

ALCOHOL & FIREARMS: RESEARCH, GAPS IN KNOWLEDGE, AND POSSIBLE INTERVENTIONS¹

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Introduction

Prevention strategies that focus only on firearms can be protracted with limited political support and uncertain consequences.^{1,2} Although the inappropriate use of firearms is necessary to the occurrence of firearm injury, there are other contributing but modifiable factors that also warrant consideration. Many of these other factors have the advantage of being less politically confrontational than firearms and, as such, may be more feasible opportunities for prevention in many communities.^{3,4}

One such modifiable factor is alcohol. People may place themselves or others at risk of gun injury by inappropriately consuming alcohol in situations where firearms are present. People may also place themselves or others at risk of gun injury by entering environments where alcohol is being consumed and where guns are present. Alcohol may, on the other hand, be less strongly implicated as a cause of firearm injury because there are so many instances of drinking where no injury occurs. Alcohol consumption is thus seen as a contributing, although not necessary, factor in the occurrence of firearm injury, and valid scientific evidence is needed to disentangle and prove its worth as a modifiable risk factor in the prevention of firearm misuse and injury.

Despite these possibilities, the scientific evidence-base that could drive alcohol policy around firearm injury prevention has not been assembled and communities interested in pursuing alcohol-related prevention strategies to reduce gun injury are left with little guidance in terms of which strategies might be best to implement. In order to assist these communities in gauging the relative value of different alcohol-related prevention strategies to reduce gun injury, and make the best use of limited prevention resources, a comprehensive review of the scientific literature pertaining specifically to alcohol and firearms was conducted to identify gaps in research and knowledge as well as potential policy and public health interventions.

Major research findings and gaps in knowledge specific to alcohol and firearms:

- Over one-third of firearm injury decedents had acutely consumed alcohol prior to their death; over one-quarter of these decedents had heavily consumed alcohol.
- Light drinking does not appear to a significant risk factor for firearm injury.
- The risk of being a victim of gun injury after drinking, especially heavy drinking, appears to be most significant among self-inflicted firearm injury victims.
- As much as one-third of violent firearms offenders concomitantly used alcohol and alcohol misuse has been significantly associated with the use of firearms.
- Alcohol outlets, especially off-premise outlets such as take outs that sell alcohol ready-to-go, may be significantly associated with increased risks of firearm assault.
- More controlled research studies are needed, especially risk factor and intervention studies, including laboratory-based randomized controlled trials and before-after policy evaluations with individual or geographic comparison groups.

¹ The authors are responsible for the content of this article, which does not necessarily represent the views of the Institute of Medicine, or the National Academy of Medicine.

Policy and public health interventions specific to alcohol and firearms:

- Policies with specifically proscribed blood alcohol levels of intoxication that restrict firearm carrying and use, equivalent to those specified nationally for drunk driving, could impact alcohol-related firearm injury via the discovery and enhanced punishment of gun carriers who are intoxicated before, and after, they discharge their weapons.
- Using multiple prior drunk driving convictions as a more precise criterion for disqualifying persons from the purchase or possession of firearms could also be a straightforward and defensible statutory solution to alcohol-related firearm injury.
- Server training, rezoning, and/or enhanced policing in areas where off-premise alcohol outlets are highly clustered are also potentially promising gun violence reduction strategies.

Alcohol and firearms: comprehensive literature review

A comprehensive literature review investigating the relationship between alcohol and firearms was completed from 1975 through most of 2014. Although a larger scientific literature exists investigating the alcohol-violence connection and the alcohol-suicide connection, this review was restricted to the alcohol-firearm injury connection. In this regard, a smaller group of articles was identified, some of which focused primarily on the alcohol-firearms connection. The remaining larger balance of articles that were identified focused primarily on alcohol and violence or alcohol and suicide, but included subset analyses of alcohol and firearms.

Three literature search engines were used: Pubmed, Web of Science, and Scopus. Standard, reproducible Boolean search algorithms were submitted to each of these three literature search engines. In Pubmed article title, abstract, and keywords were searched using the following Boolean algorithm: (("firearms"[MeSH Terms] OR "firearms"[All Fields] OR "gun"[All Fields]) OR ("firearms"[MeSH Terms] OR "firearms"[All Fields] OR "firearm"[All Fields])) AND ("ethanol"[MeSH Terms] OR "ethanol"[All Fields] OR "alcohol"[All Fields] OR "alcohols"[MeSH Terms] OR "alcohols"[All Fields] OR "alcohol outlet"). This initially produced 499 articles. After a restriction to human-only studies (excluding mostly animal-based studies), 406 articles remained. After a restriction to studies available in English, 381 articles remained as the final article yield from Pubmed. In Web of Science, article title, abstract and keywords were searched using the following Boolean algorithm: ("firearm" OR "gun") AND ("ethanol" OR "alcohol" OR "alcohol outlet"). This initially produced 316 articles. After a restriction to studies available in English, 191 articles remained as the final article yield from Web of Science. In Scopus, article title, abstract and keywords were searched using the following Boolean algorithm: ("firearm" OR "gun") AND ("ethanol" OR "alcohol" OR "alcohol outlet"). This initially produced 786 articles. After a restriction to studies available in English, 285 articles remained as the final article yield from Scopus.

These article yields of 406 (Pubmed), 316 (Web of Science), and 285 (Scopus) were then reconciled for duplicate articles. Further exclusions were then applied: (1) studies of violence, homicide, or suicide in general that did not specifically report data for firearm violence, firearm homicide, or firearm suicide; (2) studies that did not specify guns or firearms, but instead only broadly specified "weapons"; (3) forensic science case-series prior to 1995 – these were case series had already been comprehensively reviewed and summarized in a 1999 meta-analysis by Smith, et. al.⁵ which was abstracted for its relevant data; (4) smaller studies restricted to special populations - murder-suicides, schizophrenics, police officers, physicians, individuals in active

war or conflict situations; and (5) non-original research articles such as reviews, meta-analyses, and editorials (except Smith, et. al.⁵). After these restrictions, the final yield investigating the relationship between alcohol and firearms from all three search engines was 33 total articles (49 total individual articles when counting the 1999 meta-analysis by Smith, et. al.⁵).

These 33 articles were then separated and analyzed in multiple categories based on focus, information reported, and/or study design. Reporting of article summaries and effects occurred in these categories: (1) alcohol use and firearm injury victims, (2) alcohol use and firearm use, (3) alcohol sales outlets and firearm injury victims, and (4) alcohol laws in the US and firearm use. Weighted means of different study effect sizes were also calculated based on the subject study population sizes in each article.

(1) Alcohol use and firearm injury victimization

A prior meta-analysis of articles from 1975-1995 by Smith, et. al.⁵ identified 18 articles that specifically addressed alcohol consumption and firearm injury. All these articles were decedent case-series drawn mostly from published coroner and medical examiner studies, as well as some hospital-based studies. One of the articles in this prior meta-analysis reported on unintentional firearm injury, 9 on firearm homicide, and 8 on firearm suicide. To these articles was added a list of 11 articles published after 1995.

Table 1 shows the summary results of the studies in this grouping that reporting the prevalence of acute alcohol use among firearm injury decedents. These summary results included all 29 articles, each of which reported on a case series of firearm injury decedents and their levels of alcohol consumption. These articles reported alcohol levels estimated from blood specimens as blood-alcohol concentrations (BAC, in mg/dL). A BAC > 0 mg/dL indicated “any alcohol use” and a BAC > 100 mg/dL indicated “heavy alcohol use”.

Over 35% of firearm injury decedents had acutely consumed alcohol prior to their death; over 25% of these decedents had heavily consumed alcohol. A weighted mean of 38.8% of firearm homicide decedents had acutely consumed any alcohol prior to their death. A weighted mean of 30.2% of firearm homicide decedents had acutely consumed a heavy amount of alcohol prior to their death. A weighted mean of 35.2% of firearm suicide decedents had acutely consumed any alcohol prior to their death. A weighted mean of 25.7% of firearm suicide decedents had acutely consumed a heavy amount of alcohol prior to their death. Articles published after 1995 reported remarkably similar levels of alcohol involvement among firearm injury decedents as the prior 20-year Smith, et. al.⁵ meta-analysis, and one other prior literature review⁶, suggesting consistency of these percentages over time.

Despite being large in number, these prior case-series analyses offer little guidance in terms of the actual risk that acute alcohol might have on becoming a victim of firearm injury, either from others or from oneself. Only considering cases of firearm death has value in terms of some aspects of public health planning, but could produce highly inaccurate estimates of the etiologic risk that alcohol might create in terms of actually being shot given the high levels of alcohol consumption in the general population.⁷ Table 2 lists studies reporting odds ratio risk estimates of the relationship between acute alcohol consumption and subsequently becoming a victim of firearm injury. The table consists of two studies, both case-control studies incorporate fatal and nonfatal case groups alongside population-based, community controls.^{3,4} Alcohol consumption in both studies was measured using blood specimens, police reports, and participant self-reports.

The risk of being a victim of gun injury after acute alcohol use appears to be most pronounced, and statistically significant, among self-inflicted firearm injury victims (including

completed suicides). The consumption of any amount of alcohol was associated with a

	Study population (n)	Any alcohol use (%)	Heavy alcohol use (%)
<u>Firearm homicide</u>			
Smith, et al., 1999 ³	6,145	38.9	30.6
Andreucetti, et al, 2009 ⁸	1,605	40.1	na
Branas, et al., 2009 ⁵	126	24.5	8.2
Darke, et al, 2008 ⁹	128	37.5	na
Hougen, et al, 2000 ¹⁰	83	25.3	na
Study population- weighted mean		38.8	30.2
<u>Firearm suicide</u>			
Smith, et al., 1999 ³	601	33.1	31.4
Blumenthal et al, 2007 ¹¹	406	40.0	36.0
Branas, et al, 2011 ⁴	137	31.0	19.9
Conner, et al, 2014 ¹²	19,621	35.0	na
Kaplan, et al, 2009 ¹⁵	11,554	na	27.3
Kaplan, et al, 2013 ¹⁴	29,198	na	24.8
Shields, et al, 2006 ¹⁵	1,932	37.9	na
Sutton, et al, 2005 ¹⁶	38	42.1	26.3
Study population- weighted mean		35.2	25.7
<u>Unintentional injury death</u>			
Smith, et al., 1999 ³	54	48.7	20.5

Table 1. Studies reporting prevalence of acute alcohol use among firearm injury deaths

	Study population (n)	Type of alcohol use	Alcohol use and firearm injury odds ratio (95% CI)
<u>Firearm assault</u>			
Branas, et al., 2009 ³	Adults (1,361)	Any alcohol use	1.3 (0.5, 3.3)
Branas, et al., 2009 ³	Adults (1,361)	Heavy alcohol use	2.7 (0.9, 7.9)
<u>Firearm homicide</u>			
Branas, et al., 2009 ³	Adults (251)	Any alcohol use	0.3 (0.1, 3.1)
Branas, et al., 2009 ³	Adults (251)	Heavy alcohol use	6.2 (0.4, 92.5)
<u>Firearm self-inflicted injury</u>			
Branas, et al, 2011 ⁴	Adults (451)	Any alcohol use	4.2 (2.3, 8.0) *
Branas, et al, 2011 ⁴	Adults (451)	Heavy alcohol use	77.1 (8.8, 678.4) *
<u>Firearm suicide</u>			
Branas, et al, 2011 ⁴	Adults (411)	Any alcohol use	5.9 (2.9, 12.1) *
Branas, et al, 2011 ⁴	Adults (411)	Heavy alcohol use	85.8 (10.0, 732.3) *

* statistically significant, p<0.05

Table 2. Studies reporting odds ratios between acute alcohol use and firearm injury

statistically significant, 4-5 times higher risk of self-inflicted firearm injury.⁴ This risk was much higher for heavy consumption of alcohol. Statistically significant risks of alcohol consumption and firearm assault and homicide were not found. However, a near-significant risk, almost 3 times higher, was found between heavy alcohol consumption and firearm assault.³

By comparison, light drinkers in both studies^{3,4} were at about the same risk of being shot as nondrinkers. This suggests that alcohol consumption in moderation may not be a major risk factor for firearm injury. Even though they had consumed, light drinkers likely retained enough clear judgment and perception to keep their risk in check when compared with heavy drinkers.

Heavily consuming alcohol can lower inhibitions, increase confidence, and potentially release violent inclinations.¹⁷ Otherwise noncombative individuals may overreact to perceived threats and instigate violent situations due to alcohol-impaired judgment of verbal and nonverbal social cues.^{18,19} Potential victims who are intoxicated are potentially more vulnerable targets for predatory crimes such as firearm homicide.²⁰

By comparison, the majority of completed suicides involve guns²¹ and, as demonstrated here, over one-third of gun suicides involve alcohol. Gun suicide victims often “brace” themselves with alcohol in anticipation of a painful or violent end.^{5,22-24} These individuals may be uncertain about killing themselves making the risks they face temporary and the availability of alcohol and guns during these times especially important.²⁵ Acute alcohol consumption, and perhaps heavy alcohol consumption, may make the impulsive and painful act of shooting oneself potentially easier and significantly more likely.⁴ Although a select few means of suicide are supported by the right-to-die movement, suicides committed with guns are viewed as acts of extremely traumatic violence, intolerable even to euthanasia advocates.^{4,22}

(2) Alcohol use and firearm use

A common and well-documented gun safety rule is “never use alcohol ... before or while shooting”.²⁶ Despite this, the current literature review suggests that a nontrivial proportion of firearm users also concomitantly use or misuse alcohol. Table 3 lists 13 studies demonstrating that the percentage of firearms users who had some amount of alcohol involvement, either before or while they were using their firearm, ranged from 1% among a cohort of hunters to 60% in a group of out-of-treatment substance using women. A weighted mean of 16.4% of firearm users had some form of alcohol involvement ranging from any alcohol use to binge drinking and alcohol dependence.

Only three studies reported percent estimates of the consumption of alcohol at the time of firearm use, and these percentages ranged from 1.0-34.0%.²⁷⁻²⁹ Two of these three studies analyzed large cohorts of criminal offenders. The remaining studies reported time-independent estimates of the relationship between alcohol and firearm use. While these remaining studies document important information about the nontrivial levels of alcohol involvement among firearm users, many of them are limited by cross-sectional study designs and absence of comparison groups.

Table 4 lists 10 studies reporting odds ratio risk estimates of the relationship between alcohol consumption and firearm use. The definitions of alcohol involvement were almost entirely based on self-reports and ranged from any alcohol use to heavy alcohol use and binge drinking; the definitions of firearm use were also based on self-reports and ranged from general gun ownership and gun access to gun carrying. Four studies analyzed groups of adults and reported odds ratios of the association between alcohol and gun use in the range of 1.3-1.8, with all reported odds

ratios being statistically significant or nearly statistically significant. Across all 10 studies a weighted mean odds ratio of 4.2 demonstrated a generally positive risk association between alcohol use and firearm use.

To date, only a single randomized controlled trial has been conducted investigating alcohol consumption and the ability to use a firearm.³⁰ Trial participants were male, 21-40-year-old, non-habitual drinkers, with no professional firearms training who were randomly assigned to receive alcohol (titrated to 0.05 or 0.10 g%) or placebo alcohol. All participants were then subjected to a series of real-world, large screen video-immersion scenarios using a high-fidelity deadly force judgment and decision-making simulator with real, untethered firearms that had been retrofitted to fire “laser bullets” and discharge compressed air cartridges in order to simulate real firearm recoil and noise in potentially threatening situations. These same simulators are used by many law enforcement and military agencies for training and testing purposes. Accuracy and speed for target shooting, reaction time scenarios, and scenarios requiring judgment about when to use a gun were measured for all participants.

Prior experimental trials of firearm shooting and accuracy have exposed participants to various conditions and substances in an effort to see how they perform with firearms. These conditions and substances have included exposure to cold, heat, caffeine, sleep deprivation, beta-blockers, and antihistamines.³¹⁻⁴³ While not including alcohol, these prior studies also demonstrate that trials of firearm shooting and accuracy have been undertaken and have produced useful scientific results. They also provide us with a framework of how a trial of alcohol consumption and subsequent firearm performance could proceed and what performance and outcome parameters might be worth measuring.

The primary goal of the Carr, et al trial was to demonstrate the feasibility of performing a blinded randomized, controlled trial investigating the relationship between alcohol consumption and firearm use.³⁰ The study did indeed demonstrate that such a trial was feasible, successfully enrolling and analyzing 12 randomly allocated subjects who completed 160 firearm performance scenarios. A secondary goal of the trial was to explore the effect of alcohol on the ability to appropriately use a firearm. Small increases in the frequency with which intoxicated subjects reached for their gun, produced their gun, and fired their gun were found. Intoxicated subjects also demonstrated a decrease in accuracy and slower reaction times in scenarios not requiring judgment, but faster reaction times in scenarios requiring complex decision making before deciding to use force.

In general, alcohol in small to moderate amounts will degrade various psychomotor skills, including reaction time, eye-hand coordination, accuracy, balance, and complex coordination of gross-motor movements. Alcohol also has little if any beneficial effects on the metabolic or physiologic functions that underpin physical performance such as energy metabolism, maximal oxygen consumption, heart rate, stroke volume, and cardiac output. Alcohol consumption could in fact decrease performance via some of these metabolic or physiologic parameters. Alcohol may also adversely affect the regulation of body temperature and decrease muscular work capacity during prolonged physical performance challenges.⁴⁴ Alcohol thus will very likely impair the psychomotor skills and cognitive function that underlie human performance such as safely driving a car⁴⁵ or, by extension, firing a gun. Complex skills that require central nervous system processing are impaired even at low blood alcohol levels. Psychomotor and judgment-based tasks that require divided attention, tracking, visual search, and recognition with response are significantly impaired at blood alcohol levels as low as 0.015 g%.⁴⁴ It thus seems reasonable that any degradation in performance will be dependent upon the amount of alcohol consumed

and that at some point a threshold of intoxication will be reached above which performance will significantly degrade.

On the other hand, in the absence of a large confirmatory trial, it can also be hypothesized that low levels of alcohol consumption may improve firearm shooting performance. Prior to a ban on alcohol use by the International Olympic Committee in 1968, it was observed that elite Olympic pistol shooters regularly consumed alcohol to decrease anxiety levels, increase self-confidence, and enhance performance.⁴⁶ Low levels of alcohol may reduce anxiety and tremor and thus may benefit performance of tasks that require steady hands and aim such as firing a gun. Archers have been shown to perform better in terms of certain markers related to aiming after consuming alcohol to low blood alcohol levels, between 0.02 g% and 0.05 g%. These aiming enhancements can also be speculated to be even larger when shooting guns as they are tied to weight load requirements on the shooter's arms which would presumably be less for a firearm shooter as opposed to an archer.⁴⁴

Most research on alcohol's relationship to injury has targeted drunk driving, strongly influencing public policy and resulting in decreases to the number of traffic fatalities involving alcohol. Massive, government-sponsored driving simulators and extensive insurance industry automobile crash test facilities have brought to light some of our most important and life-saving discoveries related to alcohol and automobile safety.⁴⁷ Markedly less robust have been research efforts for other, common but potentially hazardous, psychomotor tasks under the influence of alcohol, such the handling of firearms. Although analogous to drunk driving, "drunk firing" remains a largely unstudied risk factor. Consideration of the "day-after" hangover effects of alcohol and the ability to appropriately handle a firearm is also worthy of further study.^{28,48} Reductions in firearm-related injuries could result from alcohol research efforts among firearms users comparable to those that have already devoted to motor vehicle drivers, including randomized controlled trials.

(3) Alcohol sales outlets and firearm injury victims

Individuals may place themselves at risk of firearm injury by consuming alcohol, but also possibly by entering into environments where alcohol is being consumed. One environmental approach to the control of injuries due to firearms may be to focus on point-of-sale alcohol outlets whose availability can vary greatly between different geographic areas. These alcohol outlets can typically be categorized as on-premise establishments such as bars and taverns on which alcohol is both purchased and consumed, and off-premise establishments such as take-outs and delis where alcohol is purchased but must be consumed elsewhere. However, even though changing the geographic distribution of alcohol outlets through zoning or other strategies is potentially feasible for many municipalities, the evidence that densely clustered alcohol outlets produce violence remains conflicted. Localities interested in rezoning alcohol outlets are similarly conflicted when deciding how best to proceed.

Despite a relatively large literature addressing the relationship between alcohol outlets and violence more broadly, only a select few studies have reported on the relationship between alcohol outlets and firearm violence more specifically. This literature review found only 3 such alcohol outlet-firearm injury studies. Relevant findings from these 3 studies are shown in Table 5 and demonstrate few strong or remarkable relationships. However, one study³ did find that being in an area of high off-premise alcohol outlet availability significantly

increased the risk of being shot in an assault by 2.0 times and that the combined effect of being a heavy drinker in an area of high off-premise alcohol outlet availability significantly increased the risk of being shot in an assault by over 9.0 times.

In many resource-challenged urban neighborhoods, amid nonworking street lamps, vacant properties, and abandoned residences, off-premise alcohol outlets are a paradoxical center of activity, often well-lit and well-trafficked with a steady interchange of patrons. The risks generated by off-premise outlets may be the result of the sale and nearby street consumption of high-quantity, high-alcohol content beverages, as well as an often small number of servers who frequently work from behind fortified walls of bulletproof glass, and only briefly interact with patrons to distribute alcohol. Off-premise outlets can also attract heavy drinkers and other at-risk patrons; signage prohibiting “fighting” or “drug dealing” in many off-premise outlets are markers of these at-risk patrons.^{3,49,50} Given this, training off-premise servers to cutoff heavy drinkers and promptly report the outbreak of arguments to police could be promising gun violence reduction strategies. Other approaches to reducing gun violence may include a general rezoning or reduction of off-premise outlet availability and/or enhanced policing of public drunkenness in neighborhoods where off-premise outlets are highly clustered.³

(4) Alcohol laws in the US and firearm use

US federal law does not prohibit alcohol abusers from obtaining firearms.⁵¹ In light of this, one study specifically reviewed state laws restricting the intersection of firearms and alcohol.⁵² The study’s results are summarized in Table 6. These results broadly show that as of 2008, a total of 46 laws in 31 states restricted the intersection of alcohol and firearms.

More specifically, a total of 18 states categorically restricted firearm ownership or firearm use by individuals on the grounds of “habitual alcohol use”. Of these states, 4 restricted the sale or transfer of firearms to habitual alcohol users, 3 restricted firearm possession by habitual alcohol users, 7 restricted licensure of firearms to habitual alcohol users, and 8 restricted concealed carrying of firearms by habitual alcohol users. An additional 3 states restricted firearm ownership by people who are currently or have previously been under treatment for alcohol addiction, abuse, or dependence, and 2 states restricted possession of firearms by people convicted of alcohol-related crimes.

A total of 12 states had alcohol-specific firearm restrictions with respect to location, such as restricting possession of a loaded firearm in places where intoxicating liquor was sold for on-premise consumption. A total of 26 states had laws restricting firearms for people who were intoxicated: 6 states restricted the sale or transfer of firearms to an intoxicated person, 4 states restricted the carrying of a concealed weapon while intoxicated, and 20 states specifically restricted possession and/or discharge of a firearm by an intoxicated person.

Many states do little to restrict the intersection of alcohol and firearms. In a considerable number of states, firearm ownership and use is precluded for people with a history of habitual alcohol use or who have received or are receiving treatment for alcohol abuse and dependence. However, almost half of all states have no restrictions on ownership, possession, or use of a firearm while intoxicated. Complicating matters further, the terms “intoxication” and “habitual” are not explicitly defined by the legal code in many states. Even in the few states that have penalties, their firearms laws are highly inconsistent and do not define proscribed alcohol consumption levels that should be policed as “intoxicated” or “under the influence” by the legal system.^{51,52}

	Study population (n)	Type of alcohol use	Type of firearm use	Alcohol use (%) among firearm users
Black, et al., 1994 ⁵³	Adolescent boys (192)	Any alcohol use	Gun carrying	36.0%
Carter, et al, 2013 ⁵⁴	Adolescents (689)	Binge drinking	Gun possession	39.6%
Greenfeld, et al, 2001 ²⁷	Crime offenders (1,982,552)	Any alcohol use	Gun use	15.6%
Hemenway, et al, 1997 ⁵⁵	Gun owners (800)	Binge drinking	Gun ownership	20.0%
Junozovic, et al, 2013 ²⁸	Hunters (1,000)	Any alcohol use	Gun use	1.0%
Johnson, et al, 2012 ⁵⁶	Out-of-treatment substance using women (858)	Alcohol dependence	Gun carrying	60.0%
Kuhns, et al, 2013 ²⁹	Homicide offenders (28,265)	Positive for alcohol or reportedly intoxicated	Gun use	34.0%
Nordstrom, et al, 2001 ⁵⁷	Adults (983)	Alcohol dependence	Home with loaded, unlocked guns	13.0%
Peleg-Oren, et al, 2009 ⁵⁸	Teenagers (12,352)	Drinking before age 13	Gun carrying	12.0%
Simon, et al, 1997 ⁵⁹	Teenagers (504)	Any alcohol use	Gun carrying	56.5%
Stevens, et al, 2001 ⁶⁰	Adolescents (3,145)	Any alcohol use	Gun use	17.4%
Swahn, et al, 2002 ⁶¹	Adolescents (18,454)	Alcohol easily available at home	Gun easily available at home	42.0%
Wintemute, 2011 ⁶²	Adults (15,474)	Any alcohol use	Gun owner	59.3%
	Study population- weighted mean			16.4%

Table 3. Studies reporting prevalence of alcohol use among firearms users

	Study population (n)	Type of alcohol use	Type of firearm use	Alcohol use and firearm use, odds ratio (95% CI)
DuRant, et al, 1997 ⁶³	Adolescents (3,054)	Any alcohol use	Gun carrying	1.8 (1.4, 2.3) *
DuRant, et al, 1999 ⁶⁴	Adolescents (2,227)	Any alcohol use	Gun carrying	4.6 (1.3, 16.6) *
Erickson, et al, 2006 ⁶⁵	Teenage girls (510)	Heavy alcohol use	Threaten or try to hurt with a gun	2.3
Johnson, et al, 2012 ⁵⁶	Out-of-treatment substance using women (858)	Alcohol dependence	Gun carrying	1.3 (0.9, 1.8)
Loh, et al, 2010 ⁶⁰	Adolescents (3,050)	Binge drinking	Gun access	1.8 (1.4, 2.3) *
Loh, et al, 2010 ⁶⁰	Adolescents (3,050)	Any alcohol use	Gun access	3.4 (2.9, 4.0) *
Nelson, et al, 1996 ⁶⁷	Adults (6,202)	Binge drinking	Home with loaded, unlocked guns	1.7 (1.3, 2.3) *
Nelson, et al, 1996 ⁶⁷	Adults (6,202)	Binge drinking	Gun carrying	1.5 (0.9, 2.4)
Peleg-Oren, et al, 2009 ⁵⁸	Teenagers (12,352)	Drinking before age 13	Gun carrying	29.4 (6.6, 125.0) *
Simon, et al, 1997 ⁵⁷	Teenagers (504)	Any alcohol use	Gun carrying	2.5 (1.6, 4.2) *
Stevens, et al, 2001 ⁶⁹	Adolescents (3,145)	Any alcohol use	Gun use	2.1 (1.3, 3.3) *
Wintemute, 2011 ⁶²	Adults (15,474)	Any alcohol use	Gun owner	1.3 (1.2, 1.5) *
Wintemute, 2011 ⁶²	Adults (15,474)	Any alcohol use	Home with loaded, unlocked guns	1.4 (1.2, 1.7) *
Wintemute, 2011 ⁶²	Adults (15,474)	Any alcohol use	Gun carrying	1.3 (0.9, 1.8)
Wintemute, 2011 ⁶²	Adults (15,474)	Binge drinking	Gun owner	1.3 (1.2, 1.5) *
Wintemute, 2011 ⁶²	Adults (15,474)	Binge drinking	Home with loaded, unlocked guns	1.8 (1.5, 2.3) *
Wintemute, 2011 ⁶²	Adults (15,474)	Binge drinking	Gun carrying	1.5 (1.0, 2.1) *
Study population- weighted mean				OR = 4.2

* statistically significant, p<0.05

Table 4. Studies reporting odds ratios between alcohol use and firearm use

	Study population (n)	Being proximal to alcohol outlets, point estimate (95% CI)	Being proximal to on-premise alcohol outlets, point estimate (95% CI)	Being proximal to off-premise alcohol outlets, point estimate (95% CI)
<u>Firearm assault and homicide</u>				
Branas, et al., 2009	Adult firearm assaults and controls (1,361)	OR = 1.2 (0.6, 2.5)	OR = 1.1 (0.6, 2.2)	OR = 2.0 (1.1, 3.8) *
Branas, et al., 2009	Adult firearm homicides and controls (1,361)	OR = 0.7 (0.2, 2.8)	OR = 0.9 (0.3, 2.7)	OR = 4.2 (0.8, 21.8)
Schofield and Denson, 2013	Gun crime rates in counties (57)	na	Beta = 4.8 (-3.2, 12.8)	Beta = -4.5 (-13.3, 4.3)
<u>Firearm self-inflicted and suicide</u>				
Branas, et al., 2011	Adult self-inflicted gun injuries and controls (451)	OR = 0.8 (0.4, 1.3)	OR = 0.8 (0.4, 1.3)	OR = 1.6 (0.8, 2.9)
Branas, et al., 2011	Adult firearm suicides and controls (1,361)	OR = 0.6 (0.4, 1.1)	OR = 0.6 (0.4, 1.1)	OR = 1.3 (0.7, 2.6)

* statistically significant, p<0.05

Table 5. Studies reporting relationship between proximity to alcohol outlets and firearm injury

Statutory laws or regulations with precise definitions of disqualifying criteria could be useful in allowing those conducting background checks of firearms purchasers or those checking the legality or capacity of ongoing firearm possession, to appropriately distinguish prohibited persons on the basis of alcohol use. Legally proscribing “habitual drunkards”, and other imprecisely defined categories of people, from firearm possession does not provide law enforcement with the objective criteria needed to uniformly and efficiently carry out this prohibition.⁵¹

Since the early 1970s, states have enacted a wide range of laws to combat drinking and driving. These laws include lowering the drinking age, lowering blood alcohol limits from 0.10 to 0.08 milligrams per deciliter, creating stiffer penalties for offenders, and creating sobriety check points to effectively enforce these laws. All 50 states and the District of Columbia have established laws making it a crime to drive with a blood alcohol concentration at or above a proscribed level, 0.08 milligrams per deciliter. Violations of these laws carry clear legal penalties for drivers who have consumed alcohol past the proscribed level, to “intoxication”.

Although 20 states had restrictions on the possession, concealed carry, or discharge of firearms by intoxicated persons, most of these states leave the actual definition of intoxicated entirely unspecified (e.g., many laws simply states ‘above the level of intoxication’ with no numerical blood alcohol limit). A select few states, however, specify the proscribed level of intoxication for firearms to be the same as the state’s drunk driving law cutoff for blood alcohol concentration. This is a potentially straightforward and useful opportunity for replication across all states, especially given that alcohol consumption beyond a blood alcohol level of .08 milligrams per deciliter can impair the ability to use a firearm.⁵² Policies restricting firearm carrying/use while intoxicated could have larger impacts via the discovery and enhanced punishment of gun carriers who are intoxicated before, and after, they discharge their weapons.

Using multiple prior drunk driving convictions as a more precise criterion for disqualifying persons from the purchase or possession of firearms could also be a straightforward and defensible statutory solution to alcohol-related firearm injury.⁵¹ This is especially relevant given that one study has shown drinking and driving to be 2-4 times more likely among people who carry firearms for protection, drive or ride in vehicles with loaded firearms, or live in a home with loaded and unlocked firearms.⁶²

In addition, penalties for the purchase or possession of guns while in a restricted alcohol category or while under the influence of alcohol vary from no punishment at all to community service, fine, and/or jail time. In some states, unintentionally causing the death of another person with an automobile or a boat while intoxicated carries with it a mandatory jail sentence, but unintentionally causing the death of another person with a gun while intoxicated has no specific legal penalties.⁵² Stricter penalties and greater consistency of such penalties could help deter alcohol-related firearm injury.

Law	States
States restricting firearm possession and/or discharge of a firearm by intoxicated persons (at home or in public places)	AK, CO, CT, FL, GA, MD, MA, MI, MN, MO, NV, NM, OH, OK, RI, SC, SD, TN, TX, UT
States restricting carrying concealed firearms while intoxicated (in public places)	ID, ME, MT, NC
States restricting firearm sale or transfer to intoxicated persons	AK, DE, IN, MD, TN, TX
States restricting possession of a loaded firearm in a place where intoxicating liquor is sold for on-premise consumption	AK, AR, IL, KY, LA, MI, NM, OK, SC, TN, TX, WI
States restricting firearm possession by alcohol addicts and/or habitual alcohol users (at home or in public places)	AL, FL, OH
States restricting carrying concealed firearms by alcohol addicts and/or habitual alcohol users (in public places)	CO, FL, KY, LA, MS, MO, NM, WY
States restricting firearm sale, transfer, ownership, and/or licensure to alcohol addicts and/or habitual alcohol users	AL, GA, HI, IA, IN, MA, MD, NJ, NV, RI, PA, TN, WV
States restricting firearm possession by persons convicted of other alcohol-related crimes (such as drunk driving)	PA, AR

Table 6. State laws restricting sales, possession, or use of firearms by those who were intoxicated or habitual alcohol users, 2008⁵²

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