scotia (NS), and the Northwest Territories (NT) (see Supplemental Table 1

for data-source details). These provinces/territories comprised approximately 95.5% of Canada's population in 2006 (Statistics Canada, 2014). Data requests were made to Prince Edward Island, New Brunswick, Newfoundland and Labrador, and the Yukon, but data were not available for our research purposes.

2.2. Construction of MVC outcomes

The definitions of police-reportable and provincial/territorial database reportable MVCs differed across provinces/territories, and some changes occurred during the study span (Supplementary Table 1). All provinces/territories require police to attend MVCs in which injuries or fatalities occur.

2.2.1. Alcohol-related MVCs

In all police-report forms of MVCs, there were province/territory-specific items designating alcohol involvement at the driver level (as opposed to the collision level). In the current study, "alcohol-related" MVCs were those in which the responding police officer indicated the involvement of at least one alcohol-related condition as a contributing factor in the collision (see Supplementary Table 1). Police-officer indications of alcohol as a contributing factor in a collision do not necessarily signify that a driver exceeded federal or provincial/territorial legal blood alcohol concentration (BAC) limits defining driver alcohol impairment. Alcohol-related MVC outcomes were analyzed at the provincial/territorial level.

Prior research has demonstrated that Canadian police are fairly accurate in ascertaining alcohol involvement among drivers injured in MVCs. For example, indications of alcohol involvement in police traffic crash data systems (which are used in the current study) had a positive predictive value (PPV) of approximately 0.83 (95% CI 0.80–0.86) in relation to BAC values exceeding zero reported in the electronic medical records of injured drivers admitted to emergency departments or hospital trauma centers in British Columbia (Brubacher et al., 2013). Research from US settings also has demonstrated similar results, with police indications of alcohol involvement in crash records having high PPV (e.g., 0.84–0.85) in relation to gold-standard assessments of BACs ≥0.01 g/dl in injured or killed drivers (Grossman et al., 1996; McCarthy et al., 2009).

2.2.2. Alcohol-related severe MVCs and alcohol-related fatal MVCs

Alcohol-related severe collisions were defined as follows: crashes involving at least one injury or fatality and an indication of alcohol as a contributing factor in the crash. Alcohol-related fatal collisions were defined as collisions in which at least one fatality occurred and alcohol was listed as a contributing factor. We aggregated these outcomes to the national level so as to support robust estimates.

2.2.3. Proxy for alcohol-related MVCs: nighttime MVCs

MVCs occurring at night are commonly used as a surrogate to identify alcohol-related MVCs (Mann et al., 2001; Babor et al., 2010; Young et al., 2004). The following proxy was also used to identify alcohol-related MVCs: (Gore et al., 2011) nighttime MVCs from the hours of 24 h to 5:59 h (Midnight to 5:59 AM). Nighttime MVC outcomes were analyzed at the provincial/territorial level.

2.3. Alcohol-related collisions: count data

The primary analyses in the current study used provincial/territorial counts of alcohol-related fatal and nonfatal MVCs within drivers' age-in-weeks bins, pooled across the specific data span available in each province/territory. We chose to analyze counts within the age-in-weeks bins—rather than rates (which would be based on counts in the numerator and population statistics in the denominator)—for two reasons: the denominator for our primary age-in-weeks independent variable cannot be calculated (or imputed accurately) from population