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DIFFERENCES IN RISK OF INJURY IN THE U.S. GENERAL POPULATION BY INJURY TREATMENT TYPE: DATA FROM THE 1995–2010 NATIONAL ALCOHOL SURVEYS

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Abstract

Background—While emergency room (ER) studies have documented a strong association of alcohol with injury, these studies are not necessarily representative of the general population. To evaluate comparative risk of injury from drinking for those treated in the ER with non-ER treated injuries (those treated elsewhere or those not treated), data on alcohol and injury are analyzed in the U.S. general population by type of injury treatment.

Method—Relative risk (RR) of injury from drinking within six hours prior to the event was analyzed using case-crossover analysis based on respondents' usual frequency of drinking in four (1995–2010) National Alcohol Surveys (n=4819).

Results—RR was 1.01 for the total injured and significantly elevated for ER-treated injured (1.46), but not for those treated elsewhere (0.75) and those not treated (1.02). RR was significantly elevated for those aged 18–30 years (1.45; 1.14, 1.85), Blacks (1.54; 1.11, 2.14) and Hispanics (1.98; 1.51, 2.59), those positive on the RAPS4 as a measure of alcohol dependence (2.41; 1.86, 3.11), and for motor vehicle injuries (2.61; 1.49, 4.58) or cutting/piercing injuries (2.045, 1.01, 3.81). For those reporting ER-treated injuries, significant effect modification was found for those aged 18–30 years (RR=2.29), Blacks (RR= 2.59) and Hispanics (RR= 2.68), high risk taking (RR=1.71) positive RAPS4 (RR=3.69), and for motor vehicle (RR=3.79), and cutting/piercing injuries (RR=2.60).

Conclusions—Data suggest alcohol plays a larger role in injuries for which ER treatment is sought than for other injuries, and estimates for injury from drinking derived from ER studies may be elevated. Future general population studies should take into account intensity of exposure to alcohol prior to injury, potential recall bias (by eliciting data on the proximity of injury to time of the respondent interview) and severity of injury, for improving estimates of the attributable burden of alcohol to injury in society.

Keywords

injury; drinking; injury-treatment-type; general population

INTRODUCTION

While emergency room (ER) studies have documented a strong association of alcohol with non-fatal injury (Cherpitel, 2007; Romelsjö, 1995), injuries treated in the ER are not representative of all injuries, nor are data coming from these studies necessarily representative of the larger population which these ERs serve, even when strict probability sampling techniques are used. Patients falling into ER samples are more frequent users of the ER than other ER patients, and have also been found more likely to be frequent heavy drinkers than those in the general population (Borges et al., 1998; Cherpitel, 1995).

Risk of injury due to alcohol in ER studies has generally been based on the case-control method, in which non-injured patients serve as quasi-controls (Cherpitel, 1993a; Cherpitel, 2007). These patients, however, may not be good control subjects, since some conditions treated in the ER, such as liver cirrhosis, are directly linked to long-term chronic heavy drinking, resulting in a greater likelihood of drinking compared to those in the general population (Cherpitel, 1993b). Conversely, patients may choose to abstain from alcohol due to health problems, including the problem which brought the patient to the ER (the “sick quitter” effect) (Shaper, 1990).

An alternative approach to examine risk of injury is the case-crossover method (Maclure, 1991; Mittleman et al., 1993) in which patients are used as their own controls in studying the effect of a transient factor (e.g., alcohol exposure) on the risk of an acute event (injury). Compared to the case-control method, the case-crossover method avoids the potential control biases noted above, as well as potential confounding of the alcohol-injury relationship from stable within-person risk factors (e.g., demographic and dispositional characteristics and usual alcohol use patterns) (Vinson et al., 1995; Vinson et al., 2003). Prior research in the general population found, using case-crossover analysis based on the usual frequency of drinking, risk of injury during the last year was significant only for those reporting an injury treated in the ER and not for those reporting an injury treated elsewhere or an injury that was not treated (Cherpitel and Ye, 2008). Additionally, findings from this same study using risk function analysis, suggested that risk of injury related to usual volume of consumption and the number of high maximum days varied by injury treatment type (Cherpitel and Ye, 2009).

To examine differences in risk of injury by type of injury treatment, not possible in ER-based studies, data were analyzed from general population respondents who reported an injury during the preceding year, in a merged sample from the Alcohol Research Group’s four most recent U.S. National Alcohol Surveys (1995, 2000, 2005, 2010). Analysis also included other factors which might be expected to affect the alcohol-injury relationship, such as demographic characteristics, type/cause of injury, alcohol dependence and risk taking disposition. Accurate estimates of risk of injury are critical for informing the attributable burden of injury to alcohol, a key priority identified by the World Health Assembly Resolution on Alcohol and Global Strategy to Reduce the Harmful Use of Alcohol (World Health Organization, 2010). Estimates of the alcohol attributable fraction (AAF) of injury in the ongoing work on Comparative Risk Assessment of the Global Burden of Disease have largely relied on studies conducted in ERs (Taylor et al., 2010). AAFs are endorsed by the World Health Organization for making priority decisions between conditions (Lim et al., 2012; World Health Organization, 2004), and many monitoring and surveillance systems include indicators of alcohol-attributable injury as core elements (World Health Organization, 2000). Efforts to improve these systems, called for by the World Health Assembly (2010), emphasize the necessity of improving estimation of RR of injury.

Within this context, risk of injury estimates are compared between those reporting injury treated in the ER and both those reporting injuries treated elsewhere and those reporting untreated injuries among respondents in the U.S. general population.

METHODS

Samples

Fieldwork for the 1995 and 2000 National Alcohol Surveys was sub-contracted to the Institute for Survey Research at Temple University, while fieldwork for the 2005 was subcontracted to DataStat, Inc., and for the 2010 survey to Micro International. Data for the 1995 survey were obtained from face-to-face interviews in respondents' homes in the 48 contiguous states. A multistage area-probability sample was drawn, of those aged 18 years and older living in households, using 100 primary sampling units with an oversampling of Blacks and Hispanics. Completed interviews were obtained on 4925 respondents, representing a 77% completion rate.

Data from the 2000, 2005 and 2010 surveys were collected using Random Digit Dial (RDD) Computer Assisted Telephone Interviews (CATI) of those aged 18 years and older in all 50 U.S. states and the District, again with an oversampling of Blacks and Hispanics. Completed interviews were obtained on 7612 respondents, representing a 58% completion rate in the 2000 survey; 6919 respondents, representing a 56% completion rate in the 2005 survey, and 7969 respondents, representing a 52% response rate in the 2010 survey (all considered acceptable rates for telephone surveys (Frey, 1989)). Both the 2000 and 2005 surveys sampled landlines only, while the 2010 survey added cell-phones in the sampling frame. Non-response in all surveys was due to refusals, incapacitation, language barriers and failure to establish contact. To examine potential biases related to mode of the survey, differences in alcohol consumption and alcohol-related harm were analyzed between the 1995 and 2000 surveys, with few differences found (Midanik and Greenfield, 2003; Midanik et al., 2001).

Data Collection

Interviews were conducted with informed consent once contact had been established with the respondent by trained interviewers using a structured interview schedule of about one hour in length for the 1995 in-person interview, and 45 minutes for the telephone interviews.

Instruments

Respondents were asked if they had had an *injury during the last year* (including both intentional and unintentional injuries) for which they thought about treatment, whether they obtained treatment for that injury, and if so, the type of treatment (ER, primary care, or other type of treatment). If respondents reported more than one injury, information about the most recent event was elicited, including (for the 2005 and 2010 surveys) the *type/cause of injury*, categorized as: 1) fall, 2) motor vehicle, 3) cutting or piercing, 4) other. Respondents were also asked if they had *consumed any alcohol* in the six hours prior to the injury. A series of questions related to the *quantity and frequency (Q-F) of usual drinking* during the last year was also asked (Clark and Hilton, 1991). The *Rapid Alcohol Problems Screen* (RAPS4) (Cherpitel, 2000), a 4-item instrument which was developed in the ER setting based on an optimal set of screening items from several instruments, was used as a measure of alcohol dependence during the last year, with a cut point of one indicative of dependence.

Questions related to *risk taking/impulsivity/sensation seeking* were adapted (Eysenck and Eysenck, 1977; Jackson, 1974) and items combined and analyzed using principal axis factor analysis (Cherpitel, 1993c; Cherpitel, 1999). The composite scale is comprised of seven items, including "act without stopping to think", "get kick out of doing dangerous things",

“like to test oneself by doing chancy things”, “like to try new things for excitement”, “like new and different sensation”, “act impulsively”, and “not let risk of getting hurt stop good time”. Respondents were asked whether each statement described them, on a four-point scale of not at all, a little, some, quite a lot. A mean value for items for each respondent was calculated and a dichotomous risk taking scale developed to reflect scoring high (mean score >3, representing 39% of the total combined sample) or low (mean score ≤3, representing 61% of the sample). Demographic characteristics including gender, age and race/ethnicity were also obtained.

Data Analysis

Data are analyzed on the 20% (n=4819) who reported an injury during the preceding year across the four surveys combined, by injury-treatment type (Table 1) and by potential risk modifiers for the total compared to those reporting an ER treated injury (Table 2). Of those reporting an injury, aged 18 years did not indicate whether/where they received treatment. Chi-squared test were used to analyze significant differences in demographic and drinking characteristic across the three treatment types (Table 1).

Relative Risk (RR) of injury from drinking prior to injury is calculated based on case-crossover analysis (Maclure, 1991; Mittleman et al., 1993) derived from the person’s usual drinking during the last year. Each person’s drinking prior to injury was compared to the likelihood of drinking at that time based on his or her usual frequency of drinking in the last 12 months, using the formula: $RR = \sum x_i(1-p_i) / \sum (1-x_i)p_i$, where $x_i = 1$ if drinking prior to injury and p_i is probability of drinking based on usual frequency (Maclure, 1991). A six-hour interval for sleeping each 24-hour period was excluded when calculating the probability of drinking (Maclure and Mittleman, 2000).

Variations in the magnitude of RR across levels of fixed characteristics – gender, age, race/ethnicity, risk taking, alcohol dependence (RASP4), and type/cause of injury - were examined as possible effect modifiers. Strata-specific RRs were estimated for each level of potential modifiers, for example, separately for men and women. χ^2 test of homogeneity was performed to examine whether the effects differ across levels of potential modifiers (Rothman and Greenland, 1998).

Data were weighted to adjust for the probability of selection (number of households, multiple phone lines and adult residents in households), ethnic oversampling and non-response. Data were also weighted to reflect the US adult (aged 18+ years) population proportions of ethnicity by region by age by gender groups. Percentages and relative risk estimates are reported as weighted and n’s as unweighted.

RESULTS

The percentages of any injury were quite similar across the survey years, ranging from 18.2% (2005) to 21.6% (for both 1995 and 2010, not shown). Table 1 shows demographic characteristics of the three injury treatment-type groups. Of those reporting an injury, 30% (29–30% across survey years) reported going to the ER, 46% (43–48%) reported going to a private doctor, clinic or to some other place, and 23% (22–27%) reported no treatment. Differences were significant across the three treatment-type groups for age, race/ethnicity, and reporting drinking prior to the event ($p < 0.05$), and marginally significant for gender ($p = 0.057$).

Risk of injury from drinking prior to the event was significant for those reporting ER treatment ($RR = 1.46; 1.18, 1.80$), but negatively predictive for those seeking injury treatment elsewhere ($RR = .75; 0.60, 0.94$). For untreated injuries RR was 1.02 (not significant). For all

injury treatment types, no relationship was found between drinking prior to the event and injury (RR=1.01).

Table 2 shows relative risk of injury by potential effect modification for a number of variables that might be expected to affect the alcohol-injury relationship, for the total and for those reporting ER treatment. Risk was significantly elevated for those aged 18–30 years, ethnic minorities, those positive on the RAPS4, and motor vehicle and cutting/piercing injuries. Additionally, for those reporting ER treatment, risk was significantly elevated for those scoring high on risk taking disposition.

DISCUSSION

These data indicate that alcohol plays a larger role in those injuries for which ER treatment is sought than for other types of injury, and risk is elevated for those younger, ethnic minorities, those reporting indicators of alcohol dependence and those with motor vehicle or cutting/piercing injuries. It is possible that risk of injury may be greater for injuries treated in the ER due to the severity of the injury (among other factors), since injuries treated in ERs are likely more serious than injuries not requiring emergency treatment. It should also be noted that the intensity of exposure (Murray and Lopez, 1996), was not taken into account, i.e., the amount of alcohol consumed prior to injury, or the time between the last drink and the event -- both of which are likely important to risk of injury from drinking across all three treatment-type groups.

All RR estimates here were smaller than those found in the majority of studies of patients in the ER. A case-crossover analysis of ER studies, using the pair-matched approach across 10 countries, found a RR of 5.7 for drinking within six hours of injury (Borges et al., 2006b), while another study across 16 countries, using the usual frequency case-crossover approach, found a pooled random effects RR of 5.69 for drinking during this same time (Borges et al., 2006a). A recent review and meta-analysis of 28 ER studies found an overall RR, based on drinking within six hours prior to the event, of 2.8, which varied depending on the study design, from 1.9 for case-control studies to 4.2 for usual frequency case-crossover studies (Zeisser et al., 2013). Estimates here are also lower than those from an earlier study of risk of injury in the U.S. general population, also based on drinking within six hours prior to the event and using the case-crossover usual frequency approach, as used here: 1.85 for ER-treated injury, 1.42 for other-treated injury and 1.47 for un-treated injury (Cherpitel and Ye, 2008). However, that study did not adjust for sleeping time, as in the present study, and making this adjustment results in less usual unexposed time and consequently a smaller RR of injury.

One potential explanation for lower RR estimates of drinking prior to injury from studies of the general population compared to ER studies is that these national surveys have similar proportions of males and females who report ER treatment, contrary to ER studies which generally show a larger proportion of male patients (who are more likely to drink) than female injury patients (Borges et al., 2006a). Additionally, larger proportions of patients are under 30 years of age in ER samples compared to those in the present study, and those younger are more likely to be drinking prior to injury and to have a higher RR for injury than those older (Borges et al., 2006a). It should also be noted that data on drinking prior to the event in the present study, across all injury treatment types, was subject to the respondent's recall over the past year. Drinking prior to an injury in ER studies may be more accurately remembered by patients admitted to the ER shortly after the event, and the 'protective' effect of drinking found here for those in the general population who were treated elsewhere (RR=.73) may reflect this recall bias.

The purpose of the present study, however, was not to compare estimates of risk from drinking of injuries treated in ERs from the general population with those from ER studies, as these estimates would not be comparable, not only because of the potential recall bias mentioned above, but also because ER studies are only representative of the particular clientele served by the ERs, and ERs have been found to vary substantially across studies. For example, RR based on self-reported consumption within six hours prior to injury from a meta-analysis of case-control ER studies (all using the same study design and methodology) ranged from 1.07 (in a suburban health maintenance organization ER) to 2.38 (in a publically-funded inner city ER) across five studies (representing 10 ERs) in the U.S. (Cherpitel et al., 2005). Also, as noted above, ER patients are more frequent heavy drinkers than those in the general population, and are also more frequent users of these facilities (Borges et al., 1998; Cherpitel, 1992; Cherpitel, 1995), both of which may be associated with other differences (e.g., demographic characteristics) that can affect the alcohol-injury relationship.

Analysis here found RR of injury was modified by cause of injury, risk taking disposition and indicators of alcohol dependence. While risk of injury has been found to be larger for traffic-related injuries than for some other types of injury in ER studies (Borges et al., 2009), significant effect modification was not found (Borges et al., 2006b). Previous general population studies have found independent effects of alcohol and risk taking disposition on injury (Cherpitel, 1993c; Cherpitel, 1999), however, one ER study did not find dispositional variables related to injury (Bazargan-Hejazi et al., 2007), nor did a study of ski injury (Cherpitel et al., 1998). The RAPS4 as an indicator of alcohol dependence, however, has been found to be a significant effect modifier in prior ER studies (Bazargan-Hejazi et al., 2007; Borges et al., 2006b).

The purpose of these analyses was to shed light on differences in RR of injury for those treated in the ER compared to those not treated in an ER, and findings here emphasize the additional risk at which alcohol places the individual for injuries that are treated in the ER, supporting prior research which suggests the ER visit as an important opportunity for screening, brief intervention and referral to treatment for alcohol-related problems.

A strength of the study is the analysis of data from four U.S. National Alcohol Survey, spanning a 15 year period, weighted to be representative of the general population and, by nature, also representative of the mix of ER types and of other injury treatment types available in the population. Several limitations to the study also apply. As noted above, no measure of injury severity was obtained, although those injuries treated in the ER are presumed to be of greater severity than injuries treated elsewhere or those not treated. Additionally, the amount of alcohol consumed was not obtained, and ER studies have found a dose-response relationship between alcohol and risk of injury (Borges et al., 2006b). It would also be expected that a respondent would be more likely to recall drinking before an injury event that resulted in a visit to an ER than for an injury not requiring ER attention. All three of these limitations may have resulted in a higher RR of injury from drinking among those reporting an injury treated in the ER during the last year than for an injury treated elsewhere or not treated. As noted above, prior analysis did not find significant differences for alcohol consumption or for alcohol-problem variables by mode of survey, and it is, therefore, unlikely that mode had a differential effect on reporting drinking prior to injury by injury treatment type. Additionally, respondent burden of a relatively lengthy interview (45 minutes to one hour) is also unlikely to have resulted in a differential effect on reporting drinking prior to injury by injury treatment type.

Data here suggest alcohol plays a larger role in injuries for which ER treatment is sought than for other injuries, and RR estimates derived only from ER studies may be elevated.

Elevated risk from drinking for injuries treated in the ER may not only be related to risk taking disposition, as found here, but also to severity of injury (not measured here). Future general population studies should also take into account intensity of exposure to alcohol prior to injury, and potential recall bias (by eliciting data on the proximity of injury to time of the respondent interview), which are necessary for determining unbiased estimates of the RR of injury from drinking, and for improving estimates of the attributable burden of alcohol to injury based in general population studies.

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Table 1
Demographic and Drinking Characteristics (in percent) and Relative Risk of Injury by Injury Treatment Type

	Total (4819) ^a	ER Treated (1466)	Other Treated (2215)	Non Treated (1120)	Chi-Square
Males	53.7	51.3	53.3	57.6	<i>p</i> =0.057
18–30	26.2	28.9	20.0	35.1	<i>p</i> <0.001
Race/ethnicity					
White	76.0	72.3	78.9	75.3	<i>p</i> =0.007
Blacks	9.6	12.8	8.0	8.7	
Hispanics	8.7	8.9	8.1	9.9	
Others	5.7	6.0	5.0	6.2	
Reported drinking	5.2	6.6	3.9	6.0	<i>p</i> =0.030
Relative Risk	1.01 (0.89, 1.15)	1.46*** (1.18, 1.80)	0.75* (0.60, 0.94)	1.02 (0.79, 1.32)	

^a 18 did not indicate whether/where they received treatment.

p<0.01,

p<0.001

Table 2

Relative Risk of Injury from Drinking within 6 hours prior to the event by Potential Risk Modifiers for Total and ER-treated Injury

	Total	ER Treated
Total	1.01 (0.89, 1.15)	1.46 (1.18, 1.80) ***
Gender	(p=0.163) ^a	(p=0.761) ^a
Males	0.95 (0.80, 1.12)	1.43 (1.08, 1.87) *
Females	1.15 (0.93, 1.43)	1.53 (1.08, 2.16) *
Age	(p<0.001) ^a	(p=0.003) ^a
18–30	1.45 (1.14, 1.85) **	2.29 (1.56, 3.37) ***
>30	0.83 (0.71, 0.98) *	1.11 (0.85, 1.46)
Race/ethnicity	(p<0.001) ^a	(p=0.002) ^a
White	0.89 (0.76, 1.06)	1.26 (0.94, 1.68)
Black	1.54 (1.11, 2.14) *	2.59 (1.64, 4.09) ***
Hispanic	1.98 (1.51, 2.59) ***	2.68 (1.74, 4.12) ***
Risk taking	(p=0.038) ^a	(p<0.001) ^a
High	1.04 (0.87, 1.25)	1.71 (1.30, 2.26) ***
Low	0.76 (0.61, 0.97) *	0.64 (0.40, 1.03)
Alcohol dependence	(p<0.001) ^a	(p<0.001) ^a
Positive RAPS4 ^b	2.41 (1.86, 3.11) ***	3.69 (2.41, 5.65) ***
Negative RAPS4 ^b	0.63 (0.51, 0.78) ***	0.77 (0.54, 1.10)
Type/cause of injury ^c	(p<0.001) ^a	(p=0.007) ^a
Fall	0.98 (0.68, 1.40)	1.05 (0.56, 1.95)
Motor vehicle	2.61 (1.49, 4.58) ***	3.79 (1.99, 7.21) ***
Cutting or piercing	2.04 (1.10, 3.81) *	2.60 (1.04, 6.50) *
Other	0.89 (0.68, 1.16)	1.27 (0.76, 2.13)

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

^a χ^2 test of homogeneity

^b Rapid Alcohol Problems Screen

^c Available only for 2005 and 2010 surveys