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Alcohol, drug and other prior crimes and risk of arrest in handgun purchasers: protocol for a controlled observational study

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Abstract

Background and objective—Alcohol abuse is common in the USA and is a well-established risk factor for violence. Other drug use and criminal activity are risk factors as well and frequently occur together with alcohol abuse. Firearm ownership is also common; there are >50 million firearm owners in the USA. This study assesses the relationships between alcohol and drug abuse and future violence among firearm owners, which no prior research has done.

Design and study population—This records-based retrospective cohort study will involve all persons who legally purchased handguns in California in 2001—approximately 116 000 individuals—with follow-up through the end of 2013.

Methods—The principal exposures include prior convictions for alcohol-related and drug-related offenses. The primary outcome measure is an arrest following handgun purchase for a violent Crime Index offense: homicide, rape, robbery or aggravated assault. Subjects will be considered at risk for outcome events for only as long as their residence in California can be established independently of outcome events. Covariates include individual characteristics (eg,

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Contributors

All authors contributed to the design of the study and provided critical editorial input. GJW drafted the manuscript.

Competing interests

None declared.

Ethics approval

This study has been approved by the Institutional Review Board of the University of California, Davis (654883-1).

Provenance and peer review

Not commissioned; internally peer reviewed.

age, sex, criminal history, firearm purchase history) and community characteristics (eg, demographics, socioeconomic measures, firearm ownership and alcohol outlet density). We will employ survival analytic methods, expressing effects as HRs.

Discussion—The results of this large-scale study are likely to be generalisable and to have important implications for violence prevention policies and programmes.

BACKGROUND

Alcohol abuse is common in the USA. (We use ‘abuse’ in this article to refer to the gamut of alcohol-related or drug-related problems.) In the 2013 Behavioral Risk Factor Surveillance System survey, 16.8% of respondents reported binge drinking in the previous 30 days (5 drinks on an occasion for men, 4 drinks for women) and 6.2% reported heavy drinking (>60 drinks over 30 days for men, >30 drinks for women).¹ Acute alcohol intoxication and a history of alcohol abuse have well-established associations with violence, including firearm violence. For men, alcohol-attributable mortality from firearm violence approximates that for MVCs.²

Firearm ownership is also common in the USA; >50 million adults—approximately 35% of men and 11% of women—are estimated to own firearms.³ Firearm violence “poses a serious threat to the safety and welfare of the American public”,⁴ with 11 208 firearm homicides and 21 175 firearm suicides in 2013.⁵ The combined mortality rate from firearm suicide and homicide has changed little in more than a decade.⁶

Firearm owners may be more likely than others to abuse alcohol.⁷ Yet no longitudinal research has determined whether alcohol abuse is associated with risk for violence among firearm owners. This study will determine whether associations between individual alcohol abuse and community alcohol outlet density exist in a large population of legal purchasers of handguns.

Our principal hypotheses are as follows:

- Among authorised purchasers of handguns in California, prior arrests and convictions for alcohol-related offenses, drug-related offenses and other non-violent misdemeanour crimes will each be associated with an increase in risk for violent and firearm-related criminal activity following handgun purchase.
- Risk will increase both as the number of prior arrests or convictions associated with each of these three types of offense increases and as the number of types of offense that are present increases.
- An increase in risk will persist after controlling for other known or potential individual risk factors (eg, demographics, firearm purchase history) and community characteristics (eg, demographics, socioeconomic status, firearm ownership, alcohol outlet density).
- Alcohol outlet density will be independently associated with risk for violent and firearm-related criminal activity.

We next briefly review some of the most salient studies providing the foundation and context for our proposed research. A more detailed review has been published elsewhere.²

Alcohol abuse and risk for violence

Acute intoxication—In Bureau of Justice Statistics (BJS) surveys, approximately 37% of inmates convicted of violent crimes reported being under the influence of alcohol when those crimes were committed.⁸⁹ Acute alcohol use or intoxication among homicide offenders ranges from 33% to 60% in toxicology studies.¹⁰¹¹ Acute alcohol use is associated with a substantial, dose-dependent increase in risk for suicide,^{12–14} which appears to be greatest for firearm suicide.¹⁵¹⁶

History of abuse—Large-scale survey studies have found an association between prior alcohol abuse and an increased risk of violence against others generally, and intimate partner violence, child abuse and child neglect.^{17–19} In a multicity case–control study, persons who committed suicide were more likely to have had alcohol-related trouble at work or hospitalisations for complications of alcohol use.²⁰ Prior alcohol abuse is associated with increased risk for a first suicide attempt.²¹

Driving under the influence offenses—Driving under the influence (DUI) is the most common of the alcohol-related offenses we will study.²² One persistent finding of DUI research is the relationship between the number of DUI offenses and the prevalence of other risk behaviours, including drug use and other criminal activity.^{23–26} One such study used military police records to identify arrests. Repeat DUI offenders were more likely than first offenders (or non-offenders) to have been arrested for a violent crime, concealed weapon carrying or drug possession.²⁷

Alcohol outlet density—Alcohol outlet density affects both the quantity and circumstances of individual alcohol consumption.²⁸ Alcohol outlet distribution, particularly of on-premise establishments like bars, taverns and pubs, is an independent predictor of the rate and distribution of violence in communities.^{29–32} Alcohol outlet density is also associated with other conditions related to crime and violence, such as neighbourhood social disorganisation and residential instability, and its effects must be assessed with these conditions in mind.³¹

Other key exposures

Drug abuse—In a 2004 BJS survey, >25% of inmates incarcerated for violent crimes reported committing those crimes while under the influence of drugs; >50% reported use in the preceding month.³³ Homicide offenders have rates of acute drug use or intoxication of 33–38% in toxicology studies.¹⁰ In National Violent Death Reporting System suicide data for 2010, opiates, marijuana and cocaine were identified in 20.0%, 10.2% and 4.6%, respectively, of those tested.¹²

Large-scale surveys have found that, as with alcohol, pre-existing drug abuse is associated with an increased risk of violence against others, intimate partner violence, child abuse and

child neglect.¹⁷¹⁹ In surveys and a systematic review, drug abuse has been associated with increases in risk for subsequent suicide attempts and self-directed non-fatal violence.¹³¹⁷²¹

Criminal history—Risk for new criminal activity, including violence, is greatly increased among persons with a criminal history.^{434–42} A dose–response relationship exists; the more extensive the prior criminal record, the greater the risk of subsequent offending.⁴³ Risk for violence is highly concentrated, with 6–10% of offenders committing >50% of violent offenses.³⁷ After an index offense, risk for reoffending is highest initially and declines exponentially thereafter, approaching that for non-offenders after 10–20 years.^{44–46}

Other factors—Risk for violence is strongly related to male sex and (for interpersonal violence) younger age.^{434–3747} Community characteristics such as concentrated poverty and residential segregation are associated with risk for violence and are believed to operate by multiple mechanisms.^{3648–51}

Co-occurrence of key exposures

Our principal exposures will likely co-occur but have been demonstrated to be statistically separable in previous research; each may act directly and modify risk associated with the others. Mental illness research is particularly informative on this point. In a nationally representative survey, the probability of incident violent behaviour was low for persons reporting neither substance abuse nor violence in the past, increased for those reporting only substance abuse or violence, and increased still further for those reporting both.⁵² In a case–control study of suicide, alcohol abuse was associated with a far greater increase in suicide risk among persons with a history of violence than among persons with no such history.⁵³

Findings specific to firearm owners

Alcohol abuse—No study has examined associations between alcohol abuse and future violence among firearm owners. While alcohol abuse has been linked to homicide and suicide risk when firearms are in the home, such studies are not restricted to firearm owners and do not assess risk for committing interpersonal violence.^{2053–56}

Firearm ownership itself may be associated with alcohol abuse, including binge drinking and heavy drinking.^{757–63} Moreover, firearm owners who abuse alcohol are more likely than others to engage in firearm-related risk behaviours, including behaviours likely to be associated with violence.⁷⁶²⁶³

Demographics and criminal history—Longitudinal studies of violent and non-violent criminal activity among handgun purchasers in California have shown large increases in risk for men, a direct relationship between risk and the extent of any criminal history, and an inverse relationship between risk and age.^{64–67}

Firearm ownership—Firearm ownership itself has been associated with an increased risk of arrest⁵⁷⁶⁸ or ‘trouble with the police.’⁶⁰ Carrying a firearm in public has also been linked to arrest for a non-traffic offense⁶²⁶⁸ and aggressive or hostile driving behaviour.⁶⁹⁷⁰

METHODS

Overview

This is a records-based retrospective cohort study. The study population will comprise all persons who legally purchased handguns in California in 2001—approximately 116 000 individuals. The measurement period for capturing outcome events will begin with each subject's first handgun purchase in 2001 and end on 31 December 2013. We will extract data on arrests and convictions both prior and subsequent to the inception date from subjects' criminal histories, and data on other alcohol-involved events from driver's licence records. The primary outcome event will be an arrest in California for a violent Crime Index crime: homicide, rape, robbery and aggravated assault. Subjects will be considered at risk for outcome events for only as long as their residence in the state can be verified independently of outcome events.

Background: buying a handgun in California

California requires almost all transfers of firearms—sales, including those involving a private-party seller; pawn redemptions; and gifts—to be processed by a licensed firearm retailer. Transfers at gun shows or involving internet brokers are included. Purchases cannot be completed without a driver's licence or military identification card, which must be 'swiped' through a reader to enter personal information. California also requires centralised, permanent records for firearm transfers. A separate record, referred to as a Dealer's Record of Sale (DROS), is generated for each firearm transferred. Records for handguns have been required since the early 1950s; rifle and shotgun records have been required since January 2014.

A required 10-day waiting period allows for a background check to determine whether the purchaser is a prohibited person. California prohibits purchases by individuals who are not prohibited under federal law: persons convicted of violent misdemeanours (eg, assault and battery), persons who pose an imminent danger to themselves or others and have been hospitalised for emergency psychiatric evaluation, and persons subject to temporary domestic violence restraining orders.

Data sources

DROS file—DROS records contain identifiers for the purchaser, the retailer and the firearm, and the date and time of the transaction. First-time purchasers receive a unique DROS-ID number, and their subsequent purchases are associated with that number. If a purchaser has a record in the state's Criminal History System (CHS), his unique Criminal Identification and Information (CII) number is added to his DROS record. If a prospective purchaser is found to be a prohibited person, the purchase is denied and a permanent record is kept. DROS records from 2001 will identify our study population. We will use DROS records from 1991 to 2013 and the denied file to construct each subject's handgun purchase history.

Criminal History System—CHS contains >10 million records; nearly all are computerised.⁷¹⁷² Records include extensive personal identifiers, the CII number and numbers

assigned by agencies such as the FBI. Each criminal justice action, such as a charged offense or conviction, generates a separate entry.

Offenses are recorded very specifically. Aggravated assaults involving firearms, for example, are charged under weapon-specific sections of the Penal Code. There are specific Penal Code sections for intimate partner and sexual violence. Drug offenses involving opioids and cocaine are charged separately from those involving methamphetamine.

Recording of arrests in CHS is rapid and complete.⁷¹ Conviction recording is less complete, particularly for recent offenses. This will have little impact on our baseline data, as 2001 is our inception year. It is one of several reasons for our use of arrests as outcome events. There are minor missing data conditions. For example, records for specified offenses relating to possession of small quantities of marijuana must be deleted after 24 months.

Department of Motor Vehicles files—The Driving Record File contains licensee identifiers and entries for ‘department actions’ such as DUI arrests and convictions and judgements by law enforcement officers that collision-involved drivers had consumed alcohol. These field judgements have a sensitivity of 75% and high specificity, and they are more common than DUI arrests.^{73–76} We will use department action data to improve ascertainment of DUI arrests and convictions and in a supplemental analysis will assess the effect on our findings of incorporating field judgements. We will use driver’s licence renewal and vehicle registration records to establish residence in California.

Formation of the study population

The study population will comprise all individuals with handgun purchase records in the 2001 DROS file. There are 160 619 records involving an estimated 116 675 distinct purchasers. The data suggest that 2001 was a typical year, with a sales volume and age and sex distributions similar to those for 1996–2005. For 2001, 98.8% of records include a California driver’s licence number; the remainder contain a military ID.

Data acquisition and management

Data will be provided as computer files. We will submit criminal records requests for all study subjects to CalDOJ, which will use its standard protocols for linking subjects to records. Tentative matches will be reviewed manually by us using all available data. We will categorise crimes using the FBI’s Uniform Crime Reports system⁷⁷ and a separate classification scheme for offenses of particular interest: involving firearms, intimate partner or domestic violence, and so on.

We will request records for all subjects from the Department of Motor Vehicle (DMV). In the past, we have achieved a nearly 100% hit rate for subjects with driver’s licence numbers and a >50% hit rate for others.

We will geocode subjects’ addresses and include data from the 2000 Census on characteristics of subjects’ communities at baseline. Alcohol outlet locations have been obtained and geocoded; small-area densities can be computed. Local arrest rates are available from CalDOJ.

There is no generally available direct measure of the prevalence of firearm ownership. The best-validated and most widely accepted proxy is the proportion of all suicides that involve fire-arms (FS/S).⁷⁸ These data are available at the county level. For most cities, however, FS/S is too sensitive to small-number variation. Firearm injury data are available from the California Office of Statewide Health Planning and Development,⁷⁹ which provides public access to these data geocoded to the ZIP code level and will provide tabulations to Census block groups. We will assess these data as an alternative proxy measure for firearm ownership.

Follow-up

Only events occurring in California will be captured as outcome events, as criminal records for other states are not available for this purpose. We will, therefore, consider subjects to be at risk for outcome events for only as long as their status as alive and residing in California can be verified independently of outcome events.

We will capture outcome events beginning 10 days following the DROS record date using the first record in 2001 for subjects having more than one. This is the first day on which the handgun could have been acquired, given California's waiting period. (Acquisition dates are not available.) The measurement period will end 31 December 2013.

To track subjects through our follow-up period, we will begin with linkage to DMV records and voter registration data.⁸⁰⁻⁸³ We will search the California Death Statistical Master File, which includes all deaths in California and deaths elsewhere in the USA of California residents. For subjects with incomplete follow-up, we will request credit agency reports and query the National Death Index. Records linkage procedures will vary with the data involved.⁶⁴⁻⁶⁷⁸⁴ Our follow-up period will extend beyond the measurement period in order to increase the percentage of subjects with follow-up for the entire measurement period.

Subjects with no follow-up will be excluded from longitudinal analyses. Data on outcome events will be collected for these subjects to allow for an estimate of the bias introduced by lack of follow-up.

Power analysis

The study is powered to detect differences in risk for the outcome measure of greatest interest, even though that outcome is uncommon, involving the prespecified subgroups of greatest interest, even when those subgroups are small. In our prior studies, when handgun purchasers with no criminal history served as the referent group, RRs for all outcomes among purchasers with a criminal history were 5.0.^{64,66} In this study, we will have >90% power to detect at the 0.05 level (two-sided) a HR <1.5 comparing handgun purchasers with a criminal history to those with no criminal history with respect to time to first arrest for a violent Crime Index offense. We will have >80% power to detect HRs <2.0 for most subgroups of purchasers, including those with any alcohol-related convictions and with only one conviction, and <2.5 for purchasers with multiple alcohol-related convictions versus those with no criminal history.

Analysis plan

The principal outcome measure will be an arrest for a violent Crime Index crime. Secondary outcomes will include arrests for violent crimes involving firearms; for intimate partner or domestic violence; for sexual assault; for violent crimes generally; and for crimes of the following types, considered separately: involving firearms, alcohol and drugs.

The principal independent variables relate to the existence, nature and extent of subjects' criminal histories at the time of handgun purchase. The following baseline characteristics will be included as covariates in multivariable analyses:

demographics: age, race/ethnicity, and sex;

handgun purchase history from 1991 to the index purchase;

desistance: elapsed time since the most recent arrest,^{44–46} for all offenses and for offenses categorised as above.

Community characteristics: violent and non-violent crime rates, urban/rural status,⁸⁵ location by region in the state,⁸⁶ population size, demographic and socioeconomic variables, prevalence of firearm ownership and alcohol outlet density.²⁹ We are capturing changes of address and will treat community characteristics as time-varying covariates in time-to-event models.

We will use standard descriptive methods to compare subjects with and without prior criminal histories on variables in common. Generalised estimating equations⁸⁷ will be used to account for clustering within census tracts or ZIP codes in comparisons of community characteristics at baseline.⁸⁸

The primary analyses will determine the association between the primary outcome measure and the independent variables pertaining to each of four key exposures: alcohol offenses, drug offenses, other misdemeanour crimes and alcohol outlet density.

We will estimate the probability of experiencing a first new arrest over time by the Kaplan–Meier method.⁸⁹ The significance of differences in probability of arrest between study subgroups (eg, subjects with and without a criminal history) will be assessed by the log-rank test. Cox proportional hazards regression will be used to calculate univariate and adjusted HRs and 95% CIs.⁹⁰ Models that include community characteristics will use a robust sandwich estimator⁹¹ to account for clustering. Influence diagnostics will be performed, and reliance on the proportional hazards assumption will be validated.⁹²

For each independent variable, we will develop multivariable models by adding covariates in blocks: (1) individual demographic characteristics, (2) community demographic and socioeconomic characteristics, (3) crime rates and (4) firearm ownership prevalence. Parsimonious models will be developed. We will determine whether alcohol outlet density modifies the effects of each of the other independent variables. Models will be constructed that include both drug and alcohol offenses and their interaction, to assess their combined effect. Additional analyses will focus on predefined subgroups of the study population.

Secondary analyses will include crime rates, alcohol outlet density and handgun purchases during the period of observation as time-dependent covariates. We will include arrests (by offense type) as time-dependent covariates to develop models addressing desistance. We will develop conditional, total time-recurrent events models to study effects as additional arrests occur and as duration of follow-up increases.^{92–94}

Limitations

DROS records do not constitute a registry—only acquisitions are recorded—so we cannot determine whether subjects dispose of firearms and perhaps become non-owners. DROS did not capture long-gun ownership during our study period, and our findings may not apply to individuals who own long guns but not handguns.

Records capture only events known to the relevant agencies. Failed detection and lack of reporting result in missed events. Nonetheless, it is clearly of value to learn whether recorded events are associated with differences in risk, particularly because records such as we use here might constitute the basis for future interventions based on our findings.

The records are for California only, which may limit pre-purchase histories for recent immigrants. One effect of this will be occasional misclassification of subjects as having no criminal history. This will likely be a source of bias towards the null.

As discussed, persons convicted of violent misdemeanours are prohibited from purchasing firearms in California (for 10 years following those convictions). Given the effects of co-occurring alcohol abuse and violence, this may reduce the size of effects associated with alcohol-related arrests and convictions in our data—again, a conservative bias.

DISCUSSION

This study will assess the complex relationships between alcohol abuse (as assessed by arrests and convictions for alcohol-related offenses), other important and co-occurring potential risk factors, and future violence among firearm owners, a large and unstudied population that is of particular interest for studies of firearm-related violence. The findings are likely to satisfy many of the Bradford Hill criteria for inference that associations in observational studies are causal.⁹⁵ The association between alcohol abuse (and other key exposures) and future violence is likely to be strong. Such an association would be consistent with a large body of prior research. The temporality criterion is addressed by the longitudinal study design. A dose–response relationship is likely, and the association would certainly be plausible and coherent with the known natural history of alcohol abuse.

The study's findings will likely have clear implications for interventions to prevent alcohol-related violence and should be generalisable as no attributes unique to the study population or setting are being examined.

The richness of the data allows us to address important subsidiary questions. One is how characteristics identified as risk factors for violence in this study population interact when multiple factors are present. Another is whether risk for future violence associated with alcohol abuse is modified by local alcohol outlet density. Still another is whether desistance

matters: is risk for continuing offenders increased in comparison with prior offenders who have ceased offending?

As much of the violence attributable to mental illness results from co-occurring alcohol or drug abuse, the findings of the study are likely to have implications for preventing violence among the mentally ill and efforts to prevent suicide and self-harm.

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