

Alcohol Sales and Risk of Serious Assault

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Abbreviations: CI, confidence interval; ICD-10, International Classification of Diseases 10th Revision; IQR, interquartile range; LCBO, Liquor Control Board of Ontario; RR, relative risk

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ABSTRACT

Background

Alcohol is a contributing cause of unintentional injuries, such as motor vehicle crashes. Prior research on the association between alcohol use and violent injury was limited to survey-based data, and the inclusion of cases from a single trauma centre, without adequate controls. Beyond these limitations was the inability of prior researchers to comprehensively capture most alcohol sales. In Ontario, most alcohol is sold through retail outlets run by the provincial government, and hospitals are financed under a provincial health care system. We assessed the risk of being hospitalized due to assault in association with retail alcohol sales across Ontario.

Methods and Findings

We performed a population-based case-crossover analysis of all persons aged 13 years and older hospitalized for assault in Ontario from 1 April 2002 to 1 December 2004. On the day prior to each assault case's hospitalization, the volume of alcohol sold at the store in closest proximity to the victim's home was compared to the volume of alcohol sold at the same store 7 d earlier. Conditional logistic regression analysis was used to determine the associated relative risk (RR) of assault per 1,000 l higher daily sales of alcohol. Of the 3,212 persons admitted to hospital for assault, nearly 25% were between the ages of 13 and 20 y, and 83% were male. A total of 1,150 assaults (36%) involved the use of a sharp or blunt weapon, and 1,532 (48%) arose during an unarmed brawl or fight. For every 1,000 l more of alcohol sold per store per day, the relative risk of being hospitalized for assault was 1.13 (95% confidence interval [CI] 1.02–1.26). The risk was accentuated for males (1.18, 95% CI 1.05–1.33), youth aged 13 to 20 y (1.21, 95% CI 0.99–1.46), and those in urban areas (1.19, 95% CI 1.06–1.35).

Conclusions

The risk of being a victim of serious assault increases with alcohol sales, especially among young urban men. Akin to reducing the risk of driving while impaired, consideration should be given to novel methods of preventing alcohol-related violence.

The Editors' Summary of this article follows the references.



Introduction

Intentional injury is a widespread cause of death, disability, property damage, demand for emergency medical service, and grief [1]. One major precipitant is interpersonal conflict [2], whose risk factors include male gender, young adult age, and low socioeconomic status [1]. A person's risk of intentional injury is not fully explained by these factors, however.

Alcohol is the most commonly purchased and consumed psychoactive substance in the Western world [3]. A chief determinant of its use is its ease of access [4]. The role of alcohol is undisputed in unintentional injuries such as motor vehicle crashes [5,6]; however, its role is less certain in intentional injuries. While there is more than a 12-fold higher risk of committing a criminally violent act within 24 h of alcohol consumption, preliminary data also suggest that recent alcohol intake is prevalent among victims of intentional injury [7]. Alcohol may impair both judgment [8] and the interpretation of facial expressions of others [9], and may place persons at higher risk of being pushed, hit, or assaulted [10].

We wondered whether prior research on the association between alcohol use and violent injury might be biased because of its reliance on survey-based or archival data such as police reports and emergency room visits (where respondents may underestimate their true alcohol consumption), the inclusion of cases from a single trauma centre, and the absence of adequate controls or the high likelihood of between-person confounding (i.e., factors that vary among persons) [11]. Herein we test the hypothesis that the risk of being hospitalized due to assault increases in relation to alcohol sales in the immediate vicinity of a person's place of residence.

Methods

Setting

We conducted a retrospective population-based case-crossover study in Ontario, Canada between 1 April 2002 and 1 December 2004 [12,13]. Ontario was selected because it is Canada's largest province (accounting for about one-third of the country's entire population of 35 million individuals). In addition, Ontario provides remarkable access to detailed computerized medical records, and has infrastructure for tracking total alcohol sales each day. The 32-mo period of study was selected because it reflected all data on alcohol sales available for analysis. Together, our study strategy encompassed all outlets run by the Liquor Control Board of Ontario (LCBO) in the province.

Assault Cases

Cases were defined as consecutive adult victims of assault aged 13 y and older who were admitted to an Ontario acute care hospital during the study interval. We excluded individuals who were below age 13 y because of the differing nature of assault in paediatric populations. We also excluded individuals who were not residents of Ontario or had no linkable health care file because of database limitations. Cases with more than one hospitalization were counted at the first admission only. Our study did not rely on individual-level consent, and followed safeguards for patient confidentiality at the Institute for Clinical Evaluative Sciences in Ontario. The Ethics Committees of St. Michael's Hospital and the Sunnybrook Health Sciences Centre granted approval for this study.

Injuries

The Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD) captured all hospitalizations in Ontario and up to 25 diagnoses coded by International Classification of Diseases 10th Revision (ICD-10). We identified cases using ICD-10 codes for external causes of morbidity and mortality related to assault. The specific codes were X85 to Y09 (<http://www.who.int/classifications/apps/icd/icd10online>; accessed 1 June 2006). These codes are estimated to capture the specific cause of injury in about 80%–85% of cases, with correct definition of the broad cause of injury in approximately 90% of cases [14,15]. We also subclassified intentional injuries due to assault by a sharp or blunt object (ICD-10 C99 and Y00), bodily force (ICD-10 Y04), sexual assault (ICD-10 Y05), or maltreatment by a domestic partner (ICD-10 Y07.0).

Demographics

The CIHI DAD was combined with the Ontario Registered Persons Database to yield basic information about the individual, such as age and sex. The patient's home postal code corresponded to the home residence location at the time of the injury. Income quintile and rural residence were defined according to the individual's home postal code using Statistics Canada census data. Patient length-of-stay was obtained as the difference between the admission date and discharge date, with stays shorter than 24 h coded as 1 d. Discharge status was coded as alive or dead, with no analysis of long-term institutionalization or rehabilitation.

Alcohol Sales

The study exposure was the daily sales of alcohol at the closest LCBO store to the patient on the day before the assault hospitalization. No alcohol can be consumed on the premises of an LCBO store. In Ontario, the sale of alcohol is regulated by provincial statute, with a legal lower limit of 19 y. All spirits, about 85% of total wine, and about 20% of all beer are sold to non-wholesale purchasers by nearly 600 LCBO retail outlets run by the provincial government [16,17]. Thus, LCBO data provide the sale of all spirits, most wine, and about one-fifth of all beer sales to individuals in Ontario. These data are otherwise complete, do not rely on individual self-report, and serve as the official record for revenue and taxation purposes [16,17].

Locality

Each LCBO sales outlet has an assigned location and postal code. We used Geographic Information System software (ARC 9.1, Environmental Systems Research Institute) to determine the straight-line distance between each LCBO outlet's postal code and each patient's home postal code [18]. The most proximate store was then selected for each case using the Synchronous Network Architecture Planning (SNAP) function. This approach provides a means of assessing total alcohol sales in the vicinity of, and around the time of, injury, independent of the nature of the patient's injuries. It does not account for nuances related to roadway layout or shopping patterns.

Design

The case-crossover design compared exposures immediately prior to the injury times to the same exposures at control times. Doing so provided an assessment of the short-

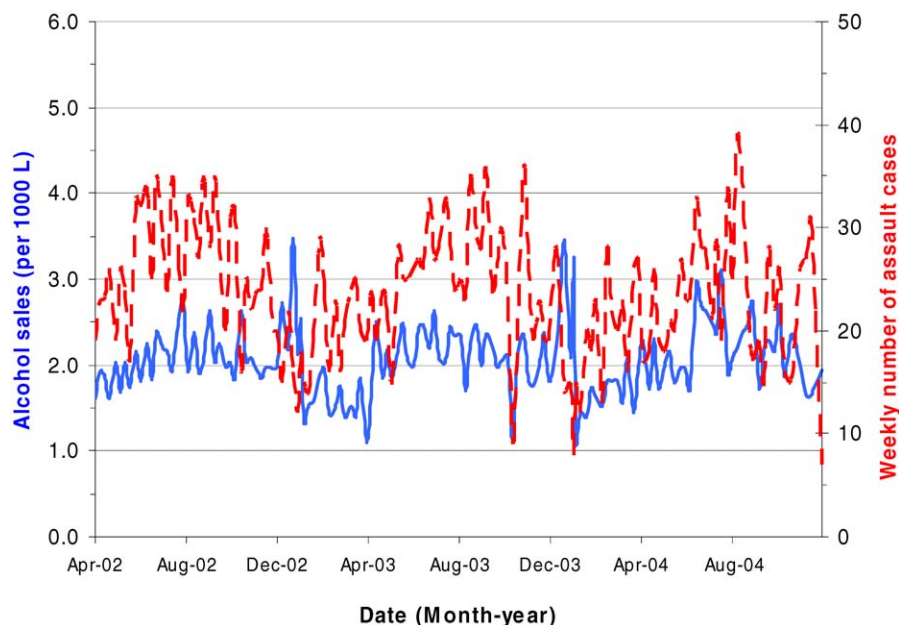


Figure 1. Mean Alcohol Sales (Blue) and Weekly Number of Hospitalized Assaults (Dashed Red)
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term effect of transient exposure on the risk of injury, and minimizes between-person confounding, since a “case” acts as his or her own control [19]. In this study, the exposure was defined as the total volume of alcohol sold at the LCBO store in closest proximity to the patient’s home 1 d before hospitalization. This was compared to the volume of alcohol sold at the same store 7 d earlier. For example, an assault admission on Sunday 24 July 2003 would compare total alcohol sales on Saturday 23 July 2003 to Saturday 16 July 2003. Doing so implicitly controls for multiple confounders such as location, season, weekend peaks, and prices [12,13]. We considered alcohol sales the day before the assault based on the notion that the alcohol would be ingested on the day and/or evening of its purchase, and that the assault admission would follow after midnight (i.e., the next calendar day) [20]. We had no method of recording the victims’ blood alcohol level, nor could they be questioned about their alcohol consumption or that of the perpetrator. We could not capture alcohol purchased at a bar or pub.

Statistics

We excluded the top and bottom 1% of alcohol sales for combined outlets to address extreme outliers, such as early store closures, when sales are abnormally low, or at times of peak sales, such as at Christmas time. The median and interquartile range (IQR) of daily alcohol sales per store were calculated in both litres (l) and 2004 Canadian dollars (Can\$), and their 10th and 90th percentile values were used to represent nadir and peak sales [21]. We used conditional logistic regression to determine the association between a hospitalization for assault and the daily sale of alcohol, per 1,000-l unit increments. We also expressed this in association with each Can\$10,000 increment of daily alcohol sales. A relative risk (RR) and 95% confidence interval (CI) was used to express this relationship [12]. Bivariate analyses were also stratified by the type of alcohol sold (liquor, wine, or beer), as

well as demographic variables. All *p*-values were two-sided, at a significance level of 0.05. All statistical analyses were performed using SAS for UNIX, Version 9.1 (SAS Institute).

Results

There were 3,903 youths and adults hospitalized due to assault during the 32-mo study period, equivalent to a rate of four per day. Of these, 15 were excluded because they resided outside Ontario, 419 could not be matched to an LCBO outlet by postal code, and 257 cases had extreme outlier LCBO sales data on the index date, the referent date, or both. This resulted in a study cohort of 3,212 cases. The number of patients was generally steady over time, with a peak between July and October of each year (Figure 1). Specifically around the December holidays, while alcohol sales rose considerably, there was a relative decline in assault cases (Figure 1).

The mean age of the cases was 32.5 y, of whom nearly 25% were between the ages of 13 and 20 y, and 83% were male (Table 1). A total of 1.5% patients died from their injuries during the hospital admission.

Among the 491 LCBO outlets closest to an assault case, the median daily volume of alcohol sales per store was 971 l, amounting to Can\$8,597 per day (Table 1). Sales peaks appeared in July and December of each year. As expected, substantial day-to-day and week-to-week variation in sales was observed (Figure 1). The most popular alcohol by volume was beer and the most expensive was spirits (Table 1).

Case-crossover analysis suggested that increasing alcohol sales was associated with a 13% (95% CI 2%–26%) higher relative risk of being hospitalized for assault for every 1,000 l more of alcohol sold per store per day (Table 2). At peak volume sales, represented by the 90th percentile value of 2,981 l for all forms of alcohol, there was a more pronounced risk of being hospitalized for assault, compared to volume sales at the 10th percentile (RR 1.41, 95% CI 1.06–1.88).

Table 1. Characteristics of Persons Hospitalized for Assault, and Descriptions of the Alcohol Sales Outlets

Category	Characteristic	Group	Value
Hospitalized cases (<i>n</i> = 3,212)	Age (y), mean (SD)	—	32.5 (14.9)
	Age (y)	13–20	772 (24.0)
		>20	2,440 (76.0)
	Males	—	2,658 (82.8)
	Urban residence	—	2,716 (84.6)
	Income quintile	1	1,057 (32.9)
		2	691 (21.5)
		3	485 (15.1)
		4	392 (12.2)
		5	321 (10.0)
	Length of stay in index hospitalization days, mean (SD)	—	5.8 (14.7)
	Discharged alive at end of index hospitalization	—	3,164 (98.5)
LCBO alcohol sales outlets (<i>n</i> = 491)	Daily alcohol sales per outlet (l), median (IQR; 90th percentile)	Spirits	239.9 (422.8; 951.6)
		Wine	242.4 (523.7; 1,099.2)
		Beer	387.8 (539.6; 1,255.1)
		All alcohol	971.0 (1,350.6; 2,981.2)
	Daily alcohol sales per outlet (Can\$), median (IQR; 90th percentile)	Spirits	4,229.3 (7,412.8; 16,025.0)
		Wine	2,203.6 (5,304.7; 11,819.5)
		Beer	1,359.5 (1,935.8; 4,505.4)
	All alcohol	8,597.0 (13,824.9; 30,033.9)	

All data are presented as a number and percent, unless otherwise specified.
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Similarly, when the 90th percentile dollar sales of all alcohol was compared to the 10th percentile sales, the RR was 1.58 (95% CI 1.18–2.14)

The increased risk of assault was evaluated for the three types of alcohol. On a volume basis, the RR was highest for spirits (1.26, 95% CI 1.02–1.55), and lowest for beer (RR 0.99, 95% CI 0.85–1.10) (Figure 2; Table 2).

Of all 3,212 assaults, 1,150 (35.8%) were related to the use of a sharp or blunt weapon (Table 3). The associated RR per 1,000 l higher sales of alcohol was 1.31 (95% CI 1.09–1.57) (Table 3). Only a small number of recorded cases were due to sexual assault or maltreatment by a spouse or partner, for which no significant association was seen in relation to alcohol sales (Table 3). The highest number of cases (*n* = 1,532) were related to an unarmed brawl or fight, which yielded a result of 1.09 (95% CI 0.94–1.27).

The higher risk of assault associated with alcohol sales was evident for individuals with differing characteristics (Figure 2). For a 1,000 l incremental rise in the daily sales of all alcohol, the risk of hospitalization was significant for males (RR 1.18, 95% CI 1.05–1.33), but not females (RR 0.89, 95% CI 0.68–1.18). Among all youth aged 13 to 20 y, this association

approached significance (RR 1.21, 95% CI 0.99–1.46) (Figure 2). In urban centres, the RR was 1.19 (95% CI 1.06–1.35).

Discussion

We observed a 13% higher risk of being hospitalized for assault with each additional 1,000 l of alcohol sold per day, equivalent to about a doubling of the usual daily sales. At peak times of alcohol sales, the risk was 41% higher, equivalent to about 1.4 additional assaults per day. About one-third of injuries were due to a sharp or blunt weapon, and were significantly associated with alcohol sales. This suggests that the cognitive impairment caused by alcohol is a factor in intentional injuries [8,9], as might be greater mixing of at-risk social groups, such as young men living in urban locations.

Our study has several limitations. First, we captured only those cases sufficiently severe to require hospitalization, but not so extensive as to lead to death at the scene. At the other extreme, some injuries may not warrant admission to hospital and are excluded from our study [22]. We examined each person as a separate case, and we do not know who had

Table 2. Risk of Assault-Related Hospitalization in Association with Daily Alcohol Sales among 3,212 Cases of Assault

Type of Alcohol	Relative Risk (95% Confidence Interval)	
	1,000 l Increase in Daily Volume of Sales per Store	\$10,000 Increase in Daily Sales per Store
Spirits	1.26 (1.02–1.55)	1.09 (0.97–1.22)
Wine	1.19 (0.97–1.46)	1.15 (0.98–1.34)
Beer	0.99 (0.85–1.10)	0.96 (0.66–1.39)
All alcohol	1.13 (1.02–1.26)	1.18 (1.06–1.31)

Definitions of assault were based on International Classification of Diseases 10th Revision (ICD-10) codes X85 to Y09.
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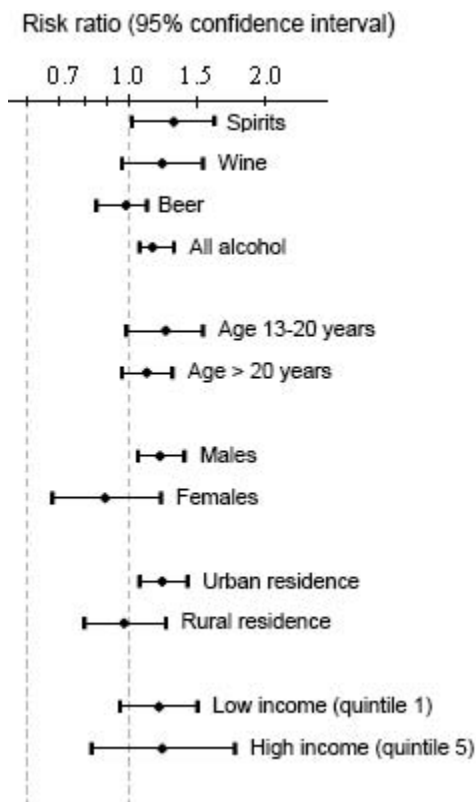


Figure 2. Risk of Hospitalization for Assault per 1,000 l Increase in Daily Alcohol Sales, According to Alcohol Type and Patient Variables
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consumed alcohol—that is, the victim of the assault, the perpetrator, or both. Moreover, we assumed the assault occurred near the patient's home residence, and we do not account for alcohol purchased at a bar, pub, or other major retail beer outlets [16,17]. We may not have detected an association between beer sales and risk of assault, since about 80% of beer is sold in non-LCBO stores. All these limitations tend to attenuate the observed relationship between alcohol sales and documented assault—hence, we probably generated conservative estimates of the true associated risk. They also emphasize that our findings likely reflect the “tip of the iceberg”—there are probably many times more alcohol-related assaults that do not require hospitalization, or that do not require medical treatment [10].

Our study also has several strengths. We measured alcohol sales in the index and referent time periods of the same store, and thereby reduced geographic or seasonal variation, an advantage of our case-crossover design [13]. Since each person serves as his or her own control, this minimizes between-person confounding related to age, sex, income, marital status, psychiatric illness, or history of alcohol overuse. Finally, we captured all assault-related hospitalizations in the entire population, and thereby can provide measures of both relative risk and absolute risk.

How well do alcohol sales reflect consumption? Smith et al. compared self-reported alcohol consumption with state-specific per capita sales in 21 states in the US [23]. The correlation coefficient (r) between per capita sales and self-reported consumption was 0.81, which extended to heavier

Table 3. Risk of Hospitalization for Assault, in Association with Daily Sales of All Forms of Alcohol, by Type of Assault

Type of Assault ^a	n (%)	RR (95% CI) per 1,000 l Increase in Daily Volume of Sales per Store
Using a sharp or blunt object ^b	1,150 (35.8)	1.31 (1.09–1.57)
Unarmed brawl or fight ^c	1,532 (47.7)	1.09 (0.94–1.27)
Sexual assault ^d	55 (1.7)	0.52 (0.13–2.18)
Maltreatment by a spouse or partner ^e	66 (2.1)	1.20 (0.33–4.31)
All other assaults	488 (15.2)	0.92 (0.69–1.24)

^aThere were 79 cases with two concomitant assault codes.

^bBased on ICD-10 codes ICD-10 X99 and Y00.

^cICD-10 code Y04.

^dICD-10 code Y05.

^eICD-10 code Y07.0.

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drinking ($r = 0.74$), binge drinking ($r = 0.59$) and drinking and driving ($r = 0.51$). Among 32,333 adults who participated in a health survey across 14 areas in England, median sales was highly correlated with heavy drinking, both for men ($r = 0.90$) and women ($r = 0.75$) [21]. Some argue that alcohol consumption is best determined through self-reported assessment of intake. However, this approach has limitations, since variability of intake is poorly captured, and most survey methods are jeopardized by social desirability bias, wherein individuals underestimate true intake [24,25]. Accurate reporting of consumption would be especially true for teens and young adults, who are restricted from bars and nightclubs by strict laws in Ontario, and who often obtain alcohol through acquaintances [26]. While some may question whether we could account for the steep rise in alcohol sales (or its consumption) around the December holidays, we actually observed that there were fewer assaults in this period (Figure 1). Inaccurate capture of alcohol sales would likely have attenuated the effect sizes generated in our study.

Our findings are consistent with other published studies, which often included fewer than 1,000 cases of assault, and were outside of a hospital setting. In the British Crime Survey on alcohol-related violence, about 40% of those committing violent acts were under the influence of alcohol [27]. Moreover, alcohol has been associated with self-inflicted intentional injury. For example, in a case-crossover study of 102 persons presenting to the emergency department, observed alcohol consumption within the previous 6 h was associated with a RR of 9.6 (95% CI 5.7–16.3) for attempted suicide [28]. Haggard-Grann et al. completed a case-crossover study of 133 violent offenders admitted to a forensic psychiatric unit and a national prison [29]. Unlike our study, they looked at the risk of violence among the perpetrators, and considered not only alcohol use, but benzodiazepine and antidepressant use as well.

US national surveys have found that underage drinkers and adult excessive drinkers consumed nearly 50% of all alcohol [30]. In the British Crime Survey, victims of alcohol-related violence were more apt to be single, unemployed males aged 16 to 29 y, who frequently visited a place where a high amount of alcohol was consumed [27]. Clearly, the argument that violent assault must be understood beyond the scope of

the volume of alcohol consumption alone is strengthened by data from Scandinavia, where the frequency of intoxication, rather than yearly volume of consumption, predicted alcohol-related harm [31]. Moreover, the societal context in which alcohol is consumed may influence not only the tendency to inebriation, but also the propensity for anti-social behaviour and violence [8–10].

The direct and indirect costs related to being hospitalized for assault are substantial. A conservative estimate of the daily cost of a hospitalization is Can\$1,000 [32], such that a 6 d average admission would amount to about Can\$6,000 in direct costs. We found there to be a 1.18 times higher risk of being hospitalized per Can\$10,000 increase in daily sales. Given that 3.3 hospitalizations per day in Ontario are due to assault, at least one more admission would be expected per Can\$17,000-incremental rise in daily alcohol sales. At peak periods of sales, when the observed risk is 1.58 times higher per Can\$10,000 incremental rise in alcohol sales, about one more admission would be expected per \$5,000-incremental rise in daily alcohol sales. Accounting for those who do not require admission, as well as other forms of alcohol-related harm [3,33], would certainly lead to larger societal costs associated with alcohol sales. Naturally, our findings may not apply to all Western countries, where drinking habits and methods of selling alcohol may differ, along with the cost of health care.

These study findings confirm that alcohol-related assault produces serious medical injuries [10]. Accordingly, our attitude toward persons who brawl while drinking alcohol [34,35] should be no different from our intolerance of those who drive while impaired. Persons who intentionally assault others may do so for many reasons, but alcohol likely plays a role therein, and may increase the likelihood that the average victim—male and in his prime—is injured severely. An awareness of this issue may serve to bolster more programs similar to the multifaceted initiatives aimed at reducing impaired driving [36,37]. Possibilities include having manufacturers and distributors stigmatize violent acts [38], creating educational product labels, and establishing more programs aimed at preventing injury. Others propose a small increase in the price of alcohol as another deterrent to excess alcohol consumption and related violence among young adults [39, 40]. Another option might be to curtail alcohol sales [41].

While the density of alcohol sales outlets appears to be a major predictor of violent crime [42,43], extending their hours of operation is not always associated with higher rates of violent assault [44]. Moreover, the evidence that different kinds of interventions in alcohol server settings such as bars can reduce injury is both poor in quality and inconclusive [45]. Some suggest that the most effective community response to alcohol-related violence is to curtail the times that alcohol is sold in bars [46] and off-premise retail outlets, and, more importantly, to limit the number of retail outlets in a given community [42,43]. The latter approach includes setting minimum distances between alcohol outlets, limiting the opening of new stores, and permanently closing outlets that break the law, such as selling alcohol to minors or to intoxicated persons [47].

Clearly, we need rigorous research on how alcohol consumption contributes to assault, in terms of the type, quantity, and rapidity of alcohol consumption, and the degree of intake by the perpetrator and the victim.

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Editors' Summary

Background. Alcohol has been produced and consumed around the world since prehistoric times. In the Western world it is now the most commonly consumed psychoactive drug (a substance that changes mood, behavior, and thought processes). The World Health Organization reports that there are 76.3 million persons with alcohol use disorders worldwide. Alcohol consumption is an important factor in unintentional injuries, such as motor vehicle crashes, and in violent criminal behavior. In the United Kingdom, for example, a higher proportion of heavy drinkers than light drinkers cause violent criminal offenses. Other figures suggest that people (in particular, young men) have an increased risk of committing a criminally violent offense within 24 h of drinking alcohol. There is also some evidence that suggests that the victims as well as the perpetrators of assaults have often been drinking recently, possibly because alcohol impairs the victim's ability to judge potentially explosive situations.

Why Was This Study Done? The researchers wanted to know more about the relationship between alcohol and intentional violence. The recognition of a clear link between driving when impaired by alcohol and motor vehicle crashes has led many countries to introduce public awareness programs that stigmatize drunk driving. If a clear link between alcohol consumption by the people involved in violent crime could also be established, similar programs might reduce alcohol-related assaults. The researchers tested the hypothesis that the risk of being hospitalized due to a violent assault increases when there are increased alcohol sales in the immediate vicinity of the victim's place of residence.

What Did the Researchers Do and Find? The researchers did their study in Ontario, Canada for three reasons. First, Ontario is Canada's largest province. Second, the province keeps detailed computerized medical records, including records of people hospitalized from being violently assaulted. Third, most alcohol is sold in government-run shops, and the district has the infrastructure to allow daily alcohol sales to be tracked. The researchers identified more than 3,000 people over the age of 13 y who were hospitalized in the province because of a serious assault during a 32-mo period. They compared the volume of alcohol sold at the liquor store nearest to the victim's home the day before the assault with the volume sold at the same store a week earlier (this type of study is called a “case-crossover” study). For every extra 1,000 l of

alcohol sold per store per day (a doubling of alcohol sales), the overall risk of being hospitalized for assault increased by 13%. The risk was highest in three subgroups of people: men (18% increased risk), youths aged 13 to 20 y (21% increased risk), and those living in urban areas (19% increased risk). At peak times of alcohol sales, the risk of assault was 41% higher than at times when alcohol sales were lowest.

What Do These Findings Mean? These findings indicate that the risk of being seriously assaulted increases with the amount of alcohol sold locally the day before the assault and show that the individuals most at risk are young men living in urban areas. Because the study considers only serious assaults and alcohol sold in shops (i.e., not including alcohol sold in bars), it probably underestimates the association between alcohol and assault. It also does not indicate whether the victim or perpetrator of the assault (or both) had been drinking, and its findings may not apply to countries with different drinking habits. Nevertheless, these findings support the idea that the consumption of alcohol contributes to the occurrence of medical injuries from intentional violence. Increasing the price of alcohol or making alcohol harder to obtain might help to reduce the occurrence of alcohol-related assaults. The researchers suggest that a particularly effective approach may be to stigmatize alcohol-related brawling, analogous to the way that driving under the influence of alcohol has been made socially unacceptable.

Additional Information. Please access these Web sites via the online version of this summary at <http://dx.doi.org/10.1371/journal.pmed.0050104>.

- This study is further discussed in a *PLoS Medicine* Perspective by Bennetts and Seabrook
- The US National Institute on Alcohol Abuse and Alcoholism provides information on all aspects of alcohol abuse, including an article on alcohol use and violence among young adults
- Alcohol-related assault is examined in the British Crime Survey
- Alcohol Concern, the UK national agency on alcohol misuse, provides fact sheets on the health impacts of alcohol, young people's drinking, and alcohol and crime
- The Canadian Centre for Addiction and Mental Health in Toronto provides information about alcohol addiction (in English and French)