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ALCOHOL AND INJURY IN THE U.S. GENERAL POPULATION: A RISK FUNCTION ANALYSIS FROM THE 2005 NATIONAL ALCOHOL SURVEY

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Abstract

A risk function analysis of data is reported from the 2005 National Alcohol Survey on average daily volume of alcohol and frequency of consuming 5 or more drinks per day with reporting: 1) any injury during the preceding year; 2) an injury which was treated; and, 3) an injury which was treated in the emergency room (ER). Data suggest the association of alcohol and injury based on ER studies is not representative of all injuries, and should be taken into account in deriving estimates of risk of injury related to alcohol and alcohol attributable fractions based on ER studies.

Keywords

General population; Emergency room; Injury; Alcohol use

INTRODUCTION

The majority of data on risk of injury from alcohol come from emergency room (ER) studies, but we do not know how representative these data are of the general population, or the level of risk at which various quantities of alcohol or particular patterns of drinking place the individual for injury.

A recent risk function analysis of ER data from seven countries (including ten ERs in the U.S.) on injury related to average daily volume of consumption and the number of occasions in which five or more drinks were consumed at one time (5+days) during the last year, found risk of injury increased proportionally with increased alcohol consumption, but a threshold effect was achieved at relatively low levels of mean daily consumption and higher consumption times, possibly indicative of developed tolerance on the part of heavier drinkers¹. Increases in injury risk were found to an average of about 2 drink per day, with a leveling off of risk at higher volumes. In the U.S. risk of injury increased to 12 or more 5+ days. While similar risk curves were found for males and females, females were generally at lower risk of injury. Studies of alcohol and injury conducted in ERs, however, have found ER patients more likely to be frequent heavy drinkers than those in the general population from which they come². Injured patients seeking treatment in an ER have also been found to be heavier drinkers than injured patients seeking other kinds of treatment or no treatment³, both of which raise the question as to the representativeness of data on risk of injury from drinking based on studies of ER patients.

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An earlier risk function analysis of alcohol and injury in the U.S. general population found risk of injury to be lower for those averaging from 2 to 3/4 drinks per day compared to those averaging less ⁴, suggesting a “j-shaped” curve, with the lowest risk at lower levels of alcohol consumption compared to abstinence, and increasing more rapidly at higher levels of consumption. This analysis also found risk of injury to level off at six to eight 5+days during the last year.

Other studies have found a dose-response relation between risk of injury and volume of consumption. Blood alcohol concentrations (BACs) of 0.8%, 1.0%, 1.5% and 2.0% have been found to be associated with a 2-fold, 7-fold, 10-fold and 20-fold increase, respectively, in risk of a road traffic accident in the U.S. ⁵. A Finnish study found ER patients with BACs between 0.05 and .10mg% were over three times more likely to be injured from falls than those with no detectable blood alcohol, while those with BACs over 0.15mg% were 60 times more likely to suffer a fall injury ⁶.

While volume of consumption at a given time appears important for risk of injury, pattern of consumption may also be important. A study of injuries related to vehicular crashes found men with higher BACs were more likely to be frequent heavier drinkers, and to drink to intoxication more frequently, than those with negative BACs ⁷. Another study, however, found that among accident-involved drivers, while risk increased with increasing BAC, more frequent drinkers were found to be at lower risk than less frequent drinkers at all BAC levels ⁸. As mentioned earlier, a threshold level for alcohol consumption may exist, above which there is little added effect on injury risk, and those tolerant to alcohol (more frequent, heavy drinkers) may be less affected below a certain level of consumption.

To examine the association of injury with volume and pattern of consumption in the U.S. general population, and differences in association for injuries treated in the ER compared to other injuries, findings are reported here from a risk function analysis of data from the 2005 National Alcohol Survey. Reporting an injury during the last year is described as a function of the average number of drinks consumed per day (daily volume), and the frequency of consuming five or more drinks on a single day (5+ days), separately, in the following nested injury-treatment categories: 1) any injury during the preceding year; 2) an injury which was treated; and, 3) an injury which was treated in the ER. Findings here will inform how risk of injury may vary by whether or not an injury is treated in the ER, which is important for a better understanding of the representativeness of data on alcohol and risk of injury obtained from ER studies. Additionally, these data are important for a better understanding of the risk at which alcohol places the individual for injury, and for informing potential safe levels of drinking in relation to injury occurrence. Given the recent debate over the health benefits of moderate drinking, this is an important research area.

METHODS

Data collection

Fieldwork for the NAS was sub-contracted to DataStat, Inc. Data were collected via Random Digit Dial (RDD) Computer Assisted Telephone Interviews (CATI) of the U.S. general population age 18 and over in the 50 US states and the District, with an over-sampling of blacks and Hispanics and the 13 low-population states. Interviews were conducted with informed consent once contact had been made with the respondent by trained interviewers using a structured interview schedule of about 45 minutes in length. Completed interviews were obtained on 6919 respondents, representing a 56% completion rate (which has been considered acceptable for telephone surveys ⁹).

Instruments

Respondents were asked, among other items, whether they had had an injury during the last year for which they thought about treatment, whether they had obtained treatment for that event, and the type of treatment obtained (ER, other type of treatment or no treatment). Injury was categorized into the following nested categories: any injury, a treated injury, an ER-treated injury.

Respondents were also asked a series of graduated frequency (GF) questions to estimate frequency of drinking in successively lower amount-per-day intervals, in which drinking frequency of 12+, 8–11, 5–7, 3–4, 2, and 1 drinks per day, in that order, were assessed. Seven discrete choices for frequency ranged from “every day or nearly every day” to “never in the last year.” The GF approach was developed to measure not only the volume of consumption, but also heavy drinking and drinking pattern variation¹⁰. The GF approach has been validated against drinking diary data (Hilton, 1989) and has been recommended for use in the international monitoring of consumption survey¹¹.

A 12-month volume measure was first constructed by multiplying the midpoint of each specific quantity interval in the GF series by the midpoint of its associated frequency interval and then summed across intervals. The *average number of drinks per day* was then derived by dividing the overall volume by the number of days in a year. Nine categories for this measure were developed ranging from 0 to 5+ drinks per day. All of those averaging 5 or more drinks per day were grouped into the last category, since the number of patients averaging a larger daily volume than 5 drinks was too small for meaningful analysis. The frequency of high BACs (*the number of 5+ days*) was derived from summing the frequency of consuming 12+, 8–11 and 5–7 drinks per day in the GF series. Seven categories were developed, ranging from abstainers to 3–7 days per week.

Data Analysis

Data were weighted to adjust for the probability of selection (number of households, multiple phone lines and adult residents in households), and non-response. Post-stratification weights were also used to map sample respondents with the US adult (18+) population proportions of ethnicity by region by age by gender groups, and within Hispanics by country of birth. Data were analyzed using Stata, Version 8 to take into account the complex sampling design, and all analyses were weighted using Stata survey commands (Stata Corp., 2003).

Untransformed risk curves were plotted, separately, for the three nested injury treatment groups by the average number of drinks per day and by the number of 5+ days during the last year. Midpoints for each category of both drinking measures were used. For both measures the highest levels were designated by taking the average of volume or 5+ days in that range. For 5+ drinking days, abstainers are plotted separately in order to differentiate them from those current drinkers who reported no 5+ occasions during the last year.

Table 1 shows the midpoints used for average daily volume and 5+ days, and the number of patients in each category, for all respondents. Risk curves are plotted for the three nested injury treatment-types for the total and by gender. The 95% confidence interval for each point plotted for each risk curve is indicated by open symbols corresponding to the plotted symbol. Overlapping confidence intervals indicate that observed differences are not significant for plotted points.

Sample Characteristics

Among the 6919 respondents, 16.6% reported an injury during the last year (n=1149), 13.6% (n=943) reported an injury for which some type of treatment was sought, and 5.2% (n=362)

reported an injury for which ER treatment was obtained. Table 2 shows demographic characteristics for those not reporting an injury, and for those reporting an injury by the three nested injury treatment-type groups.

RESULTS

Daily Volume

Figure 1 shows the risk of injury by average daily volume for the three injury-treatment types. Risk of injury peaked at ½ drink per day for any injury and for a treated injury, and then leveled off, while risk increased to 4 drinks per day for an ER-treated injury and then fell at higher mean daily volume levels.

For men, the risk of reporting any injury or a treated injury peaked at just ½ drink per day, and then fell, leveling off at 2.5 drinks per day, while the risk of reporting an ER treated injury increased to an average of 4 drinks per day (Figure 2).

For women the risk of all three injury treatment types increased to an average of 8 drinks per day (Figure 3).

5+ Drinking Days

Figure 4 shows the risk of injury by the number of 5+ days for the three injury-treatment types. Risk was highest at just one 5+ day for any injury and a treated injury, while risk of an ER-treated injury increased to 78 5+ days, and then fell

For men, the risk of reporting any injury or a treated injury peaked at one 5+ day in the last year, while the risk of reporting an ER treated injury increased to 78 5+ days.

For women, the risk for any injury or a treated injury increased to 270 5+ days in the last year, while the risk of an ER-treated injury increased to 78 5+ days.

DISCUSSION

For men, the risk of reporting any injury or a treated injury increased to an average of 2.5 drinks per day and one 5+ day in the last year, while the risk of reporting an ER treated injury increased to an average of 4 drinks per day and to 78 5+ days in the last year. For women the risk of all three injury types increased to an average of 8 drinks per day, and to 270 5+ days in the last year for any injury or a treated injury, and 78 5+ days for an ER-treated injury. Dose-response relationships were found to differ across injury treatment-types and gender. A stronger relationship was found in risk related to average daily volume for ER-treated injuries compared to other injuries for men, but not for women. A stronger dose-response was also found in risk for ER-treated injuries related to high maximum days for both men and women. With the exception of the risk of ER-treated injuries associated with high maximum days, women showed a stronger association of increased levels of drinking (both average daily volume and heavier consumption times) than men, suggesting the possibility that men may have developed a greater degree of tolerance related to higher levels of consumption than women.

Findings reported here suggest that risk of injury related to increased levels of drinking not only differs by gender, but also by injury treatment-type, and by injury-treatment-type by gender. Injuries treated in ERs are not necessarily representative of other injuries, and ER-treated injuries are likely of greater severity than those not requiring emergency treatment or those not treated at all. Prior studies have reported a positive association between injury severity and alcohol consumption¹², which may account for the greater risk related to volume and high maximum days found for injuries treated in the ER; however, other studies have not found

severity of injury related to drinking, and this has been an issue of on-going debate ¹³ with mixed findings ^{14, 15}.

As mentioned, a prior risk function analysis of alcohol and injury in the U.S. general population found risk of injury lower for those averaging from 2 to 3/4 drinks per day compared to those averaging less ⁴, but data here do not support this “j-shaped” association. Data here do support findings from that same study; however, that suggests risk of injury appears to increase with reported consumption of as little as one drink on daily average.

Limitations

While the data reported here are from a general population probability sample, adjusted to take into account selection biases and to reflect demographic characteristics of the U.S. adult population, the data are based on recall of both drinking and injury over the last year. Although the GF method to obtain quantity and frequency of drinking data has been validated against drinking diary data, as noted above (Hilton, 1989), a Canadian pilot study found an overestimation of frequency and volume of drinking using the GF method compared to overall and beverage-specific quantity-frequency type measures (Graham, et al., 2004). An additional caveat is that those having incurred less severe injuries which do not require treatment may be less likely to recall having had such an injury during the last year, which may have biased study findings. It should also be noted that risk of injury in these analyses was examined across all causes of injury, and alcohol is known to have a greater association with some kinds of injuries than with others; e.g., motor vehicular accidents ¹⁶ and injuries resulting from violence ¹⁷. Future research should explore risk of injury in general population samples by individual causes of injury.

Conclusion

Based on these and prior data, no safe level of consumption appears to exist in relation to injury risk. Risk of injury appears to occur at relatively low levels of consumption (as little as one drink per day), and preventive efforts to reduce alcohol-related injury will have a greater impact if aimed at more moderate drinkers, as opposed to heavier drinkers who are fewer in number and for whom increased consumption does not appear to carry a proportional increase in injury risk. These data also suggest that the association of volume and high maximum days with risk of injury is different for injuries treated in the ER compared to those treated elsewhere or those that go untreated, and this is important to take into account in deriving estimates of the risk of injury related to alcohol and alcohol attributable fractions.

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Figure 1.
Volume (mean drinks per day last year)

Figure 2.
Volume (mean drinks per day last year) - Men

Figure 3.
Volume (mean drinks per day last year) - Women

Figure 4.
Number of 5+ days

Figure 5.
Number of 5+ days - Men

Figure 6.
Number of 5+ days - Women

Table 1

Alcohol Use Categories

Volume: Mean Drinks Per Day	Midpoint	N	Males	Females
Abstainers	0	2,740	1,063	1,677
> 0 – 0.24	0.12	2,228	919	1,309
0.25 – 0.49	0.37	454	259	195
0.5 – 0.74	0.62	293	168	125
0.75 – 0.99	0.87	217	140	77
1 – 1.9	1.49	474	324	150
2 – 2.9	2.49	210	146	64
3 – 4.9	3.99	137	97	40
> 5	7.73	122	103	19
Number of 5+ Days				
Abstainers	0	2,740	1,063	1,677
Never	0	2,858	1,226	1,632
Once	1	273	177	96
2 – 11 times per year	6	395	270	125
1 – 3 times per month	24	256	187	69
1 – 2 times per week	78	214	174	40
3 – 7 times per week	270	155	127	28

Table 2

Demographic Characteristics by Injury Treatment Type (in %)

	No Injury (5751)	Any Injury (1149)	Treated Injury (943)	ER-Treated Injury (362)
Males	47	54	53	50
18 – 29	20	23	22	29
Ethnicity				
White	69	76	77	75
Hispanic	13	9	8	8
Black	11	10	9	12
Other	6	6	5	5
Education				
High school or less	41	36	36	39
Some college	25	29	30	33
College graduate	34	35	34	28
Marital status				
Married/living together	68	66	66	63
Separate/divorced/widowed	15	15	16	19
Never married	17	18	18	19