

# Alcohol and Boating-Related Fatalities in North Carolina

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## **Abstract**

Alcohol use is widely believed to be an important contributing factor in boating crashes and boating-related injuries and fatalities. As part of a multi-year case-control study of the role of alcohol in boating-related fatalities in North Carolina, we examined characteristics of 349 cases reported to the North Carolina Medical Examiner's Office from 1989 through 1998. Victims were almost exclusively male and ranged widely in age, although there were relatively few children. Fatalities occurred mainly in the spring and summer months, during the hours between noon and 7 p.m., and on weekends. In just over half of cases the victim was the operator of the boat. Forty-two percent of individuals age 16 and above for whom a valid BAC was obtained had measurable amounts of alcohol; 27% had BACs in excess of 100 mg/dL; 11% were above 200 mg/dL. The presence of any alcohol and high BAC ( $\geq 100$  mg/dL) were generally unrelated to victim characteristics, position in the boat, or environmental circumstances. In comparison with alcohol involvement (for drivers and passengers) in fatal motor vehicle crashes, a somewhat greater proportion of boating fatalities exhibited measurable amounts of alcohol, but more motor vehicle occupants had BACs in excess of 100 mg/dL. Results suggest that interventions and policies to reduce alcohol-related recreational boating deaths will need to be substantially different from those that are used to prevent drinking-driving deaths.

## **Introduction**

Approximately 1,000 persons die in recreational boating accidents each year in the U.S (Baker et al., 1992). The United States Coast Guard reported that 821 people died in boating-related accidents in 1997, but due to data collection limitations it is suspected that the actual number of deaths is even higher (USCG, 1997). Alcohol use is believed to be an important contributing factor in many of these fatalities. Measurements and reports of alcohol's contribution to boating fatalities indicate that these incidents are conceptualized as being "motor vehicle crashes on the water," focusing on the impairment of boat operators. Official Coast Guard classifications define alcohol involvement in boating accidents as "any accident in which alcoholic beverages are consumed in the boat *and the investigating official has determined that the operator was impaired or affected while operating the boat* (emphasis added)" (USCG, 1997). Although impaired operators represent part of the problem of boating fatalities, alcohol-related boating deaths also include both operator and passenger drownings in which impaired boat operation has little if any bearing on the accident. In fact, only about 20% of boating deaths are due to crashes with resulting trauma; the vast majority are due to drowning. Unlike motor vehicle crashes, where a passenger's alcohol use has little direct effect on his/her well-being, alcohol use by boat passengers may contribute as much, if not more, to their death than alcohol use by the operator of the boat.

This paper describes boating-related fatalities in North Carolina, focusing on the prevalence of alcohol among all victims, not merely operators. North Carolina records of boating fatalities are a strong source of data because a measure of blood alcohol concentration (BAC) is available for most cases, and because state officials investigate the majority of cases.

## **Materials and methods**

Data comprise all recreational boating-related deaths in NC from 1989 to 1998. For the purposes of this study, the definition of boating-related fatalities consists of deaths resulting from boating-related activities. It includes drownings when victims entered the water involuntarily, such as falling overboard, or after capsizing or sinking; trauma-related deaths resulting from collision of a boat (or someone being towed) colliding with an object; lightning strikes and carbon-monoxide deaths while boating. Finally, we also include cases in which individuals entered the water voluntarily, using the boat as a platform for swimming, as these deaths are directly related to recreational boating activities; in this way, this definition is broader than the standard definition that the US Coast Guard employs. Data exclude fatalities on commercial vessels, suicides and homicides, and deaths from natural causes in which victims were on boats but never entered the water (e.g., heart attack).

Data were obtained by searching fatality records maintained by the North Carolina Medical Examiner's Office. Most cases were identified using standard e-codes for boating fatalities. The search also examined drowning cases because standard codes for boating fatalities exclude some cases that this study includes, primarily swimming-while-boating deaths. The North Carolina Wildlife Resources Commission investigates a large proportion of boating fatalities; information from these investigations is also included in the data set. The WRC uses a more restrictive

definition of boating fatalities and does not investigate cases on private waters. Consequently, only 67% of cases have this additional information.

A total of 349 cases that met the criteria above were identified. Because the focus here is the role of alcohol, we limited analyses to those cases for which a valid BAC value obtained from a blood sample was available ( $n = 314$ ). Because endogenous alcohol production during decomposition confounds BAC estimation, we also excluded cases in which the victim's body was recovered more than 48 hours after the time of death ( $n = 55$ ). Hence, the analyses reported here are based on 259 cases.

## Results

Victims were almost exclusively male (90%), and ranged widely in age (3 to 83, median = 37), although most were between the ages of 16 – 45 (68%). In 56% of cases the victim was the operator of the boat. The majority of fatalities occurred in the spring (March – May, 28%) and summer (June – August, 41%), during the hours between noon and 7 p.m. (54%) and on weekends (59%). Location of the accident was most commonly a lake (37%), followed by rivers (21%), ocean sounds (20%) and ponds (18%). Fatal incidents most often involved motorboats (39%), followed by rowboats (16%), canoes (8%) and personal watercraft (7%). Boat type was unknown for 19% of cases. Boats were generally small, with a mean length of 15 feet (4.5 meters).

### *Alcohol involvement*

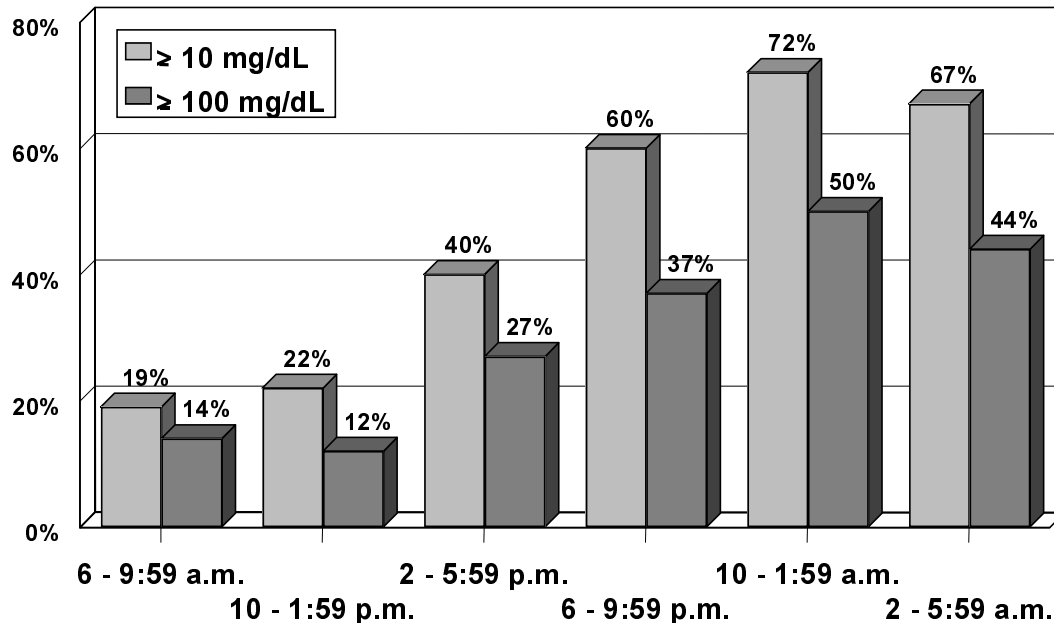
The youngest victim who registered any alcohol was sixteen years old. Consequently, victims below age 16 ( $n = 19$ ) are excluded from the following analyses. Forty-two percent of victims for whom a valid alcohol determination was available had a positive BAC. Fifteen percent had BACs from 10 – 90 mg/dL, 16% were between 100 – 190 and 11% were 200 or above. Among those with measurable alcohol, the mean BAC was 149 mg/dL (median = 130).

Presence of alcohol varied little by individual characteristics. Similar proportions of males and females had been drinking (42% vs. 40%, n.s.) and had high BACs ( $\geq 100$  mg/dL; 27% vs. 32%, n.s.). However, among those who had been drinking, females had significantly higher BACs than males (mean = 213 vs. 142 mg/dL,  $p < .04$ ).

With the exception that victims below the legal drinking age (21) were less likely to have high BACs, alcohol use did not vary much by age. Among those age 16-20, 10% had a BAC  $\geq 100$  mg/dL, compared to 29% of those age 21 or older ( $p < .03$ ). Although alcohol use and high BACs appeared to be somewhat more common in the 26-35 age group, neither mean BAC, proportion non-zero, nor proportion above 100 mg/dL differed significantly by age group (excluding those below age 21).

Neither positive nor high BAC was associated with victims' race, ethnicity, or marital status. Alcohol use was also unrelated to boat type, boat length, or primary activity of the victim.

**Figure 1. BAC by Time of Incident**



### *Time of Incident*

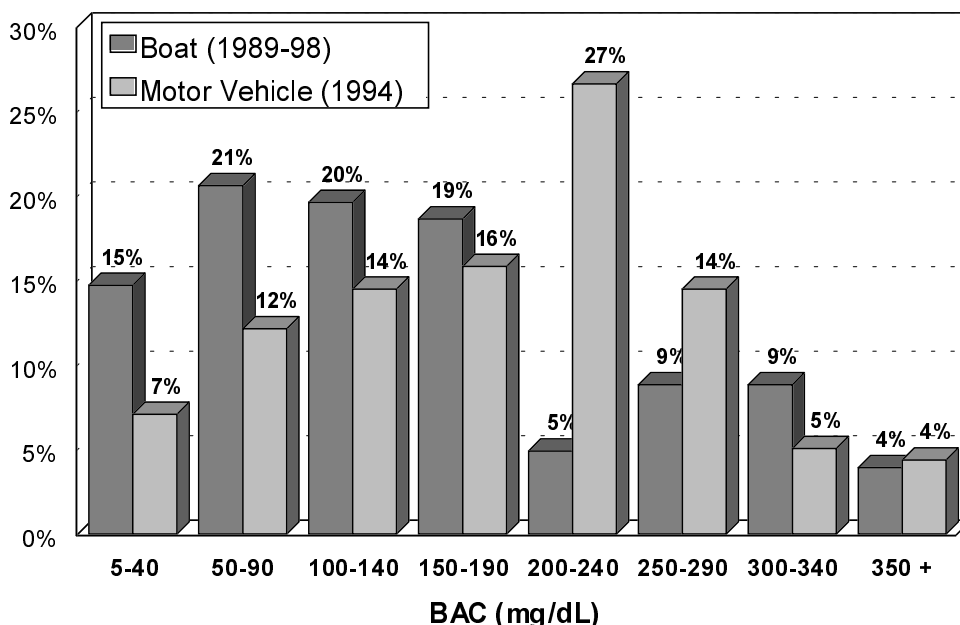
The BAC of victims shows a clear association with time of fatal incidents with more than two-thirds being positive and nearly half over 100mg/dL between 10 p.m. and 6 a.m. (Figure 1). There was no clear association of alcohol use or BAC levels with time of year. Although there are too few cases to detect any clear trend, it does appear that the proportion of victims with BACs in excess of 100 mg/dL has declined. Between 1989-1993, 33% of victims had high BACs, compared to 22% between 1994-1998 ( $p < .07$ ).

### *Alcohol in boating deaths vs. roadway deaths*

As drinking and boating is generally conceptualized as a similar phenomenon to drinking-driving, it is instructive to compare alcohol involvement in boating and motor vehicle deaths. To do this, we obtained data recorded for all 1994 North Carolina motor vehicle deaths ( $n=1,431$ ) from the Fatality Analysis Reporting System (FARS). For the following analyses, all bicyclists, pedestrians and persons under age 16 were excluded. A valid BAC measurement was available for 964 persons who died as occupants of a motor vehicle.

Although drivers represent a substantially greater proportion of motor vehicle fatalities than passengers (75% vs. 56%), BAC values were similar for motor vehicle passengers and drivers, as was found with boat occupants. There was more alcohol involvement in boating deaths (42% non-zero BAC vs. 32% non-zero for motor vehicles). Boating deaths, however, were more likely to involve low levels of alcohol; 36% of alcohol positive boating deaths involved relatively low BACs (< 100 mg/dL), compared to only 19% of motor vehicle fatalities. In contrast, half of those killed in motor vehicle crashes had a BAC of 200 mg/dL or greater, compared with only 27% of boating accident victims (see Figure 2).

**Figure 2. North Carolina Boating and Motor Vehicle Occupant Fatalities by BAC (Alcohol Positive Only)**



## Discussion

Results show that alcohol use is common among victims, but its use differs from that of automobile crash victims. There are two significant differences here. First, although boating deaths are somewhat more likely to involve some drinking, those victims who have been drinking in general are much more likely to have lower BACs than killed motor vehicle occupants. This is consistent with findings from studies of drowning; impairment from alcohol use is particularly dangerous for persons in aquatic environments (Howland et al., 1993, 1995).

Second, alcohol related deaths among recreational boaters differ from those of motor vehicle occupants in how individuals die. Whereas most motor vehicle occupant fatalities result from acute trauma sustained in a crash, this is a relatively uncommon cause of death in boating deaths. Hence, although policies designed to encourage competent, safe vehicle operation among drivers should directly reduce injuries to all occupants, that is not the case for boaters. Some jurisdictions have adopted and promoted the designated driver concept for boat operators, and

there may be some small benefit from the careful use of a ‘designated skipper.’ The fact that drinking occupants are at substantial risk regardless of whether a boat crashes or is even moving, however, suggests that substantially different approaches from those used for motor vehicles will be needed to reduce alcohol-related risks to recreational boaters.

There is another way in which drawing on policies in the motor vehicle arena to set policies for boating may be ill advised. Several states have established a BAC limit for boat operators that is the same as for drivers of motor vehicles. There are presently no data concerning the relative risk of a boating crash (or other ‘accident’ such as capsizing) as a function of operator BAC. However, unpublished data from our ongoing study of alcohol involvement in drowning strongly suggest that even low amounts of alcohol substantially increase the risk of drowning. In view of the substantial differences between the boating and roadway environments it may be that a BAC limit of 80 or 100 mg/dL is far too high. Findings of the present study, while not definitive, clearly suggest that lower BACs are more risky for boat occupants than for motor vehicle occupants.

### **Acknowledgments**

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