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ALCOHOL AND CASUALTIES: A COMPARISON OF EMERGENCY ROOM AND CORONER DATA

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Abstract—Data from a probability sample of casualty patients treated at a county hospital emergency room (ER) during a 1 year period ($N = 1124$) are compared to data from coroner reports of all fatalities arising from unnatural causes during the same time period in the same county ($N = 304$). The two samples are compared on: demographic characteristics, causes of casualty (fall, laceration/puncture wound, motor vehicle, fire, ingestion, other cause), place of injury, and alcohol and drug use prior to the event. Alcohol and drug use data were obtained by breathalyzer and self-reports in the ER sample and by toxicology screening of blood upon autopsy in the coroner sample. The coroner sample was significantly more likely to be male, younger and white compared to the ER sample. A significantly larger proportion of the coroner sample was positive for alcohol (43%) compared to those breathalyzed within 6 hr of injury who reported no drinking after the event (11%) and to those who reported drinking within the 6 hr prior to the event (28%) in the ER sample. Among those who were alcohol positive no difference was found between the coroner sample and the ER sample for the proportion of those who were also drug positive (24% in each). Cases in the coroner sample were no more likely to involve violence (17%) than those in the ER sample (20%). Violence-related fatalities were more likely to involve alcohol (47%) than non-fatal injuries (19%), but were no more likely to involve drug use in combination with alcohol (39% *vs.* 31%, respectively).

INTRODUCTION

The aim of this paper is to begin filling a gap in our knowledge concerning alcohol's role in injury occurrence. Here data on both fatal and non-fatal injuries will be analyzed in terms of demographic characteristics of those injured or killed, on alcohol consumption, and on the characteristics of the injuries sustained. Importantly, probability samples of both emergency room patients and coroner's cases were used in this work with the aim of representing all those in the same county-wide population who received ER treatment or who were killed during the study period. The need for an overall study of the relationship between alcohol and injuries in a given population can be seen in the great variation in findings among studies which have not covered entire populations or all kinds of injuries.

For instance, the prevalence of alcohol's involvement in both fatal and non-fatal injuries has been the focus, separately, of a number of studies. Data on alcohol's involvement in fatalities have come primarily from medical examiner records, while data on non-fatal injuries have mainly come from studies of patients seen in hospital emergency rooms (ERs). Many of these studies, however, include only specific types of injuries, such as those sustained in motor vehicle crashes, while others which did include all types of injuries did not use representative samples of patients. Thus, while alcohol is thought to be positively associated with severity of injury, a great deal of variation exists in the reported prevalence of alcohol's presence among injury patients found in ER studies and among victims of fatal injuries found in coroner studies. To what extent this variation may be due to the socio-demographic make-up of the individual populations studied is unknown, because no studies have examined alcohol's presence in both fatal and non-fatal injuries across all injury types in representative samples of cases from the same locale during the same period of time. The purpose of this paper is to begin filling this gap in knowledge by analyzing the prevalence of alcohol

involvement in a representative sample of injuries seen in emergency rooms and in all coroner cases which arose in the same population during the same period of time. The samples, described below, were intended to represent all ER cases and all coroner cases in a single county during a 1-year period. Not only can this provide a useful measure of alcohol's involvement in a study population, it also will permit comparisons between this study population and others in studies which also use comprehensive probability samples.

Alcohol's presence in fatal injuries has primarily been documented through the use of coroner reports, as noted. Estimates for positive blood alcohol have ranged from 43% (Able, 1985) to 59% (Berkelman *et al.*, 1985) for all injuries including suicide and homicide. The prevalence of alcoholism has also been examined in fatal injuries. Two such studies of coroner cases have found a quarter of accident fatalities to meet criteria for alcoholism (Haberman and Baden, 1974; Haberman, 1987), and alcoholics who have been followed longitudinally have been found to have a three-fold increase in risk for accidental death when age, gender and ethnicity have been controlled (Combs-Orme *et al.*, 1983). Prospective studies have also found a positive association between heavy drinking and injury death (Klatsky *et al.*, 1981) as well as a dose–response relationship between the number of drinks consumed per occasion and risk for fatal injury (Anda *et al.*, 1988).

The prevalence of positive blood alcohol among probability or representative samples of emergency room cases is lower than that found among coroner cases, ranging from 6% (Cherpitel, 1993*a*) to 34% (James *et al.*, 1984), and has been found to vary widely according to the socio-demographic characteristics of the ER population sampled (Cherpitel, 1993*b*).

A number of studies have examined mortality outcome among injury cases. While one of these studies found those positive for alcohol six times more likely to die than those who were negative (Pories *et al.*, 1992), other studies have found little difference within specific injury categories in the prevalence of positive blood alcohol among those who died subsequent to injury and those who survived (Blomberg and Fell, 1979; Huth *et al.*, 1983; Thal *et al.*, 1985; Brainard *et al.*, 1989). One study actually found that a larger proportion of those with detectable alcohol survived injury compared to those with no alcohol (Ward *et al.*, 1982).

Thus, it is not clear how alcohol's presence in injury fatalities compares to alcohol's presence in non-fatal injuries, since none of these studies compared representative samples of both groups of injury victims across all kinds of injury. Reported here is a comparative analysis of the association of alcohol consumption and injury in a probability sample of casualty patients admitted to the emergency room of the county hospital in a Northern California county during a 1-year period with those dying of unnatural causes during the same period of time in the same county. Comparisons are made on alcohol and drug use at the time of injury, place where the injury occurred, and demographic characteristics. Such analyses will contribute to a better understanding of alcohol's presence and role in fatal compared to non-fatal injuries, and may suggest prevention strategies for the reduction of alcohol related injuries.

METHODS

Sample selection

Emergency room sample. A one-third probability sample was taken of every casualty patient over the age of 18 admitted to the emergency room of the county hospital between December 1986 and December 1987. Sampling was carried out for 1 week at a time for each shift. Shifts were rotated during the 52 weeks of data collection so that each shift was equally represented for each day of the week. The sample was drawn from the emergency room triage forms and the ER logbook which generally represented consecutive admissions of patients to the ER. Patients who were too seriously injured to be interviewed at the time of ER admission were followed into the hospital and interviewed after their condition had stabilized. The sampling scheme provided a total sample of 1549 patients, of whom 1124 were interviewed and breathalyzed, for a 73% completion rate. Non-interviews were due to the following reasons: being in police custody (9%), physical condition (including death) prohibiting the interview (8%), refusal (7%), leaving prior to completing the interview (3%). Those who were not interviewed were not

significantly different from those interviewed on gender or age; however, the non-interviewed were slightly older than those interviewed. Among those interviewed 8% (71) were admitted to the hospital. None of those who were interviewed subsequently died.

Another, separate, probability sample of casualty patients drawn from this same ER, which was part of a larger merged data set of seven emergency rooms in the county, and which was weighted to be representative of all of those seeking emergency care for an injury in the county (Cherpitel, in press), was compared to the merged data set on age, gender, race and positive breathalyzer readings to determine how representative the ER sample from the county hospital is of the ER population in the entire county. The ER sample from the county hospital was found to differ from the representative sample of ERs only on age, with those in the county hospital ER more likely to be younger.

Coroner sample

The coroner sample was obtained by abstracting county coroner records on all of those 18 and older who died of unnatural causes: homicide (17%), suicide (28%), motor vehicular crashes (28%), other causes (24%), undetermined causes (3%) during the same year in which the emergency room data were collected ($N = 304$).

Instruments

Data were collected in the ER using a 15–20 min interviewer-administered questionnaire and a breath sample to estimate blood alcohol level at the time of ER admission. The Alcosensor III breathalyzer was used, which provides estimates of blood alcohol which have a high correlation with chemical analysis of blood (Gibb *et al.*, 1984). Interviews were conducted by professional interviewers trained and supervised by the University of California, Berkeley, Survey Research Center. Breath samples and interviews were obtained as soon as possible after a patient had been selected for the study. Patients in the study sample were approached with an information sheet describing the purpose of the study and then asked to give their informed consent to participate.

Patients were interviewed regarding demographic characteristics, the cause of the injury and the place where the event happened, whether violence was involved in the event, and whether alcohol was consumed during the 6 hr prior to the injury. Those who reported drinking during this time were asked whether any of the following drugs were also used during the 6 hr prior to the event: 'uppers' (speed, amphetamines or cocaine), 'downers' (tranquilizers, barbiturates, librium, valium or quaaludes), codeine, demerol, methadone, marijuana, hashish, THC, hallucinogens (LSD, mescaline, psilocybin or angel dust), heroin, opium.

Coroner records were abstracted for the following data: demographic characteristics, cause of the fatal injury, place where the injury event occurred, and the presence of blood alcohol and drugs from toxicology screening.

Cause of injury categories were developed in the emergency room study based on the patients' explanation of the injury event as follows: (1) falls, (2) cutting/piercing (including gunshot and stab wounds), (3) motor vehicle (including drivers, passengers and pedestrians), (4) fire, (5) ingestion (of alcohol, drugs or other toxic substances) (6) other (which included all causes of injury not covered by the other categories). In the emergency room other causes generally included less serious injuries such as contusions and sprains of unknown cause. These cause categories were derived from an earlier emergency room study of alcohol and injury (Wechsler *et al.*, 1969). In the coroner study, medical examiner records were reviewed and data obtained to assign cases to one of these cause categories.

Data analysis and significance testing are based on comparison of population proportions between the ER sample and the coroner sample.

Sample characteristics

Table 1 shows the gender, age and race distribution for the two samples. Also shown are the demographic characteristics of a household probability sample of all residents living in the same county in 1989 (Cherpitel, 1993*a*). The coroner sample was more likely to be male, older and white compared to the ER sample. Both of these samples were more likely to be male and white compared to those in the general population of the county. The ER sample was more likely to be younger than the general population sample while the coroner sample was more likely to be

Table 1. Demographic characteristics (in percent)

	County: General population (2626)	Emergency room (1124)	Coroner (304)
Gender			
Male	49	64§	74*§
Female	51	36	26
Age			
18–29	43	52§	33*§
30–39	23	30§	25
40–49	12	10	16*
50–59	7	4§	7
60–69	7	3§	8*
70+	8	1§	12*§
Race			
White	64	70§	79*§
Black	21	12§	13§
Latino	9	10	5*§
Asian	2	2	2
Other	5	6	1*§
Violence involved	—	20(802)	17

*$P < 0.05$ (comparison of proportions between coroner sample and ER sample).

§$P < 0.05$ (comparison of proportions between the coroner sample and the general population sample and between the ER sample and the general population sample).

older. The ER and coroner samples did not differ in the proportion whose injury involved violence.

In the ER sample 287 patients were admitted to the ER for follow-up visits for previous injuries and were therefore not asked questions pertaining to drinking and drug use prior to the injury or the place of the injury event. These patients have consequently been excluded from analyses reported here. Additionally, breathalyzer results are reported only for the 255 patients who reached the emergency room and were breathalyzed within 6 hr of the injury event and who reported no drinking after the event.

Reported toxicology screening for alcohol and drugs in the coroner sample is limited to the 189 cases who died within 6 hr of their injury and whose blood was drawn within 6 hr after death.

RESULTS

Table 2 shows by cause of injury both the proportion of those breathalyzed within 6 hr of injury who were positive (range of 0.02 to 0.51) and who were legally intoxicated, and the proportion who reported drinking within 6 hr prior to the event, for the ER sample. For the coroner sample, Table 2 shows the proportion of those who died within 6 hr of injury and whose blood was drawn within 6 hr after death who were alcohol positive (range of 0.01 to 0.41) and, separately, who were legally intoxicated. In California, 0.10 (10 mg of alcohol per 100 ml of blood) was considered legally intoxicated at the time of this study although this has recently been reduced to 0.08. As can been seen in this table, although a larger proportion of those in the ER sample reported drinking prior to injury than were found positive on the breathalyzer, those in the coroner sample were significantly more likely to be alcohol positive than either those who were positive on the breathalyzer or those who reported drinking. The coroner cases were also more likely to be legally intoxicated than those in the ER sample. While prior emergency room studies have found those with violence-related injuries more likely to be alcohol positive than those with all other causes of injuries (excluding ingestion—usually ingestion of alcohol) (Cherpitel, 1993*c*), those with violence-related injuries in the coroner sample were significantly more likely to be positive and to be legally intoxicated than those in the ER sample. Notably, half of those who died with injuries sustained from motor vehicle crashes were found to have alcohol in the blood, and most of these were legally intoxicated at the time of the event, while only 3% of those injured in motor vehicular accidents were positive and none were legally intoxicated based on breathalyzer readings.

The proportion of positive blood alcohol was also analyzed in the two samples eliminating the 6 hr limitation (not shown here). The prevalence of positive blood alcohol in the coroner sample did not differ greatly from that which included the 6 hr limit (40% were found to be positive with 28% at or above 0.10 *vs.* 43% positive and 32% at or above 0.10). However, in the ER sample a significantly larger proportion were found to be positive (17% *vs.* 11%) although little difference was found for the proportion at 0.10 or above (7% *vs.* 6%).

The proportion of those in the ER sample reporting drinking in the 6 hr prior to the event who also reported taking any one of the drugs mentioned above was compared to the proportion of those alcohol positive in the coroner sample who were also drug positive on toxicology

Table 2. Percent alcohol positive, by cause of injury and by violence-related injury

Cause of injury	Emergency room: Positive	Breathalyzer† ≥ 0.10		Self-report		Coroner: Positive	Blood† ≥ 0.10	
Fall	19	9	(53)	29	(212)	50	50	(2)
Cutting/piercing	13	6	(53)	23	(119)	41*‡	29*	(73)
Motor vehicle	3	0	(35)	19	(88)	49*‡	40*‡	(67)
Fire	40	0	(5)	13	(16)	14	14	(7)
Ingestion	29	29	(7)	66	(26)	50	38	(16)
Other	7	5	(102)	29	(376)	29*	25*	(24)
Violence-related	19	15	(47)	49	(160)	47*	34*	(38)
Total	11	6	(255)	28	(837)	43*‡	32*	(189)

†Positive is ≥ 0.01 (10 mg of alcohol per 100 ml of blood) and included those with a blood alcohol ≥ 0.10.
*$P < 0.05$ (comparison of proportions between coroner sample and ER sample breathalyzer readings).
‡$P < 0.05$ (comparison of proportions between coroner sample and ER sample self-report).

screening (Table 3). While some significant differences were found for specific causes of injury between the two samples, the number of those in cause-specific categories in the coroner sample is extremely small. Overall, no difference was found between the two samples, with a quarter of those who were alcohol positive also being drug positive in each sample.

Table 4 shows the proportion of those alcohol positive in the two samples by the place where the injury event occurred. Those in the coroner sample who suffered a fatal injury in their own home or in a motor vehicle crash or in the street were more likely to be alcohol positive, and to be legally intoxicated, than those suffering non-fatal injuries in these same locations. Particularly notable in this table is that none of those injured at work in either sample were found to be positive for estimated blood alcohol.

Table 3. Percent drug positive among those alcohol positive, by cause of injury and by violence-related injury

Cause of injury	Emergency room: Self-report		Coroner: Blood	
Fall	23	(62)	100*	(1)
Cutting/piercing	19	(27)	30	(30)
Motor vehicle	12	(17)	3	(33)
Fire	0	(2)	100	(1)
Ingestion	56	(16)	100*	(7)
Other	24	(108)	0*	(7)
Violence-related	31	(77)	39	(18)
Total	24	(232)	24	(79)

*$P < 0.05$ (comparison of proportions between coroner sample and ER sample).

Place of injury was also examined by drug status for those who were alcohol positive in the two samples. As seen in Table 5, those in the coroner sample who were injured in the home of another were more likely to be positive for drugs in combination with alcohol than those in the ER sample. Again it should be noted that the place-specific categories in the coroner sample are quite small.

DISCUSSION

We began by noting that prior studies investigating the relationship between alcohol and injuries produced results that varied substantially. Some of this variation may be due to sampling methods which varied from study to study, some may be due to the different sociodemographic characteristics of the populations samples, and, of course, some variation may be due to differences in the relationship between alcohol and specific kinds of injuries which have often been singled our for study.

The present study sought to avoid such possible sources of variation by (1) using probability sampling methods in both the ER and the coroner samples, and (2) covering a representative sample of ER cases and all coroner cases in a given setting during the same 1-year span, and (3) analyzing the relationship of alcohol to injury while specifying the sociodemographic characteristics of the study populations, and (4) specifying the kinds of events or types of accidents which resulted in death or injury.

These attributes of the study should facilitate

Table 4. Percent alcohol positive, by place of injury

Place of injury	Emergency room: Breathalyzer† Positive	≥ 0.10		Self-report		Coroner: Blood† Positive	≥ 0.10	
Home	12	4	(84)	27	(279)	36*	25*	(72)
Home of another	35	20	(20)	52	(99)	57	29	(7)
Workplace	0	0	(58)	4	(125)	0	0	(12)
Motor vehicle	5	0	(42)	20	(97)	53*‡	47*‡	(49)
Street/parking lot	21	17	(24)	36	(98)	49*	38*	(39)
Park/recreation area/ other public place	19	15	(26)	34	(135)	50	40	(10)

†Positive is ≥ 0.01 (10 mg of alcohol per 100 ml of blood) and included those wi th a blood alcohol ≥ 0.10.
*$P < 0.05$ (comparison of proportions between coroner sample and ER sample breathalyzer reading).
‡$P < 0.05$ (comparison of proportions between coroner sample and ER sample self-report).

the comparison of present results to those of other probability-sample studies which meet points 2 through 4 above. Differences thus found are likely to be due to actual differences between study populations and not due to methodological differences between studies.

The criteria upon which prevalence estimates for positive blood alcohol in the ER sample and in the coroner sample were made as comparable as possible in this study for comparative analyses. That is, a 6 hr time limit was used as the maximum amount of time lapse between the injury and obtaining a breathalyzer reading or between injury and death and death and obtaining a blood sample. There is some evidence that the prevalence of positive blood alcohol in the coroner sample may, however, be a conservative estimate: among the 12 cases on whom a blood alcohol was not obtained, notations in the coroner reports indicated that one of these individuals 'smelled of alcohol' at the time of injury/death and two others were 'known alcoholics'.

Table 5. Percent drug positive among those alcohol positive, by place of injury

Place of injury	Emergency room: Self-report		Coroner: Blood	
Home	14	(74)	24	(25)
Home of another	44	(52)	100*	(4)
Workplace	0	(5)	0	(0)
Motor vehicle	21	(19)	8	(26)
Street/parking lot	17	(35)	32	(19)
Park/recreation area/ other public place	27	(44)	20	(5)

*$P < 0.05$ (comparison of proportions between coroner sample and ER sample).

ER studies have found that alcohol's association with severity of injury varies according to the type of injury sustained (Honkanen and Smith, 1990) and one might also expect alcohol's presence in fatal injuries to vary according to the type of injury. Table 2 shows, nevertheless, that relatively more of those in the coroner sample were alcohol positive for each cause of injury except fire (although many of these differences were not significant). A review of alcohol's presence in injuries and deaths due to fires and burns, however, has also found a larger proportion of burn fatalities to be positive for blood alcohol than burn injuries (Hingson and Howland, 1993). While alcohol's presence does appear to be more prevalent among fatalities than among non-fatal injuries, regardless of the cause of injury, a larger number of both fatal and non-fatal casualty cases within cause-specific categories would be needed to support this contention.

In the presence of alcohol, drug use prior to the event did not appear to vary between the ER and coroner samples. It should be noted, however, that the toxicology screening in the coroner sample included a number of drugs which were not included in the ER interview. This, along with the fact that the ER data on drug use relied on self-reported use, may have, in fact, resulted in an underestimate of drug use in combination with alcohol in the ER sample compared to the coroner sample. Since drug use prior to the event was asked only of those who reported drinking during this time in the ER sample, we were not able to

compare those who reported drug use alone prior to the event between the two samples.

The prevalence for positive blood alcohol found here in the coroner sample (43%) is similar to that found elsewhere (43%; Able, 1985), as is the estimated prevalence for positive blood alcohol found in the ER sample: 11% by breathalyzer, 28% by self-report (Cherpitel, 1993*b*). As noted above, the ER sample was found to be similar to a representative ER sample from the same county on gender and ethnicity (although younger) and on the prevalence of positive breathalyzer readings. Results from our unpublished preliminary study of a Level I trauma center in the same county during the same time period are useful here. The county trauma center is the location for treatment of the most serious injuries. Among all of those treated in the trauma center during the year of data collection ($N = 814$) 6% died, 25% were hospitalized and the remainder were discharged home. Those 18 and over who died are included in the coroner data reported here. The gender distribution of these cases was similar to that in the coroner sample, while the age distribution was closer to that in the ER sample. Of the trauma center cases, an estimate of blood alcohol was obtained on only 42%, and of these 38% were positive with 31% at or above 0.10. These data coupled with those on the demographic characteristics of the general population of the county found in Table 1 suggest that males may be more likely than females to sustain serious or fatal injuries, while those younger may be more likely to sustain non-fatal injuries and those older more likely to die from injury. While the large amount of missing data on blood alcohol among the trauma center cases makes it difficult to compare this figure with those obtained in the ER and coroner sample, the data analyzed here suggest that alcohol is, indeed, associated with seriousness of injury, with those dying significantly more likely to have been drinking at the time than those with more minor injuries.

Although those in the general population of the county were demographically different from those in both the ER and coroner samples, it is unknown what the prevalence of alcohol use or of drug use in combination with alcohol is in the general population. A prior study mentioned above of a representative sample of all of those seeking emergency room care in this same county (Cherpitel, in press), however, found the injured significantly more likely to report heavy drinking, intoxication and alcohol-related problems than both the non-injured as well as those in the general population.

The data reported here also suggest that alcohol appears to be most prevalent among fatalities involving motor vehicle crashes, with half of these cases being alcohol positive and most of these (82%) being legally intoxicated. Although passengers and pedestrians as well as drivers were included in this category, this percent is similar to that reported for fatally injured drinking *drivers* in a nation-wide U.S. study (Simpson and Mayhew, 1991). A very low prevalence was found for alcohol's presence in non-fatal motor vehicle crashes, however, and none of these were found to be legally intoxicated at the time. Similarly, relatively large proportions from all other causes of fatality who had been drinking were found to be legally intoxicated, while among the non-fatally injured who had been drinking, only for those admitted to the ER for ingestion or for those in the other cause category were a majority found to be legally intoxicated. Only for violence-related injuries was a larger proportion who had been drinking found to be legally intoxicated among the non-fatally injured compared to the fatally injured.

The data reported here on fatal compared to non-fatal injuries occurring during the same time period in one U.S. county suggest that those fatally injured are more likely to be drinking at the time, and are also more likely to be intoxicated, than those non-fatally injured, and that both samples differ from the general population from which they come in demographic and drinking characteristics. While some of the differences found between those fatally injured and those non-fatally injured may be due to differences in the gender and age distributions of the two samples, a larger number of both fatal and non-fatal injury cases would be necessary for a determination of these differences in age-specific and gender-specific categories, as well as for individual causes of injury.

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