



Full length article

Assessing the impacts of minimum legal drinking age laws on police-reported violent victimization in Canada from 2009 to 2013

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ABSTRACT

Background/aim: Given that alcohol-related victimization is highly prevalent among young adults, the current study aimed to assess the potential impacts of Minimum Legal Drinking Age (MLDA) laws on police-reported violent victimization events among young people.

Design: A regression-discontinuity (RD) approach was applied to victimization data from the Canadian Uniform Crime Reporting 2 (UCR2) Incident-based survey from 2009–2013.

Participants/cases: All police-reported violent victimization events (females: $n = 178,566$; males: $n = 156,803$) among youth aged 14–22 years in Canada.

Measurements: Violent victimization events, primarily consisting of homicide, physical assault, sexual assault, and robbery.

Results: In comparison to youth slightly younger than the drinking age, both males and females slightly older than MLDA had significant and immediate increases in police-reported violent victimization events (females: 13.5%, 95% CI: 7.5%–19.5%, $p < 0.001$; males: 11.6%, 95% CI: 6.6%–16.7%, $p < 0.001$). Victimization occurring in the evening rose sharply immediately after the MLDA by 22.8% (95% CI: 9.9%–35.7%, $p = 0.001$) for females and 19.3% (95% CI: 11.5%–27.2%, $p < 0.001$) for males. Increases in violent victimization immediately after MLDA were most prominent in bar/restaurant/open-air settings, with victimizations rising sharply by 44.9% (95% CI: 29.5%–60.2%, $p < 0.001$) among females and 18.3% (95% CI: 7.7%–29.0%, $p = 0.001$) among males.

Conclusions: Young people gaining minimum legal drinking age incur immediate increases in police-reported violent victimizations, especially those occurring in the evening and at bar/restaurant/open-air settings. Evidence suggests that increasing the MLDA may attenuate patterns of violent victimization in newly restricted age groups.

1. Introduction

Alcohol use is a primary contributor to the global burden of morbidity and mortality of youth and young adults (Mokdad et al., 2016). To reduce such harms, many countries have implemented minimum legal drinking age (MLDA) laws. In Canada, the site of the current study, MLDA laws are controlled provincially, with Alberta, Manitoba, and Quebec maintaining an MLDA of 18 years, and the remainder of the provinces and territories imposing an age of 19 years. There is a large body of research demonstrating that age-based alcohol laws can reduce

alcohol-related harms in restricted age groups (Wagenaar and Toomey, 2002; Wechsler and Nelson, 2010). However, this literature primarily has focused on the impacts of MLDA laws on alcohol use, especially hazardous drinking and alcohol-related motor vehicle collisions (Wagenaar and Toomey, 2002; DeJong and Blanchette, 2014), while other major alcohol-related harms have received less attention.

At this time, renewed public policy debates are occurring in a number of countries about the effectiveness and most appropriate age set-point of drinking-age legislation (Giesbrecht et al., 2013; Kyprri et al., 2006; Yörük and Yörük, 2011; Amethyst Initiative: Rethink the

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Drinking Age, 2013; DeJong and Blanchette, 2014; Pitts et al., 2014). In Canada, almost all recent changes to the provincial MLDA occurred in the mid-to-late 1970's, and these legislated MLDA ages—18 years old in Alberta, Manitoba and Quebec and 19 years old for the rest of Canada—have remained unchanged since that decade. Recently, the Canadian Public Health Association (CPHA) and a national alcohol-policy coalition have recommended raising the MLDA across all provinces to at least 19 years of age (Canadian Public Health Association (CPHA), 2011; Giesbrecht et al., 2013) or—ideally—to 21 years of age (Giesbrecht et al., 2013). However, several provinces have implemented initiatives to “modernize” alcohol control policies in order to increase sales by measures such as increasing consumer access and expanding privatization of sales (Manitoba Liquor and Gaming Regulatory Consultation Committee, 2012; British Columbia Ministry of Justice, 2013; Government of Saskatchewan, 2013).

Understanding how MLDA laws might have an impact on criminal victimization among young people is critically important. Criminal victimization imposes a substantial burden on Canadian society, accounting for an estimated cost of \$12.7 billion (in year 2009 dollars) in tangible (e.g., justice system, victim, and third-party costs) and intangible (e.g., pain and suffering) costs (Hoddenbagh et al., 2014). Young people aged 15–24 years have the highest levels of victimization in Canada (Perreault, 2015). Given that alcohol use, especially binge drinking, can facilitate the occurrence of victimization among young drinkers (Wells and Thompson, 2009; Perreault, 2015), it seems reasonable to expect that MLDA restrictions (which aim to limit alcohol consumption in the youth population) might have an impact on victimization events among young people, especially as more restrictive alcohol policies are associated with reduced population levels of victimization (Naimi et al., 2017).

Evidence on the impacts of MLDA laws on victimization, however, is currently mixed. The relevant studies in the literature have presented inconsistent patterns: six demonstrated expected results, with alcohol-related victimization being significantly related to minimum age laws or release from drinking age restrictions (Jones et al., 1992; Parker, 1995; Carpenter and Dobkin, 2017; Grucza et al., 2012; Callaghan et al., 2013b; Kypri et al., 2014); two showed null results, demonstrating no evidence of relation between drinking-age laws and patterns of victimization (Hingson et al., 1985; Callaghan et al., 2013a); and one study provided unexpected findings, with implementation of higher MLDA laws being associated with higher self-reported victimization events among alcohol-restricted groups (Davis and Reynolds, 1990).

Almost all of the available studies have based their victimization outcomes on assault-related presentations to inpatient/emergency department settings or homicide records, and the current study aims to broaden the focus of the existing literature by using a population-based quasi-experimental design to assess the impacts of Canadian MLDA laws on all police-reported violent victimization events in Canada from 2009 to 2013. We expected that in comparison to youth slightly younger than the drinking age, those older individuals would have significant increases in police-reported violent victimization events occurring immediately after release from MLDA laws.

2. Material and methods

2.1. Data source

The current study used the Victim File of the Uniform Crime Reporting 2 (UCR2) Incident-Based Survey (Canadian Centre for Justice Statistics (CCJS), 2013), managed by the Canadian Centre for Justice Statistics (CCJS), Statistics Canada. The UCR2 captures details of all reported criminal incidents in Canada that have been substantiated by police (Canadian Centre for Justice Statistics (CCJS), 2013). The catchment areas of the UCR-reporting police services capture approximately 100% of the Canadian population (Fetter, 2009). Data are collected on a monthly basis from municipal, provincial/territorial and

federal police administrative files (Canadian Centre for Justice Statistics (CCJS), 2013).

Demographic characteristics of those targeted by violent offenses and details of the event are collected in the Victim File of the UCR2, with a victim defined as a “person who is the target of a violent or aggressive action or threat” (Canadian Centre for Justice Statistics (CCJS), 2013). Should multiple victimization offenses to an individual occur within a single criminal incident, the UCR2 identifies the most serious offense as designated by officials (Fetter, 2009). The CCJS relies on police to determine who is an accused and who is a victim in any altercation (P. Walsh, Personal communication). In some situations, like a fight, the accused may also be a victim. In this type of situation, the scoring rules for the UCR survey are as follows. Two incident reports are created: one with Person A as the accused and Person B as the victim, and another with Person A as the victim and Person B as the accused. The same person cannot be both the accused and the victim on one criminal incident report. In UCR2-based crime statistics, this amounts to a count of two assaults, as counts for violent crime are based on the number of victims (P. Walsh, Personal communication). The analytic approach in the current study worked upon counts of victims, as opposed to counts of criminal incidents.

The CCJS employs a systematic procedure for editing and checking the records for potential errors, and the criminal incidents flagged with potential errors are returned to the submitting police force for review (Fetter, 2009). Less than 0.5% of records are flagged as a result of potential data entry or reporting errors (Fetter, 2009). In addition, the CCJS returns a specific police service master annual file of criminal and victimization incidents to each police service to review against their own internal files and to approve before the CCJS finalizes the annual national UCR2 master file (Fetter, 2009).

2.2. Primary outcome: Violent victimization

The study focused on violent victimization as the primary outcome because of the well-substantiated link between alcohol use, aggression, violence, and victimization (Shepherd et al., 2006; Giancola et al., 2009; Boden et al., 2012). Consistent with a recent Statistics Canada approach (Perreault, 2015), the current study used an aggregated violent victimization category as the primary outcome, including: homicide, assault, sexual assault, robbery, or other violent victimization, as defined in the UCR2 (Canadian Centre for Justice Statistics (CCJS), 2013).

2.3. Time- and setting-specific outcomes: Violent victimization

Given that the UCR2 does not include any assessment related to alcohol involvement in the victimization event, we employed two approaches to identify possible alcohol-related victimizations.

2.3.1. Time-specific victimizations: evening

Prior research has used evening indicators as proxies for the identification of alcohol involvement in a range of health outcomes (Flynn and Wells, 2013), including alcohol-related motor vehicle crashes (Voas et al., 2009; Callaghan et al., 2014a) and alcohol-related injury presentations to emergency department settings (Young et al., 2004). We defined evening as the span from 10:00 p.m. to 6:59 a.m.

2.3.2. Setting-specific victimizations: bar, restaurant, open-air settings

Secondly, we selected victimization events occurring at bar, restaurant, or open-air settings as potential proxies for alcohol-involved victimizations. Bar and restaurant settings are usually associated with increased likelihood of exposure to potential aggressors, conflictual social interactions, and victimization (Wells et al., 2005; Graham et al., 2006; Perreault, 2015; Gruenewald et al., 2015). Open-air settings (as defined in the UCR2) capture the public spaces (e.g., sidewalks, parking lots) surrounding such drinking establishments where victimization

Table 1

Absolute and relative effects of release from MLDA restrictions on violent victimizations, across all settings/times, evening hours, and bar/restaurant/open-air settings.

	Absolute Effect ^a			Relative Effect ^b		
	All Settings/Times ^c	Evening Setting ^d	Bar, Restaurant, Open-air Setting ^e	All Settings/Times	Evening Setting	Bar, Restaurant, Open-air Setting
Analyses with all data points						
Female	57.7 (31.9-83.5)**	44.3 (19.3-69.3)**	41.9 (27.5-56.2)**	13.5% (7.5%-19.5%)**	22.8% (9.9%-35.7%)**	44.9% (29.5%-60.2%)**
Male	43.6 (24.8-62.3)**	33.6 (20.1-47.1)**	27.9 (11.7-44.0)**	11.6% (6.6%-16.7%)**	19.3% (11.5%-27.2%)**	18.3% (7.7%-29.0%)**
Total	99.7 (63.2-136.3)**	78.9 (44.6-113.2)**	64.8 (41.6-87.9)**	12.4% (7.9%-16.9%)**	21.4% (12.1%-30.8%)**	26.3% (16.9%-35.7%)**
Analyses with birthday-week values removed ^f						
Female	45.1 (28.0-62.2)**	30.8 (15.1-46.4)**	33.7 (22.6-44.7)**	10.5% (6.5-14.5)**	15.8% (7.7-23.9)**	36.1% (24.3-47.8)**
Male	38.2 (20.5-55.8)**	28.0 (17.8-38.3)**	18.5 (4.1-33.0)**	10.2% (5.5-14.9)**	16.1% (10.2-22.2)**	12.0% (2.6-21.4)**
Total	81.4 (57.8-105.0)**	58.8 (41.3-76.4)**	51.4 (35.0-67.7)**	10.1% (7.2-13.1)**	16.0% (11.2-20.8)**	20.9%(14.2-27.5)**

^a Jump in number of victimization incidents per week immediately following the MLDA.

^b Jump in percentage (%) of victimization incidents per week immediately following the MLDA.

^c Includes all violent victimization incidents across all settings and times.

^d Evening was defined as the period from 22:00-6:59 h. Violent victimization events occurring in the evening served as proxies for alcohol-involved violent victimization incidents.

^e Violent victimization events occurring in bar/restaurant/open-air settings served as a proxy for alcohol-involved violent victimization events.

^f The regression-discontinuity results in this section do not include the birthday-week values in the data series, given the pronounced birthday-week effects (as seen in Fig. 1).

** $p < 0.001$.

* $p < 0.05$.

events frequently culminate.

2.4. Victim age

The UCR2 Victim Files captured the exact age of the victim at time of victimization. We centered each victim's exact age into age-in-weeks in relation to the MLDA.

2.5. Analytic plan

2.5.1. Regression-discontinuity

We employed a regression-discontinuity (RD) design (Thistlethwaite and Campbell, 1960; Shadish et al., 2002)—a quasi-experimental approach which can provide credible estimates of the causal effect of an intervention on a specified outcome (Lee and Lemieux, 2009). The RD design takes advantage of the sharp discontinuity in the legality of alcohol purchasing and consumption appearing at the MLDA; our approach assigns individuals younger than the MLDA to the "alcohol-restricted" group and young adults no longer subject to the MLDA to the "alcohol-accessible" group. The primary, intuitive idea of the RD approach is that individuals slightly older than the MLDA and those slightly younger than the MLDA will be similar on observed (and unobserved) characteristics—except for the influence of the removal of the MLDA in the alcohol-accessible group. The RD design assumes that all observed and unobserved variables (which might influence the violent victimization outcomes) are smoothly distributed across the age-cutoff (Hahn et al., 2001), and the effects of the MLDA can be inferred if the regression line shows a discontinuity at the MLDA (Imbens and Lemieux, 2007). Since the observed and unobserved determinants of the violent victimization outcomes (other than the legal granting of access to alcohol) are likely to be distributed smoothly across the MLDA threshold, any sharp increases in the number of violent victimization incidents immediately following the MLDA can reasonably be attributed to release from MLDA restrictions.

2.5.2. Primary RD analyses: non-parametric local regression

In our primary nonparametric local regression analyses, we used a recent approach (Calonico et al., 2014) implemented in the R package—rdrobust (Calonico et al., 2017; R Core Team, 2014)—to fit the robust RD models with bias correction. We also used the triangular kernel weighting approach and a recently proposed strategy for

identifying the optimum bandwidth in the local regression series (Calonico et al., 2014). All RD analyses were stratified by gender and aggregated at the national level. The RD non-parametric local regression models were based upon age-in-weeks' victimization data spanning four years prior to and four years following the MLDA.

In the RD analyses, we chose to analyze violent victimization counts for two reasons. First, the denominator for each age-in-weeks bin cannot be calculated (or imputed accurately) from population statistics – that is, Statistics Canada does not provide population estimates for finely grained age-in-weeks categories across age groups. Secondly, the use of current census-based population estimates are available only for each age-in-years groupings. As a result, the calculation of rates based on age-in-years estimates might bias the estimate of the "jump" immediately after the MLDA because these population-estimate denominators change exactly at the location in which the RD analyses estimate the magnitude of the "jump." The use of count data avoids this particular potential bias.

2.5.3. Sensitivity analyses

To assess the reliability of our primary models, we undertook a series of local regression models with varying weighting approaches (i.e., triangular kernel versus uniform kernel), functional forms (i.e., linear versus quadratic), and bandwidth selection strategies. In addition, to assess the reliability of our primary results, we also used linear parametric regression models with a restricted range of 26 points (age-in-weeks) before and after the MLDA to model the impact of the MLDA on the violent victimization outcomes. Given that estimates of the impacts of the MLDA may be confounded with the effects of hazardous birthday drinking at the MLDA (Callaghan et al., 2014b), the primary local linear regression models were re-run without the MLDA birthday-week values.

3. Results

In the UCR2 database (2009–2013), there were 424,528 victimization events among 14-22-year-old males and females, with 79.0% designated as violent victimization incidents (total: $n = 335,369$; females: $n = 178,566$). Among females, 43.5% of all violent victimization episodes occurred in evening hours as compared to 56.5% in the daytime, and 23.6% of all violent victimization incidents occurred in bar/restaurant/open-air settings. Among males, 43.6% of all violent

victimization incidents occurred during the evening, and 29.8% occurred in bar, restaurant, or open-air settings.

Table 1 demonstrates the main results from the regression-discontinuity analyses. In comparison to females slightly younger than the MLDA, those just older experienced significant and immediate increases in violent victimization across all locations (13.5%, 95% CI: 7.5%–19.5%, $p < 0.001$; see Table 1). Also, males slightly older than the MLDA experienced abrupt increases in violent victimization across all settings (11.6%, 95% CI: 6.6%–16.7%, $p < 0.001$). In the evening period, females experienced sharp increases in violent victimization immediately following the MLDA (22.8%, 95% CI: 9.9%–35.7%, $p = 0.001$), and so did males (19.3%, 95% CI: 11.5%–27.2%, $p < 0.001$). In comparison to females slightly younger than the MLDA, those just older experienced increases in violent victimization in bars, restaurants, or open-air areas (44.9%, 95% CI: 29.5%–60.2%, $p < 0.001$). Males slightly older than the MLDA incurred increases in violent victimization in these three specific contexts, as well (18.3%, 95% CI: 7.7%–29.0%, $p < 0.001$). Removal of birthday-week values from the regression-discontinuity analyses produces similar patterns of statistical significance as the primary analyses, but with somewhat attenuated post-MLDA “jump” sizes (see Table 1).

Figs. 1–3 demonstrate discrete “jumps” in violent victimization immediately after release from MLDA restrictions among females and males, as well as in the combined (“total”) male-female sample. On the X-axes, Figs. 1–3 span 100 weeks prior to and following the MLDA for simplicity in the depiction of the results.

The pre-MLDA “baseline” rate of outcome events was 19.1 (95% CI 18.7–19.5) violent victimizations, 8.4 (95% CI 8.1–8.6) evening violent victimizations, and 5.7 (95% CI 5.5–6.0) violent victimizations occurring in bar/restaurant/open-air setting per 1000 person years in the Canadian population of youth 17 years old in Alberta, Manitoba and Québec, and 18 years in the rest of the country. These estimates were generated from the yearly average of the counts of police-reported violent victimization events from the UCR-2 (2009–2013) and Canadian Census statistics from 2011 (Statistics Canada, 2012).

3.1. Sensitivity analyses

Based on a different series of local regression models predicting the primary violent victimization outcome with varying weighting

approaches, functional forms, bandwidth selection strategies, the results of our sensitivity analyses demonstrated similar estimates and statistical significance associated with the “jump” in the primary outcome across all violent victimization events, as well as across nighttime and bar/restaurant/open-air settings. Linear parametric regression models with a restricted range of 26 points (age-in-weeks) before and after the MLDA also produced similar results as our primary local regression modeling. As a result, the sensitivity analyses demonstrated that our primary results (presented in Table 1) were robust to a range of variations in the RD modeling process. These results are not shown, but available from the corresponding author.

4. Discussion

The current study demonstrates that release from MLDA laws is associated with significant and immediate increases in violent victimization among young people. In comparison to young men and women younger than the MLDA, those just older experienced abrupt increases in violent victimization events (males: 11.6%; females: 13.5%), with prominent increases in violent victimization events occurring immediately following the MLDA in bar/restaurant/open-air settings and during nighttime periods.

A number of factors undermine the direct comparison of the current results with those from the prior relevant literature: varying study designs; different statistical approaches; diverse definitions of victimization outcomes; and lack of inclusion of gender-specific estimates in some studies. In the available four regression-discontinuity studies, however, the majority of RD estimates (4 out of 5) demonstrated that young men gaining the legal age incur immediate and significant increases of 6.2% (Carpenter and Dobkin, 2017); 8.3% (Callaghan et al., 2013b), 11.6% (the current study), and 15.7% (Carpenter and Dobkin, 2017) in serious victimization events (defined either as assault conditions in inpatient hospital/emergency department settings or violent victimization events in police reports). For women, the RD results are more mixed: only the findings from the current study and a prior study using Ontario inpatient/emergency department records found that release from MLDA restrictions was associated with significant increases of 8.1% and 13.5% in hospital-based assault conditions or police-reported violent victimization events, respectively (the current study; Callaghan et al., 2013b). The remaining three estimates from two

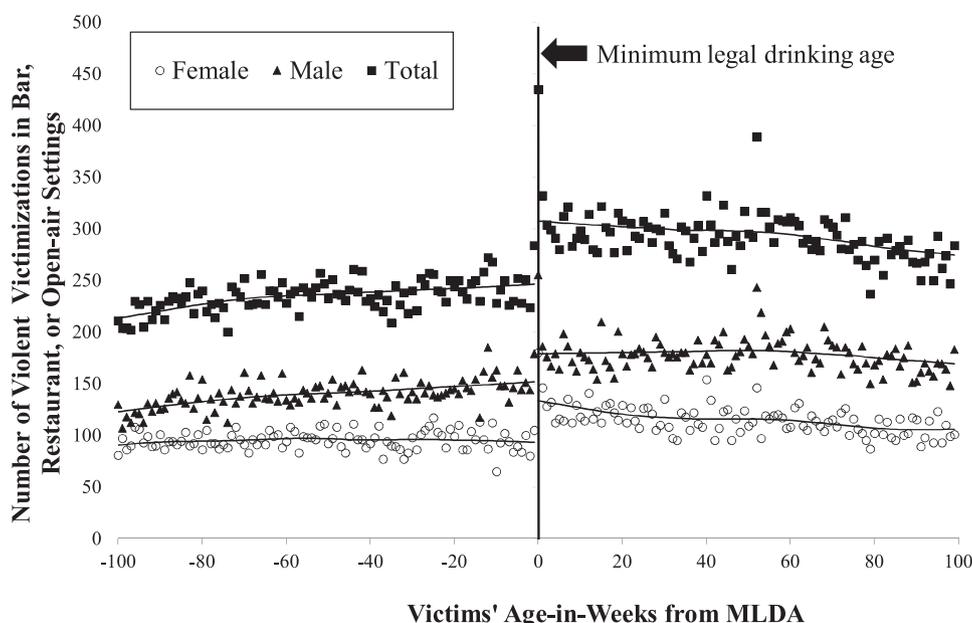


Fig. 1. Incidents of violent victimization in the Uniform Crime Reporting Survey 2 (2009–2013), across victims' age-in-weeks centered at “0” representing the minimum legal drinking age.

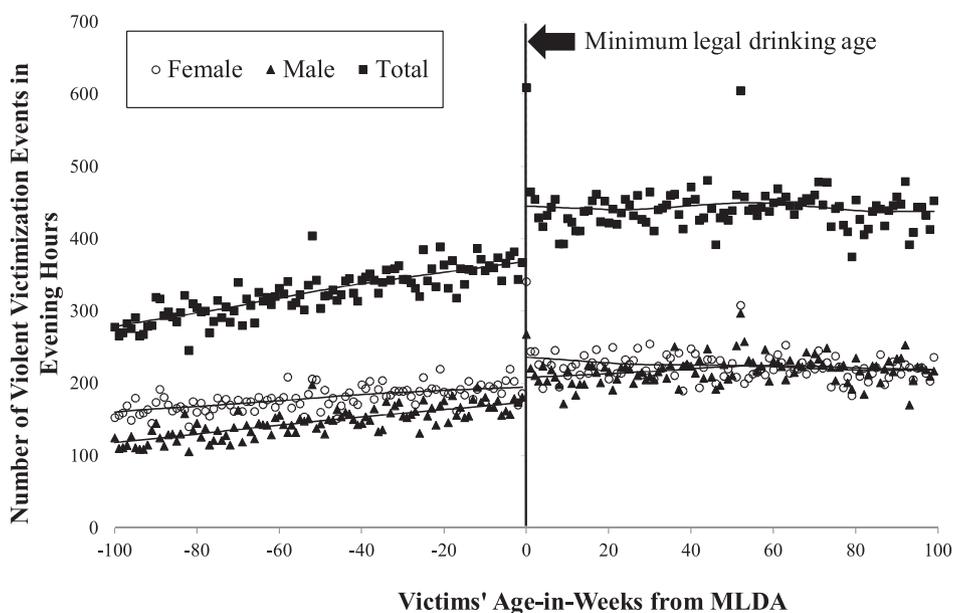


Fig. 2. Incidents of violent victimization occurring in the evening (22:00–06:59 on the date of the incident), across victims' age-in-weeks centered at "0" representing the minimum legal drinking age.

studies (Carpenter and Dobkin, 2017; Callaghan et al., 2013a) show no evidence of significant changes in violent victimization events in females immediately following the MLDA.

In the current study, drinking-age laws might have influenced violent victimization patterns through a number of mechanisms. Prior research has demonstrated that release from drinking age restrictions is associated with significant increases in population-level youth alcohol consumption, especially hazardous drinking (Carpenter and Dobkin, 2015; Carpenter et al., 2016). Intoxicated youth become more suitable targets for violent victimization, as alcohol impairment reduces an individual's ability to assess and avoid potentially violent situations (Wells and Thompson, 2009). In addition, alcohol intoxication may facilitate behavior which can trigger perpetrator aggression (Godlaski and Giancola, 2009; Heinz et al., 2011). Transition across the drinking age appears to be associated with changes in drinking context from

private to public drinking locations (Gruenewald et al., 2015), which are associated with increased likelihood of victimization (Wells et al., 2005; Graham et al., 2006; Perreault, 2015; Gruenewald et al., 2015). It seems reasonable to argue that the MLDA may reduce violent victimization in underage groups through the law's impact in reducing youth population-level alcohol consumption and in restricting access to public drinking settings (e.g., bars, nightclubs) in which victimization might be more likely to occur.

Given that our results demonstrate that aging out of MLDA restrictions is associated with significant increases in violent victimization appearing immediately after the MLDA for both males and females, the current study contributes to the literature in this area. At least in our understanding, only two prior studies have shown that MLDA legislation has an impact on female violent victimization or homicide (Gruza et al., 2012; Callaghan et al., 2013). This lack of evidence of the



Fig. 3. Incidents of violent victimization occurring at bars, restaurants, or open-air settings, across victims' age-in-weeks centered at "0" representing the minimum legal drinking age.

MLDA's effect on female victimization may be due to a number of factors, including approaches which aggregated all victimization outcome data across gender in study analyses (Hingson et al., 1985; Jones et al., 1992; Parker, 1995) or the use of inpatient hospital admissions, emergency department contacts or homicide records to identify assault-related events (Carpenter and Dobkin, 2017; Callaghan et al., 2013; Kypri et al., 2014) — sources of outcome data which may not be sensitive enough in the studies' contexts to reliably detect changes in female victimization associated with drinking-age laws. Prior research indicates that different risk factors for males and females typically are involved in drinking-related victimization (Lauritsen and Carbone-Lopez, 2011). Males are more likely to experience violent victimization than females as a result of their own violent deviant behavior involving drug and/or alcohol use or their own provocation of aggression by use of aggression, whereas females incur higher levels of victimization overall than males, despite exhibiting less violent deviant behaviors (Zaykowski and Gunter, 2013). Further, the transition from private to public drinking settings for females may contribute in a more prominent way to the observed increases in violent victimization, as a number of studies have shown that bar/nightclub settings are associated with high levels of female victimization (usually by male perpetrators) (Graham et al., 2017). Given the possibility that MLDA laws may influence violent victimization through different pathways for males and females, future research may want to explore this issue.

MLDA laws appear to reduce patterns of alcohol consumption and a broad range of alcohol-related harms in underage groups, and release from MLDA restrictions is associated with immediate increases in a wide range of adverse alcohol-related consequences (Carpenter et al., 2016; Callaghan et al., 2013a; Carpenter and Dobkin, 2017; Callaghan et al., 2013b, a; Callaghan et al., 2016b; Gatley et al., 2017; Callaghan et al., 2014a). While there is persuasive evidence that increasing the minimum legal drinking age will reduce patterns of alcohol consumption and alcohol-related harms in age-restricted youth (for reviews, see Wagenaar and Toomey, 2002; DeJong and Blanchette, 2014), there is a much less developed literature addressing whether MLDA laws might be associated with longer-term net decreases in alcohol-related consequences in the adult population. Nonetheless, a reasonable argument can be made that MLDA laws likely effect subsequent reductions in alcohol-related harms in the adult population by reducing youth frequency of drinking, heavy episodic drinking, and problematic drinking (drinking causing alcohol-related problems) – three patterns of youth alcohol consumption which are significantly associated with serious alcohol-related harms in adulthood. For example, two recent cohort studies (Guttmanova et al., 2011; Silins et al., 2018) following individuals from early adolescence until their early thirties found that drinking frequency, heavy episodic drinking, and problematic drinking during adolescence and young adulthood (up to 21 years) were significantly related to a range of deleterious alcohol-related consequences later in adulthood, such as binge drinking, alcohol dependence (and persistence of alcohol dependence across survey assessment waves), higher levels of alcohol-related problems, and alcohol-impaired driving. In addition, some studies have shown that exposure to more permissive MLDA laws is associated with harmful alcohol-related consequences in later adulthood, including persistent patterns of binge drinking (Plunk et al., 2013) and alcohol dependence (Norberg et al., 2009).

Study findings need to be interpreted in light of a number of limitations. UCR2 data does not include information about alcohol involvement in victimization events. Nonetheless, the regression-discontinuity approach assumes that potentially confounding variables are smoothly distributed across the MLDA cutoff and that any observed increase occurring immediately after the MLDA can be inferred to be a direct result of release from MLDA restrictions. In addition, our results showed significant and immediate increases after the MLDA in violent victimization events occurring at nighttime and at bar/restaurant/open-air settings – time- and setting-specific RD analyses meant to capture alcohol-involved victimizations. Given that late adolescence

and early adulthood is a time of significant life transitions, it is possible that changes associated with such periods [e.g., in educational attainment, living status (e.g., living at home with parents), socioeconomic status] may have affected our results. However, it seems unlikely that such life-transition variables would have strongly influenced our estimates of MLDA impacts because young people near the MLDA transition were separated by only a small number of weeks in age. Nonetheless, the possibility of confounding by these lifestyle variables increases as the timespan in age-in-weeks from the MLDA increases. It is not possible to untangle the potential confound between the direct effects of release from drinking age laws from the concomitant effects of gaining of legal access to bar and nightclub settings—locations which likely carry a greater likelihood for victimization. The probabilities of reporting victimization to police may vary across settings. For example, violent victimizations occurring in public settings may have a higher likelihood of being reported to police than violent victimizations occurring in private settings. Drinking contexts tend to change from private to public settings immediately after the MLDA for young adults (Gruenewald et al., 2015), and such changes might elevate the reporting probabilities of violent victimizations rather than the actual rate of violent victimization occurrence in the population. Nonetheless, our RD analyses within the bar/restaurant/open-air setting showed significant and immediate increases immediately following the MLDA (see Fig. 3) – an effect unlikely to have been influenced by changes in setting-based reporting probabilities across the MLDA. Also, the study relied on police-reported victimization events, which likely comprise only approximately one-third (31%) of all violent victimizations that actually occur (Allen, 2016).

5. Conclusions

Despite these limitations, the current study demonstrates that release from MLDA restrictions is associated with significant and immediate increases in male and female violent victimizations, especially in those events occurring at bar/restaurant/open-air settings and at nighttime periods. Given the current tension between expert-panel recommendations for more restrictive alcohol policies to improve public health and Canadian provincial efforts to liberalize alcohol policies (Giesbrecht, et al., 2013), the current study can contribute to the ongoing policy discussions by showing that restrictive alcohol minimum-age laws are associated with attenuated patterns of violent victimizations in alcohol-restricted age groups.

Contributors

Claire Benny provided substantial contributions to the initial stages of the manuscript, literature review, interpretation of the data and the preparation and revision of important content in the final version of the manuscript. Jodi Gatley made substantial contributions to the original design of the study, especially in the acquisition of the data and drafting the initial draft of the guiding research plan. Marcos Sanches contributed expertise in the design of the study, and he conducted the statistical analyses. He helped to prepare and revise the manuscript, and he provided critically important insight into the interpretation of the findings. Dr. Callaghan oversaw all aspects of the study design and scientific requirements for its completion. In particular, Dr. Callaghan contributed to the conception and design of the work, as well as the acquisition, analysis and interpretation of the data. He prepared the initial manuscript and provided oversight for the final revision. All authors take responsibility for the contents of the paper and all authors approved of the final manuscript before submission.

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Conflict of interest

None of the listed authors report any conflicts of interest in relation to the submitted manuscript.

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