

## SOME BIASES IN THE ALCOHOL INVESTIGATIVE PROCESS IN TRAFFIC FATALITIES

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**Abstract**—This study compares data regarding alcohol involvement from police records and from chemical analyses of body fluids taken prior to or after death of 121 traffic fatalities in Washtenaw County, Michigan. Differences regarding the choice of who will or will not be screened for alcohol were found. The police and emergency room personnel were more likely to focus on males and drivers, while medical examiners were less biased. The police documented whether or not drinking took place in only 36% of the cases and suspected drinking in only half of these cases. Males and at-fault drivers were most likely to be investigated. Blood alcohol level was measured before death in 11 of 29 emergency room treated victims, with 10 (91%) positive samples. All but two of those tested before death were drivers, and all but one were males. After death, blood alcohol was measured in 47% of the 121 cases, with a higher proportion of males and motor-vehicle occupants tested, compared to females and pedestrians. Alcohol was detected in 63% of the samples. A lower mean blood alcohol concentration was found in victims who received intravenous treatment, and a higher proportion of positive samples was found in victims who died immediately in the crash. Thus, the frequency of alcohol-related traffic fatalities varied between the different data sources. The police records revealed 51%, the emergency records 91%, and the medical examiner records 63% with alcohol involvement. This wide discrepancy has the potential of leading to erroneous results here and possibly in studies done elsewhere. To avoid a bias in blood alcohol figures, the authors stress the importance of routinely investigating *all* severely and fatally injured traffic victims. To yield an accurate result, the sample should ideally be taken as soon as possible after the crash and prior to intravenous treatment.

### INTRODUCTION

Injuries from motor vehicle crashes is the leading cause of death for young Americans (Baker et al. 1984), and alcohol is a well-known contributing factor to the crashes. The number of "alcohol-related" crashes shows, however, a variation of 40% to 100% among the different states (NHTSA 1988). It seems obvious that this variation probably represent an effect of biases.

Currently, measuring blood alcohol concentration (BAC) is the most accepted method for accurately detecting drunken driving. However, there are several factors in the investigative process that must be considered in order to assess the accuracy of the blood alcohol levels and the proportion of alcohol-related crashes.

The delay in drawing alcohol samples after a crash is a well-known problem (cf. Dubowski 1985), as is low reporting rates, leading to a selection of specific types of victims (Waller 1971; Kannemann and Warren 1980; Voas 1984; Lewis and Sherman 1986). Furthermore, it has been shown that even despite a high level of suspicion of alcohol involvement and assessment of culpability by the police, and high BACs recorded during hospital treatment, convictions for drunken driving may be absent (Maull, Kin-

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ning, and Hickman 1984). Other, less frequently discussed problems are the effects of blood loss and of intravenous treatment before alcohol testing of severely injured victims.

Since political intervention and sanctions against alcohol use and drunken driving rely on official data on alcohol-related crashes and from convictions for driving under the influence of alcohol, it must be of primary interest to have accurate procedures and measurements in the alcohol investigative process and a complete reporting system.

This paper compares and discusses differences between and biases of police investigations and BACs taken before and after death in fatally injured traffic victims, and suggestions for improvements are made.

## MATERIALS AND METHODS

All available death certificates and hospital and police records were reviewed for all motor vehicle fatalities occurring in Washtenaw County, Michigan, from 1985 through 1987. When available, results from blood alcohol analyses performed before and after death were also studied.

Data from the police records were also examined concerning drinking and blood alcohol levels of the surviving drivers involved in these crashes with fatal outcome.

## RESULTS

### *General*

According to the death certificates, 223 persons died in Washtenaw County from injuries sustained in motor vehicle crashes during 1985–1987. Of all these in-county deaths, 102 individuals (46%) were brought to the trauma center from outside the county and were excluded from the study.

Thus, a total of 121 fatally injured victims from 112 crashes were studied further. Of those killed in motor-vehicle crashes, 72 were drivers and 33 passengers. Passenger car (including vans and light trucks) victims dominated the study with 93 cases, followed by 7 motorcycle riders, 3 trailer occupants, 2 other four-wheel motor-vehicle occupants, and 1 pedalcyclist. Pedestrians accounted for the remaining 15 cases. Of the deceased passenger car drivers, 31 were the victims of single-vehicle crashes and 29 of multiple-vehicle crashes.

Most victims were male (93 cases, or 77%), and the 15–24 age group accounted for 40% of the total. The age and sex distribution for the group studied is shown in Fig. 1.

The occurrence of fatalities throughout the year varied. About 60% were noted in September through November (32%) and during May through July (28%). Nearly half (47%) of the fatalities occurred from Friday through Sunday, most of them (63%) between 2 P.M. and 2 A.M.

In all, 95 victims (78%) were investigated regarding alcohol; there were chemical analyses in 83 cases and in the remaining 12, cases police judgments only.

### *Police judgment of alcohol involvement*

In 43 (36%) cases, the police report indicated whether or not the victim had been drinking. In all but one of these cases the victim was a motor vehicle driver; the exception was a passenger. Other major discrepancies were found with respect to sex and at-fault category. Thus, the police officers were more likely to make judgments regarding alcohol use or nonuse for males (41% of all males), than for females (18% of all females). Furthermore, the deceased driver was at fault—according to the police—in 93% of the crashes in which judgment of alcohol use or nonuse was recorded, compared with 81% in the group with no judgment recorded.

Minor differences in the inclination to judge were found with respect to the number of vehicles involved (judgment provided in 58% of all single-vehicle crashes vs. 57% of all multiple-vehicle crashes), with respect to the age of the victim (mean age 35 years in the judgment group vs. 32 years in the nonjudgment group), or to the age of the vehicle (mean age 5 years vs. 6 years).

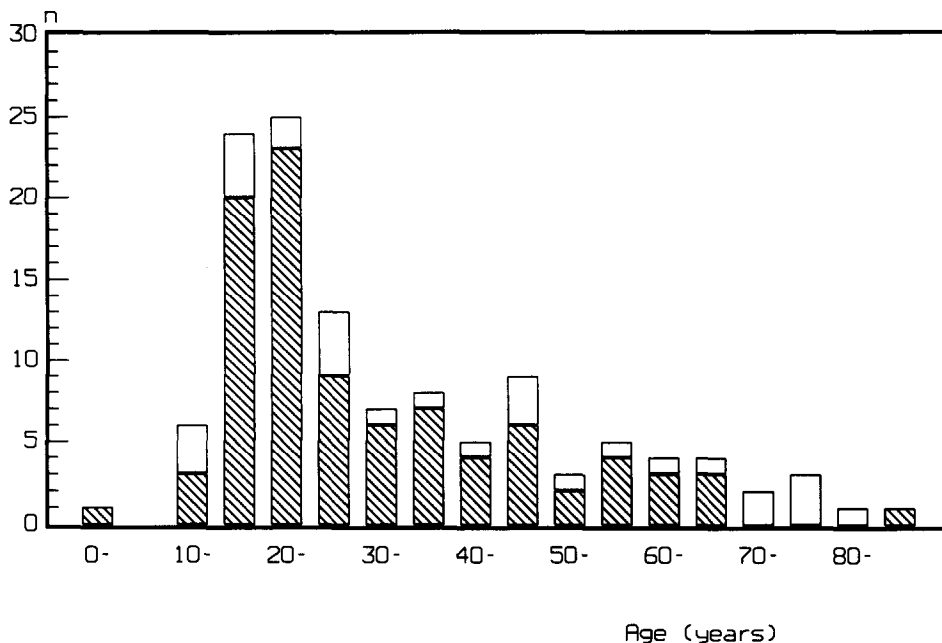


Fig. 1. Distribution by age and sex of 121 fatally injured traffic victims in Washtenaw County, MI, in 1985-1987. Striped areas = males, blank areas = females.

In 22 of the 43 (51%) victims for whom the officer recorded alcohol use or nonuse, the investigating officer had determined the person to be alcohol-impaired. The mean age for this impaired group was 27 years vs. 44 years for those judged not to have been drinking. Only one female, aged 26, was judged to have been drinking.

In only two cases in which the investigating officer reported that the victims had not been drinking, was alcohol detected. In both these instances the readings were quite high; 0.16% (measured prior to death) and 0.19% (measured after death) (Table 1).

#### *Surviving drivers*

In the total of 112 crashes with fatal outcome, there were 58 surviving drivers. Officers' judgments were reported in three-fourths (76%), with drinking indicated in 45% of these cases. At least 15 of the surviving drivers were tested for blood alcohol content, with three positive results.

#### *Antemortem alcohol tests*

For 49 of the 121 cases (40%), emergency treatment records were available. Body fluid was drawn for alcohol analyses prior to death in 12 cases—11 males and 1 female. All samples were collected in hospital emergency rooms and drawn from the blood, except one sample from urine. All victims were drivers except for two passengers and one pedestrian. The mean age of the victims tested was 30 years (range 16-57), compared

Table 1. A comparison between police judgment (HBD = had been drinking) and actual presence of blood alcohol demonstrated in blood samples drawn prior to or after death in 121 fatally injured traffic victims. Pos = Alcohol present, Neg = Alcohol not present.

HBD	Sample drawn before death			Sample drawn after death		
	Pos	Neg	Missing	Pos	Neg	Missing
Yes ( <i>n</i> = 22)	6	-	16	11	-	11
No ( <i>n</i> = 21)	1	-	20	1	8	12
Missing ( <i>n</i> = 78)	3	1	74	24	13	41
Total ( <i>N</i> = 121)	10	1	110	36	21	64

with 34 (range 2–86) for nontested victims. All blood samples but one contained alcohol, while the urine sample did not. The mean BAC was .16%. For the 10 victims testing positive, the mean age was 28 (range 16–37).

#### *Postmortem alcohol tests*

Samples were obtained after death for 73 of the 121 cases (60%), in 58 cases from blood, in 14 from vitreous body only, and in one case from urine only. All victims except one survived less than eight hours after the crash, and the age range was 13–75.

Of the victims who survived less than eight hours after the crash and who were above 12 years of age ( $n = 94$ ), those tested ( $n = 73$ ) represented 80% of the males, 67% of the females, 77% of the drivers, 83% of the passengers, and 60% of the pedestrians.

Alcohol was present in 36 (63%) of the 57 cases where a sufficient amount of blood was available for analysis, with a mean BAC of .14% (range .01–.34).

#### *Blood alcohol concentrations*

Blood alcohol testing was conducted, either prior to or following death, in over half (54%) of the victims. Males were more often inebriated and had a higher mean BAC compared with females. Nearly all passengers tested had detectable amounts of alcohol, but the mean BAC was lower compared with the drivers. None of the pedestrian cases was under the influence of alcohol (Table 2).

In only two cases was testing conducted prior to and following death. The BACs were .16% and .07% for one case and .22% and .21% for the other. Both had received intravenous treatment before the sample was taken.

#### *Intravenous treatment*

Intravenous treatment had been administered in all 12 cases in which blood was drawn before death and in 21 of the 58 cases where this was done after death. The mean BAC was .15% of those who had intravenous treatment, compared with .18% for those who had not, but there was no difference in the proportion of positive results between the two groups.

#### *Time of survival*

Of the 118 deaths where data were sufficient, 98 (83%) occurred within the first twenty-four hours with 65 (55%) surviving less than one hour and 82 (70%) less than two hours. Of those 35 cases surviving less than one hour, with blood samples drawn after death, 24 (69%) tested positive, compared with 7 of those 13 (54%) surviving between one and two hours and 5 (63%) of those 8 surviving more than two hours. For all victims testing positive, the mean postmortem BAC was .14%.

Table 2. Blood alcohol analyses of blood samples taken prior to or after death in 66 fatally injured traffic victims.

Category	Blood Tested	Alcohol detected	Mean BAC*
	<i>n</i> (%)	<i>n</i> (%)	(%)
Males ( $n = 93$ )	55 (59)	41 (74)	0.15
Females ( $n = 28$ )	11 (39)	3 (27)	0.09
Drivers** ( $n = 73$ )	43 (59)	28 (65)	0.15
Passengers ( $n = 33$ )	18 (55)	16 (89)	0.11
Pedestrians ( $n = 15$ )	5 (33)	0 (–)	–
Total ( $N = 121$ )	66 (55)	44 (67)	0.14

\*For the two victims who had blood drawn both prior to and after death, the BAC of the former is included here.

\*\*Including one pedal cyclist (not tested).

## DISCUSSION

*General*

The material in the present study is relatively typical of traffic fatalities in the United States as a whole, according to the victims' sex, age, occupant position, trafficant category, and time for the crash (cf. NHTSA 1989). The victims are thus likely to be younger male drivers killed in passenger car collisions, most often on weekends.

According to the National Highway Traffic Safety Administration (1989), about half of all traffic fatalities in the United States are "alcohol-related." However, the reporting rates differ widely among different states. In 1988, the state of Mississippi reported BACs to the Fatal Accident Reporting System for only 6% of the driver fatalities, compared with 96% for the state of Rhode Island. The average BAC reporting rate for driver fatalities in the United States was 73%. Accordingly, the percentage of inebriated drivers of all fatally injured drivers varied between 41% (Maryland and Maine) and 100% (Mississippi). The reporting rates for passengers and pedestrians were even lower, with a national average of 14% and 58%, respectively (NHTSA 1988).

In our present study of Washtenaw County, Michigan, blood alcohol levels were measured prior to or after death (or both) for 59% of the drivers, 54% of the passengers, and 33% of the pedestrians, but these cases were not necessarily reported to FARS. Although "alcohol-related" is not the equivalent to "caused by alcohol," we agree (Lewis and Sherman 1986) that the low alcohol reporting rates in many states lull both the general public and policy makers into a false sense of security by creating the impression that we know how many people are killed because of drunken driving. The knowledge of alcohol use among non-motor vehicle fatalities is even more limited.

*Police*

Drivers are most likely to be tested if there are visible signs of inebriation. This criterion is however a highly doubtful one as trained physicians judged people with a BAC of .10% or above not to be under the influence in 41% of the cases (Andréasson and Bonnichsen 1964). Further, among fatally injured drivers with a BAC exceeding .10%, 68% of the crash reports did not cite alcohol as a contributing factor (Pendleton, Hatfield, and Bremer 1986). Although there are studies reporting a somewhat higher sensitivity of police judgment concerning alcohol use (Lewis and Sherman 1986; Dischinger and Cowley 1989), it is obvious that such judgments must be followed by chemical analyses (e.g. Maull et al. 1984).

Waller (1971) found that the police were least likely to report whether or not alcohol was involved among the elderly, pedestrians, not-at-fault traffic fatalities, and drivers of new cars. Also, our present report indicates a bias in police reports with an underreporting of alcohol use/nonuse among nondrivers, females, and not-at-fault drivers. However, we observed no obvious differences in terms of age of the deceased, vehicle age, or number of vehicles involved.

These data stress the importance of accurate police procedures for investigating *all* traffic fatalities concerning alcohol use and that these investigations must always be supplemented with chemical analyses.

*Emergency staff*

The exact magnitude of bias that intravenous treatment inflicts upon the BAC is not well known. Experimental findings of an increase in BAC after loss of blood (Beck 1961) and a changed rate of elimination of alcohol for patients in shock (Brettel 1974), suggest difficulties in accurately estimating the BAC at the time of the crash in injured victims (Brettel and Maske 1971). In the present study, a blood sample was taken in the emergency room in 22% of the victims who received documented emergency treatment. All of these victims received intravenous treatment before the test, and there were delays of up to two hours before sampling, almost certainly resulting in inaccurate BACs. Even though shock and intravenous treatment could affect the BAC, as many as 10 of the 11 cases tested had detectable amounts of alcohol in their blood.

It is well documented that the more serious the crash, the greater the likelihood of alcohol involvement (e.g. Warren et al. 1981). Obviously, traffic victims taken to emergency wards represent a selected group in this respect. If the emergency staff does not routinely take blood samples from all traffic victims, it is most likely that alcohol samples will primarily be drawn from victims suspected to be inebriated, amplifying the bias. We agree that blood samples should be obtained routinely in injured patients, not only for legal purposes, but also for medical reasons (Chang and Astrachan 1988; Soderstrom and Carson 1988).

Victims who died immediately (i.e. without intravenous treatment) had the highest proportion of alcohol-containing samples in our study, and victims with intravenous treatment had a lower mean BAC than those without. To avoid a bias due to time delay and emergency treatment, the sample should be drawn as soon as possible, and prior to intravenous treatment. Furthermore, documentation of the time of the crash, the time, type, and amount of any intravenous treatment, and the quantity of blood lost is desirable.

#### *Medical examiner*

In total, samples from body fluids were drawn after death in 60% of the cases. This postmortem sampling was less biased than antemortem judgment and sampling, but there was still a selection towards male victims and motor vehicle occupants.

Obviously, to minimize any bias, alcohol analyses should be conducted on all traffic fatalities that meet stipulated criteria for survival time.

### CONCLUSIONS

A major objective of traffic safety is to determine the causal role of alcohol in all types of traffic crashes and all traffic categories, as such knowledge is necessary to encourage political interventions against alcohol abuse in general and in the traffic in particular. With low rates of testing and with selection of cases, the figures can not be unquestionable. In the present study we have elucidated some of the current problems in the investigative process of alcohol use among fatally injured traffic victims. Without police investigation and blood alcohol testing of all fatally and severely injured traffic victims, a selection of suspected inebriated cases is likely. A police investigation without a blood alcohol test is insufficient. To avoid bias due to time delays, intravenous treatment, loss of blood, and shock, the blood sample should be taken as soon as possible, preferably at the scene or during the transfer to the hospital. More research needs to be conducted to estimate the influence of injury and of intravenous treatment upon alcohol metabolism and blood alcohol concentrations.

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