ELSEVIER

Alcohol 40 (2006) 193–199

ALCOHOL

Alcohol-drinking history and fatal injury in older adults

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Received 26 September 2006; received in revised form 25 January 2007; accepted 29 January 2007

Abstract

Although most clinical guidelines for older adults allow for one drink a day in persons without a history of alcoholism, diabetes, or cardiovascular disease, alcohol may contribute to fatal injury in the elderly. Using two national surveys, this case–control study determined the associations between drinking history and fatal injuries from falls, motor vehicle crashes and suicides. We performed a case–control study using 1,735 cases who died of falls, motor vehicle crashes, or suicides selected from the 1993 National Mortality Follow-Back Survey; controls ($n = 13{,}381$) were a representative sample of the U.S. population from the 1992 National Longitudinal Alcohol Epidemiologic Survey. Cases and controls were restricted to ages 55 years and older. Having 12 or more drinks in the year before death or interview for the controls was used to assess alcohol-drinking history. The unadjusted relative odds for drinkers versus nondrinkers for falls, motor vehicle crashes, and suicides were 1.7, 1.7, and 1.6, respectively. Adjustment for age, gender, marital status, education, and working in the last year did not change these effect estimates, which all excluded the null value. Drinking increased the risk of suicide more for women than for men. Drinking history in older adults is associated about equally with an increased risk of fatal injury from falls, motor vehicle crashes, and suicides.

Keywords: Injury; Alcohol; Elderly; Fatal

1. Introduction

Older adults are particularly susceptible to the ill effects of alcohol consumption. Age-related physiological changes, such as decreased gastric alcohol dehydrogenase and reduced total body water content, result in higher blood alcohol levels per amount consumed in older adults compared to younger adults (Vestal et al., 1977). Older adults also have increased central nervous system sensitivity and decreased tolerance to alcohol (Blow, 1977). At the same peak level of blood alcohol concentration (BAC), the postural balance of older adults is twice as impaired as younger adults (Vogel-Spratt & Barrett, 1984). Over time, severe alcoholism can cause degeneration of the cerebellum and can produce marked disturbances in gait (Gilman et al., 1998). Comorbidity and subsequent medication use increase with age, thus increasing the likelihood of drug interactions with alcohol in late life. Although most clinical guidelines for older adults allow for one drink a day in persons without a history of alcoholism, diabetes, or cardiovascular disease, alcohol has both short-term and chronic effects that can contribute to fatal injury by altering the risk of the initial injurious event and the risk of subsequent fatal sequelae (Moore, 2003).

Our earlier work found that drinking history was associated with a significantly increased risk of all types of fatal injury (Chen et al., 2005); however, the relationship between alcohol use and fatal injury among older persons has yet to be explored. Falls, motor vehicle crashes, and suicide were the three leading causes of injury death among persons aged 65 years and older, comprising 64% of the 40,321 injury deaths in 2002 (National Center for Injury Prevention and Control, 2005). Using two national surveys, the aim of this case–control study was to determine the associations between drinking history and fatal injuries in the elderly, mainly from falls, motor vehicle crashes, and suicides.

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0741-8329/06/$ – see front matter
doi: 10.1016/j.alcohol.2007.01.002

Alcohol consumption is associated with falls in the total population (Hingson & Howland, 1993), but its role in the elderly is less clear. For instance, there are seven studies of nonfatal falls in the elderly that show either no statistical association or an inverse association between regular alcohol consumption and fall risk (Iliffe et al., 1991; Lord et al., 1993; Mukamal et al., 2004; Nelson et al., 1992; O'Loughlin et al., 1993; Sheahan et al., 1995; Tinetti et al., 1988). Among fatal falls, 59% occurred in persons aged 75 years or older, who comprise only 5% of the population (Baker et al., 1992). Potential mechanisms of death include fatal cerebral injuries and hip fractures, which are both associated with chronic alcohol use (Felson et al., 1988; Kirkpatrick & Pearson, 1978).

Studies of motor vehicle deaths in the elderly have shown weak associations with alcohol use. One study reported that 4% of 71 fatally injured drivers had a detectable BAC of <0.05 g/100 ml, which was below the legal limit in Sweden (Sjogren et al., 1993). Another study reported that one of 110 killed or injured elderly drivers had a BAC over 0.08 g/l00 ml (Holubowycz et al., 1994). Risk of a crash for elderly drivers has been associated with diabetes (odds ratio [OR] = 2.6, 95% confidence interval [CI] = 1.4–4.7), but only marginally with alcohol abuse (OR = 2.1, 95% CI = 0.8–6.0) (Koepsell et al., 1994). Of 4,073 older adult cases in a state-wide trauma registry over a 6-year period 1995–2001, 8.5% tested positive for blood alcohol: 5% of persons injured in motor vehicle crashes and 13% of fall victims (Selway, 2004).

Data from the National Mortality Follow-Back Survey indicated that moderate or heavy alcohol use was associated with suicide in the elderly (Grabbe et al., 1997). Compared with deaths from noninjury causes, moderate (one to two drinks/day) and heavy alcohol use (three or more drinks/day) increased the risk of suicide by about nine times. An autopsy study of alcohol use and suicide found alcohol present in 15% of adults aged 64–73 years, and in 6% of adults aged 74 years and older (Conwell et al., 1990). Adults aged 65 years or older who have more than seven drinks per week may be at risk for alcohol-related problems, including suicide (Blow et al., 2004).

Despite the different mechanisms of injury, a drinking history may represent a point at which a clinician can intervene. For this reason, we evaluated the relationship between drinking history and the causes of two-thirds of all fatal injury in older persons.

2. Materials and methods

2.1. Data

Data came from two nation-wide surveys: the 1993 National Mortality Follow-Back Survey (NMFS) (NCHS, 1998) and the 1992 National Longitudinal Alcohol Epidemiologic Survey (NLAES) (NIAAA, 1992). The NMFS provided national estimates of alcohol usage and demographic information among people who died from injuries. The NLAES provided national estimates of alcohol usage for the general public.

A stratified random sample of 22,957 death certificates representing 2,215,000 adults aged 15 years or older who died in 1993 in the United States, excluding South Dakota, were included in the 1993 NMFS. Information on decedents was obtained from informants named on the death certificates by mailed questionnaire, telephone, or personal interview. The overall response rate for the proxy respondents was 83%.

A probability sample of 42,862 civilian, noninstitutionalized adults, aged 18 years or older and living in the 48 contiguous states and the District of Columbia, were included in the 1992 NLAES. Self-reported information was obtained face to face by trained interviewers. The overall response rate was 92%.

While the survey questions differed in several ways for these two surveys, similar information was obtained on the following subject characteristics and could be compared after recoding: current alcohol consumption, cigarette smoking, demographic characteristics (age, gender, race/ethnicity), history of heart attack, education, employment, and marriage status. A history of heart attack was used as a surrogate measure of the respondent's general health condition. Education was considered a surrogate for socioeconomic status.

Because using different approaches to estimate alcohol consumption would lead to incompatible estimates for drinking levels (Dawson, 2002) we analyzed the relationship between alcohol and injury risk based upon current reported alcohol consumption. Current drinkers had at least 12 drinks in the last year of life for NMFS decedents (age 55 years or more) or in the year prior to the survey for NLAES respondents (age 55 years or more). The NMFS asked, ''During the last year of life, did [decedent] have at least 12 drinks of any kind of alcoholic beverage?'' The NLAES asked, ''Over the past 12 months, did you have at least 12 drinks of any kind of alcohol?''

Decedents were classified as abstainers or light, moderate, heavy, or very heavy drinkers according to quantity and frequency of usual alcohol consumptions (Baker et al., 2002). A light drinker had less than one drink per day. Moderate drinkers had one to three drinks daily or three to four drinks one to three times per month or five drinks less than once per month. Heavy or very heavy drinking categories were combined and defined as three or more drinks at least three times per week. Distribution of drinking levels was analyzed by cause of injury death. ''Current drinkers'' in the NLAES could not be subdivided in a manner permitting discrimination among light, moderate, or heavy drinkers for comparison with the NMFS respondents. Thus, the distribution of drinking level by age, gender, and injury mechanism is analyzed for decedents only.

2.2. Study design

The study was framed as a population-based case–control design. Cases died from injuries selected from the 1993 NMFS. Controls were respondents from the 1992 NLAES. Because South Dakota did not participate in the 1993 NMFS (i.e., the source of cases), respondents to the 1992 NLAES who resided in South Dakota were excluded from control selection. People from Alaska and Hawaii were not included in NLAES but deaths from these two states (whose residents comprise 0.7% of the U.S. population) could not be excluded from NMFS because of the lack of detailed state information in the NMFS data set.

2.3. Analyses

We focused on fatalities from motor vehicle crashes, falls, and suicides among adults aged 55 years or older. The ICD9 codes for injury causes were motor vehicle injuries (E810–819), unintentional falls (E880–888), and suicides from all causes (E950–959).

Since both NMFS and NLAES were based on multistaged sampling schemes, weighted analyses were performed throughout the study using SUDAAN software (RTI, 2002). Logistic regression was used to assess the independent association between current drinking and injury death.

This research project was approved by the Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health.

3. Results

Thirty-six percent of 1,735 cases and 29% of 13,381 controls consumed 12 or more drinks in the prior 12 months (Table 1). Cases were older on average especially those dying from falls (mean age 80 years) than controls (mean age 68 years). A higher percentage of men than women committed suicide or died in motor vehicle crashes. The percentage of cases who died in falls was higher for women than men but similar in proportion to controls. Being married was associated with reduced occurrence of all three injury events. Education differed less between cases and controls for suicides than for motor vehicle crashes or falls.

Persons who died of falls or suicide were less likely than controls to have worked in the last year. Drinking appeared to be associated with suicide more so than with motor vehicle crashes and falls. Decedents who died of falls and motor vehicle crashes were more likely to have a history of heart attack than controls.

Most decedents abstained from alcohol in the last year of life (Table 2). In most age categories, the percentage of moderate or heavy drinkers was greater in male than female decedents. The percentage of moderate or heavy drinking tended to diminish with increasing age.

Although the risk of death was greatest for ages 85 years or older, the strongest age gradient was for falls (Table 3). Men had a higher risk of all types of fatal injuries than women, especially for suicides (OR = 5.5, 95% CI: 4.6–6.5). Being single was associated with all three causes of fatal injuries. Not working in the last year was associated with higher risk of death from falls and suicides but not motor vehicle crashes. Drinking in the last year was associated with a 70% increase in the risk of death from a motor vehicle crash or fall and a 60% increase in risk of suicide; the effect estimates from the multivariable analysis for having 12 or more drinks in the last year remained approximately the same (Table 4). Men had a higher adjusted OR of suicide than women; being single was associated with suicide more so after adjustment than before. Persons who died of falls and suicides were less likely than controls to have worked in the last year even in multivariable analyses (Table 4).

The effect of current drinking was also examined by gender for each of the three fatal injury causes. The only statistically significant interaction between gender and drinking history was for suicide. The adjusted OR of suicide for women drinkers versus nondrinkers was 2.5 (95% CI: 1.67–3.68); for men the OR was 1.3 (95% CI: 1.00–1.65). The interaction of age by drinking history was not statistically significant for any of the three fatal injury causes.

4. Discussion

Having 12 or more drinks a year was associated with a 50–70% increase in risk of motor vehicle crashes, suicides, and falls. The risk associated with alcohol may be due to the direct effects of alcohol, as well as detrimental health-related behaviors that may be linked with drinking. Alcohol use together with comorbid conditions and concomitant medications may increase the risk of a crash and subsequent fatal injury. Even if the older adult is not a driver, hazardous, harmful, and at-risk drinkers are more likely than social drinkers to be driven by someone who has been drinking and not use seatbelts (Moore et al., 2001), potentially increasing the likelihood of fatality from motor vehicle crashes.

Men had a seven-fold greater adjusted risk of suicide than women. If men and women attempt suicide at similar rates, the suicide difference could be due to the lethality of firearms, which were used by 73% of elderly suicides in 2000 (Minino et al., 2000). Firearms were used in 79% of completed suicides in men and 33% in women (NCIPC, 2005). The gender difference in the effect of alcohol use on suicide risk in this study was found in our earlier analysis of the same data sets (Chen et al., 2005). Using all adults aged 18 years and above, the adjusted OR for suicide was 1.5 for male drinkers and 4.0 for female drinkers. The ORs in this study were 1.3 and 2.5. One unmeasured

Table 1
Characteristics of fatal cases from the 1993 NMFS and controls from the 1992 NLAES by injury cause and covariates

	Cases (n = 1,735)							
	Motor Vehicle		Falls		Suicides		Controls (n = 13,381)	
Variable	N^a	%[b]	N^a	%[b]	N^a	%[b]	N^a	%[b]
Age (years)								
55–64	211	30	38	10	163	26	4,838	41
65–74	204	30	64	20	188	35	4,727	35
75–84	234	30	141	31	160	32	3,017	19
85+	79	10	186	39	67	8	799	5
Gender								
Male	389	59	147	46	427	73	5,065	44
Female	339	41	282	54	151	27	8,316	56
Race/ethnicity								
White	542	80	350	89	507	93	10,923	85
Black	60	9	31	5	21	3	1,681	9
Hispanic	52	7	13	4	19	3	502	5
Other	25	4	10	2	9	1	185	2
Marital status								
Married	347	51	141	42	289	48	6,510	64
Single	356	49	277	58	276	52	6,753	36
Education								
Less than high school	261	40	163	40	191	33	4,723	34
High school graduate	226	34	118	30	176	30	4,194	33
Some college or higher	172	26	105	29	154	36	4,254	34
Worked last year								
Yes	219	33	31	9	102	18	4,292	36
No	478	67	384	91	457	82	8,977	64
Smoke >100 cigarettes/lifetime								
Yes	342	51	172	47	364	62	6,968	54
No	363	49	244	53	189	38	6,366	46
Drinking status								
Current drinker	237	38	102	30	206	47	3,668	29
Not current drinker	401	62	292	70	310	53	9,713	71
Heart attack history								
Yes	90	15	59	17	64	12	1,200	9
No	566	85	347	83	450	88	12,095	91

NMFS = National Mortality Follow-Back Survey; NLAES = National Longitudinal Alcohol Epidemiologic Survey.
[a]Un-weighted numbers.
[b]Percent based on weighted numbers.

potential confounder in this study was depression, which could be linked to both alcohol use and suicide. In all age groups, including the elderly, major depression is more common in females than males (Hybels & Blazer, 2003). Depression, however, is more strongly associated with mortality at older ages for men than women (Blazer et al., 2001).

Deaths from falls are clearly age-related and more associated with moderate to heavy drinking in men than women (Table 3). There was no appreciable gender difference in odds of a fatal fall in drinkers compared to nondrinkers (adjusted OR 1.6 for men and 1.8 for women). Low-to-moderate levels of drinking may be associated with a slightly reduced overall mortality, and many long-term care facilities allow for consumption of an occasional alcoholic beverage among some residents (Thun et al., 1997; Valmadrid et al., 1999). However, our study suggests that having 12 or more drinks in a year in persons aged 75–84 or 85 years or over may increase the likelihood of dying from a fall by four-fold and twenty-fold, respectively.

The risk of death resulting from motor vehicle crashes, suicides, and falls for elderly current drinkers could be underestimated, since current drinkers may be in better health than nondrinkers. Among 1,909 residents of Erie County, Pennsylvania aged 60 years and older, current average alcohol consumption was associated with having alcohol-related problems at ages 20 and 40 years; older men were also more likely than women to have drinking problems (Welte, 1998). The authors found that sicker and poorer respondents drank less alcohol than healthier respondents. Vigorous lifestyles among older people were

Table 2
Alcohol-drinking level in fatally injured older adults by cause, gender, and age group (percent of weighted numbers, NMFS, 1993)

Males												
Cause	MVC				Falls				Suicides			
Age group (years)	55–64	65–74	75–84	85+	55–64	65–74	75–84	85+	55–64	65–74	75–84	85+
Drinking level												
Abstainer	49.1	66.4	65.9	79.8	45.2	66.3	63.5	70.7	63.1	74.1	75.3	80.2
Light	20.3	10.2	21.5	9.6	14.6	23.3	12.2	17.6	16.1	11.3	8.7	5.7
Moderate	20.6	20.8	8.5	6.7	29.9	5.2	18.9	11.7	6.6	8.1	12.0	14.1
Heavy	10.0	2.6	4.1	3.9	10.3	5.2	5.4	—	14.3	6.5	4.0	—
Females												
Cause	MVC				Falls				Suicides			
Age group (years)	55–64	65–74	75–84	85+	55–64	65–74	75–84	85+	55–64	65–74	75–84	85+
Drinking level	74.0	79.6	78.2	69.4	78.8	82.7	89.8	85.2	61.4	82.9	83.4	75.2
Abstainer												
Light	18.5	17.1	16.1	27.1	21.2	7.5	5.1	11.4	11.8	11.2	4.2	11.1
Moderate	7.5	2.3	3.3	3.5	—	9.8	5.1	3.4	13.6	2.0	8.6	13.7
Heavy	—	1.0	2.4	—	—	—	—	—	13.3	3.9	3.9	—

MVC = motor vehicle crash; NMFS = National Mortality Follow-Back Survey.

Table 3
Relative odds of dying by injury cause according to each study variable using an internal reference group (case and control distributions shown in Table 1)

	Motor vehicle ($N = 528$)		Falls ($N = 344$)		Suicides ($N = 440$)	
	OR	95% CI	OR	95% CI	OR	95% CI
Age (years)						
55–64	—		—		—	
65–74	1.2	(0.91–1.55)	1.7	(1.02–2.84)	1.6	(1.32–1.84)
75–84	2.2	(1.63–2.93)	4.2	(2.65–6.55)	1.9	(1.53–2.28)
85+	2.7	(1.79–4.12)	19.6	(12.1–31.8)	2.6	(1.93–3.42)
Gender						
Male	2.3	(1.87–2.82)	1.3	(0.94–1.79)	5.5	(4.61–6.50)
Female	—		—		—	
Race/ethnicity						
White	—		—		—	
Black	1.0	(0.74–1.47)	0.5	(0.27–0.76)	0.4	(0.23–0.58)
Hispanic	1.5	(0.97–2.17)	0.9	(0.42–1.80)	0.7	(0.41–1.12)
Other	2.1	(1.20–3.50)	1.3	(0.56–3.07)	0.6	(0.30–1.35)
Marital status						
Married	—		—		—	
Single	1.8	(1.48–2.27)	1.4	(1.05–1.98)	1.6	(1.34–1.93)
Education						
Less than high school	1.5	(1.13–1.91)	1.0	(0.74–1.41)	1.3	(1.01–1.61)
High school graduate	1.5	(1.14–1.86)	1.2	(0.86–1.74)	1.2	(0.94–1.52)
Some college or higher	—		—		—	
Worked last year						
Yes	—		—		—	
No	0.8	(0.63–1.04)	2.6	(1.61–4.12)	2.2	(1.81–2.78)
Smoke >100 cigarettes/lifetime						
Yes	0.7	(0.57–0.86)	1.2	(0.85–1.53)	1.9	(1.53–2.24)
No	—		—		—	
Heart attack						
Yes	1.6	(1.20–2.13)	1.6	(1.00–2.51)	1.6	(1.17–2.08)
No	—		—		—	
12+ Drinks last year						
Yes	1.7	(1.33–2.09)	1.7	(1.21–2.30)	1.6	(1.34–1.98)
No	—		—		—	

OR = odds ratio; CI = confidence interval.
Note: — denotes reference category.

Table 4
Multivariable analyses of three causes of death in relation to selected covariates[a]

Variable	Motor vehicle OR (95% CI)	Fall OR (95% CI)	Suicide OR (95% CI)
Age (years)			
55–64	—	—	—
65–74	1.2 (0.9–1.6)	1.7 (1.0–2.9)	1.2 (0.9–1.4)
75–84	2.2 (1.7–3.0)	4.4 (2.8–6.8)	1.2 (0.9–1.5)
85+	3.0 (2.0–4.4)	21.3 (13.6–33.5)	1.4 (0.9–1.9)
Gender			
Male	2.1 (1.7–2.5)	1.4 (1.0–1.8)	7.3 (5.8–9.2)
Female	—	—	—
Marital status			
Single	1.8 (1.5–2.2)	1.4 (1.0–2.0)	2.4 (1.9–3.0)
Married	—	—	—
Education			
<12 Years	1.5 (1.2–1.9)	0.9 (0.7–1.3)	1.2 (0.9–1.6)
High school graduate	1.4 (1.1–1.8)	1.2 (0.9–1.7)	1.3 (1.0–1.7)
College or higher	—	—	—
Worked last year			
Yes	—	—	—
No	0.8 (0.6–1.0)	2.6 (1.6–4.2)	2.2 (1.6–2.8)
Heart attack history			
Yes	1.6 (1.2–2.1)	1.6 (1.1–2.6)	1.1 (0.8–1.5)
No	—	—	
12+ Drinks last year			
Yes	1.6 (1.3–1.9)	1.7 (1.3–2.4)	1.5 (1.2–1.8)
No	—	—	—

OR = odds ratio; CI = confidence interval; — = reference category.
[a]Separate logistic regression models for each type of injury death were run with all the above covariates included.

associated with more drinking, perhaps being a marker of better health. In our study, however, adjustment for history of heart attack and education did not change the effect estimates for drinking history and fatal injury (Table 4).

Two limitations of this study stand out. One is that alcohol exposure at the actual time of the event is unknown. We have assumed that the effects seen in this study are both chronic and acute in nature. Knowing exposure closer to the time of the actual event would be useful for determining the short-term risk of an injury within hours of drinking alcohol. The case-crossover design has been used to measure the effect of alcohol exposure 6 h prior to an injury event compared to an earlier 6-h time period (Borges et al., 2004).

In this study, alcohol exposure was obtained from proxies for the cases but from self-reports for the controls. If people tend to underreport their own drinking and honestly report their next of kin's drinking behavior, the association between alcohol consumption and the risk of fatal injury would be overestimated. However, previous studies comparing alcohol information obtained from respondents with that from their next of kin indicate that proxy respondents seem to be reliable sources of alcohol information (Graham & Jackson, 1993). The percentage of nonspouse proxies for older adults in the current study (about 50% were single) may have reduced the quality of the alcohol exposure information.

Although clinicians are less likely to detect alcohol problems in women, the educated, and those with higher socioeconomic status, screening devices such as the CAGE and SMAST-G questions can be integrated into the standard brief clinical history (Blow, 1997). Once the drinking history is characterized, older adults with depression, comorbidities, potential medication interactions, high risk for falls, and, perhaps, anyone over the age of 75 years may warrant intervention (Blow, 1997).

Injury control among older adults will become increasingly important as the numbers of older adults grow in proportion to the rest of the U.S. population. From 2010 to 2030, the number of persons aged 65 years and older is projected to increase by 76%, while the number of persons under age 65 years increases by 7% (Day, 1996). Thus, knowledge of key determinants of injury such as alcohol use is needed to use the best approaches to injury prevention in the elderly.

Acknowledgments

This research was supported by CDC National Center for Injury Prevention and Control grant H400-888-2152. Ms. Edith Jones prepared the manuscript.

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