A Pilot Survey of Aquatic Activities and Related Consumption of Alcohol, with Implications for Drowning

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Synopsis

The investigators considered the relationship between participation in aquatic activities and the consumption of alcohol, with their implications for the risk of drowning. In a telephone survey with random-digit dialing, interviewers asked Massachusetts residents ages 20 years and older how often they engaged in various aquatic activities, in what settings, and how often they drank alcohol in connection with participation in aquatic activities.

Of 294 respondents, 79 percent of the men and 72 percent of the women reported participating in aquatic activities during August 1988, the month prior to the interview. Respondents were asked to identify their most recent aquatic activity. The mean number of days of participation in the month was 13. The most frequently reported aquatic activities were swimming (76 percent), followed by sunbathing (74 percent), power boating (25 percent), and fishing from shore (15 percent). Among those persons reporting participation in aquatic activities, 55 percent had been at the ocean on the most recent occasion, 26 percent at lakes or ponds, 17 percent at pools, and 2 percent at rivers.

Among those persons reporting aquatic activities, 36 percent of the men and 11 percent of the women reported having drunk alcohol on the most recent occasion. Those who reported drinking in aquatic settings were more likely to report driving after drinking than those who did not drive.

Implementation of new Federal regulations and State laws concerning drinking and boating should be accompanied by public education on the risks of drowning if aquatic activities and alcohol consumption are combined.

DROWNING RANKS third among the causes of unintentional injury and death in the United States. About 7,200 persons drown each year; about 6,000 of these drownings (83 percent) do not involve boats; the other 1,200 drownings (17 percent) occur in connection with recreational boating (*1*).

Our purpose was to obtain preliminary data on the frequency with which people engage in various activities on or near the water, in what settings, and the prevalence of the use of alcohol by those engaged in aquatic activities. We devised several questions to provide these data as part of a larger survey concerning traffic safety behaviors in Massachusetts.

Although numerous studies have been reported on alcohol consumption among drowning victims, the causal role of drinking in drownings has been obscured by a lack of information on drinking behaviors among those engaged in aquatic activities (*2*). Nevertheless, the presumption that alcohol contributes to drownings is reasonable in several respects. Accordingly, in recent years most States, as well as the Federal Government, have adopted regulations pertaining to the use of alcohol while boating. In a manner analogous to *per se* laws for drunken driving, the regulations set standards for intoxication by establishing levels of blood alcohol concentrations (BAC) to be used in conjunction with previous laws prohibiting operation of a vessel by persons considered under the influence of alcohol.

Among the reasons to suspect that alcohol plays a causal role in some proportion of drownings are that (*a*) the skills or judgment to avoid life-threatening circumstances may be impaired among persons consuming alcohol in aquatic settings; (*b*) alcohol creates a sensation of warmth and may lead some swimmers to remain in cold water longer than they would if sober; (*c*) alcohol intoxication may increase the risk of caloric labyrinthitis, an inner ear disturbance that may cause a person suddenly immersed in water to become disori-

Table 1. Demographic characteristics of 294 respondents to survey of participation in aquatic activities and consumption of alcohol in Massachusetts, 1988 (percentage distribution)

Characteristic	Percent
Age, mean (in years)	42
Sex:	
Men	46
Women	54
Educational attainment:	
Grade school or less	1
Some high school	6
High school diploma	31
Vocational school	2
2-year college degree	6
Some college	20
4-year college degree	22
Graduate school	12
Marital status:	
Never married	25
Married	59
Separated	2
Widowed	7
Divorced	8
Racial or ethnic background:	
White, not Hispanic	93
Black	4
Hispanic	1
Asian	1
Other	1
Current work status:	
Student	2
Working	74
Unemployed	1
Homemaker	11
Retired	11
Disabled	2
Total family income:	
Less than $5,000	2
$5,000–$9,999	4
$10,000–$19,999	17
$20,000–$29,999	16
$30,000–$39,999	17
$40,000–$49,999	14
$50,000 or more	29
No response	1

Table 2. Aquatic activity and setting of 221 subjects reporting on most recent occasion, Massachusetts, August 1988 (percentages)

Characteristic	Percent
Most recent activity:	
Ocean	55
Lake or pond	26
Pool	17
River	2
Type of activity:	
Swimming	76
Sunbathing	73
Power boating	25
Fishing from shore	14
Fishing from boat	11
Rowing or paddling	11
Sail boating	9
Water skiing	7
Surf boarding	2
Sail boarding	1
Other	23

ented and to swim down rather than up (*3*); and, (*d*) alcohol may retard laryngospasm when water is aspirated, weaken the diving response, or inhibit response to asphyxial blood-gas changes, such as increased carbon dioxide levels (*4*). (The diving response is a mechanism of the body to conserve oxygen during long submersion by slowing the heart rate and reducing the blood supply to a large portion of the body's tissues.)

Environmental stress factors associated with water-related activities may work synergistically with alcohol to degrade performance. The U.S. Coast Guard conducted field tests that documented the effects of sun, wind, glare, vibration, noise, and wave motion on the performance of boat operators. Performance measures included reaction times and error rates in making course corrections. Results indicated that 4 hours' exposure to boating stresses produced a kind of boater's hypnosis, a fatigue that caused a reduction in performance similar to alcohol ingestion (*5*).

Sober persons may drown as a result of the actions of persons who have been drinking, for example, when a boat operator who has been drinking causes an accident fatal to a passenger, a swimmer, or another boater.

In a previous report, Howland and Hingson (*2*) reviewed the relationship between alcohol and drowning. Thirty-six studies published in the years 1950–85 were identified. Most were descriptive studies reporting the percent of drowning victims found positive for alcohol at autopsy. Many reports suffered from methodological problems.

The results of two well-executed studies of drowning victims 15 years of age and older differed; one reported that 29 percent were positive for alcohol (*6*), and the other reported that 47 percent were positive (*7*). The difference could be explained by the fact that each study used different criteria to include cases. Waller (*6*) studied only victims submerged 6 hours or less; Dietz and Baker (*7*) included those submerged up to 12 hours. Alcohols produced by the decomposition process can confound detection of ingested alcohol.

Little information is available on drinking behaviors of persons engaged in aquatic activities, and the extent to which alcohol plays a causal role in drownings cannot be determined. Several relevant reports provide information only on boaters. In a survey of boat owners by BOAT/US (a boat owners' interest group), 35 percent of respondents indicated that they drank alcoholic beverages while under way. The estimate is comparable to the findings of a 1976 Coast Guard survey of boat owners; 40 percent routinely carried alcohol on boating outings (*5*). In a study that involved alcohol testing among boaters at sea in Finland, 30 percent had positive breath tests, although most had relatively low levels of BACs (*8*).

Methods

During the summer months of 1988, 2,260 Massachusetts adults 20 years of age and older were interviewed concerning traffic safety behaviors. The survey used a random digit statewide telephone dialing tech-

nique (*9*). One respondent in the age group was randomly selected from each household called (*10*). The 306 adults interviewed during September 1988 were asked if they had engaged in aquatic activities in August; if so, they were queried about their activities on the most recent occasion (such as swimming, boating, and fishing), the settings (such as pool, river, ocean, lake, or pond), and drinking of alcohol. Analysis of the responses drew upon answers to the aquatic activities questions as well as the questions pertaining to traffic safety behaviors.

Results

Of the 306 persons queried, 96 percent (294 of 306) provided information on aquatic activities during August. Demographic characteristics of respondents are shown in table 1. Seventy-five percent of respondents (221 of 294) reported aquatic activities during that month. The mean number of days of reported aquatic activity during the month was 13. The proportions of men (79 percent) and women (72 percent) reporting aquatic activities were not significantly different, although women reported significantly more days of activity during that month (14 days) than men (12 days) ($P = 0.04$).

One hundred twenty persons (55 percent) reported they were at the ocean on the most recent occasion; 57 (26 percent) were at lakes or ponds; 38 (17 percent) were at pools; and 5 (2 percent) were at rivers (table 2).

Although many respondents reported more than one aquatic activity on the most recent occasion, swimming was the most frequently reported (76 percent), followed by sunbathing (74 percent), power boating (25 percent), and fishing from shore (15 percent) (table 2).

With the exception of power boating, age was not an important determinant of activity when responses were analyzed, even after separating subjects into two age groups, 20 through 25 years, and 26 years or more. The proportion of respondents 20 through 25 years who reported power boating (41 percent) was significantly greater than the proportion among the older respondents (22 percent) ($P < 0.03$). The sex of respondents was not associated with specific activities, with the exception of fishing, which men were more likely to report (40 percent) than women (13 percent) ($P = 0.0002$).

Alcohol consumption. Of the 221 persons reporting aquatic activities, 51 (23 percent) reported drinking alcohol on the most recent occasion; men were significantly more likely to report drinking (36 percent) than women (11 percent) ($P < 0.0001$) (table 3). Men who reported drinking in connection with aquatic activities were younger (mean age 35 years) than men who reported not drinking (mean age 38 years), but not significantly so; similarly, women who reported drinking (mean age 34 years) were not significantly younger than women who reported not drinking (mean age 41 years).

Table 3. Characteristics of 51 subjects who participated in aquatic activities who also consumed alcohol (percentages), Massachusetts, August 1988

Characteristic	Percent of 221 participants who drank alcohol	Percent of drinkers who had 4 or more drinks
Sex:		
Men	36	28
Women	11	35
Age group, in years:		
20–29	28	54
30–39	22	23
40–49	30	7
50–59	7	0
60–64	0	0
65 and older	17	0
Activity:		
Swimming	26	35
Power boating	31	37
Sailing	27	0
Fishing from shore	23	40
Fishing from boat	22	22
Sunbathing	23	33
Location:		
Ocean	20	33
Pool	22	29
River	36	25
Lake or pond	29	27

There was considerable variation in the amount of alcohol reported consumed by persons in different age groups. Overall, of those who reported drinking during their most recent aquatic activity, 29 percent (15 of 51) reported having had 4 or more drinks. For those who drank within 2 hours of beginning or ending aquatic activity, the mean number of drinks reported was 3.8; men reported consuming an average of 4.0 drinks and women reported 3.1.

Of those 20 through 29 years of age who reported drinking alcohol, 54 percent had had 4 or more drinks. Of those in the 30- through 39-year age group who reported drinking, 23 percent said they had consumed 4 or more drinks. Only 7 percent of those drinking in the 40- through 49-year age group reported 4 or more drinks. None of the respondents 50 years of age or older who reported drinking said they had had more than 4 drinks during their most recent aquatic activity (table 3).

The proportion of those responding who reported aquatic activity and related alcohol consumption did not appear to vary by the type of activity. The activities and the percent reporting alcohol consumption were power boating, 31 percent; sailboating, 27 percent; swimming, 26 percent; sunbathing, 23 percent; and fishing, 22 percent (table 3). Heavy drinking was most frequent among those who were fishing from the shore (40 percent). None of the respondents who reported sailing

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said they had consumed 4 or more drinks (table 3).

The proportion of respondents who reported aquatic activity while drinking alcohol varied more by location than activity. Of those reporting having been at the ocean, 20 percent reported drinking; at a pool, 22 percent; at a river, 36 percent; and at a lake or pond, 29 percent. Of those who drank at these locations, the proportion who had 4 or more drinks was 33 percent at the ocean; 29 percent at a pool; 25 percent at a river; and 27 percent at a lake or pond (table 3).

Of the 51 persons who reported drinking alcohol during their most recent aquatic activity, 75 percent reported drinking beer, 24 percent reported drinking wine or wine coolers, and 16 percent reported drinking liquor.

Because our pilot survey of aquatic activities was added to a questionnaire concerning traffic safety behaviors, we were able to investigate the association between drinking and aquatic activities as well as between drinking and driving. Of the 294 respondents, 209 reported both aquatic activities and driving during the month prior to the interview. Those who reported drinking during their most recent aquatic activity were four times as likely to report having driven at least once after drinking during the prior month than those not drinking in connection with aquatic activity ($P = 0.000$) (table 4). The association was particularly marked for women; women who drank in connection with aquatic activity were 14 times as likely as women who did not to report having driven after drinking at least once during the month prior to the interview.

Discussion

Although this preliminary study of aquatic activities and associated drinking was limited with respect to geography and sample size, it yields several suggestive findings.

First, participation in aquatic activities appears common among the general population, with 75 percent of the respondents having participated in an aquatic activity during the month prior to the interview. Moreover, among those who had, participation appeared to be frequent. On average, respondents reported aquatic activity for about one-third of the days during the reference month.

The magnitude of the rates of participation was increased by such factors as Massachusetts being a coastal State with a significant proportion of its population residing within an hour's drive of the Atlantic Ocean; the survey being conducted with reference to August, a month when many people take vacations; and August 1988 having been a particularly hot month. Accordingly, generalizations about aquatic exposure rates in other populations, using these data, must be made with caution. Further research is needed to determine estimates of participation in aquatic activities in various geographic regions at various times of year.

Second, men and women did not appear to differ with respect to rates of participation in aquatic activity or specific aquatic activities. This finding is important because of the sex differential in drowning rates. For all ages, the ratio of drowning rates for men to those for women is about 12 to 1 for fatalities involving boats and 5 to 1 for nonboating drownings. The drowning rate for males peaks at 2 years of age, declines until age 10, and then rises sharply to a maximum at age 18 years; the female drowning rate is highest at 1 year of age and declines thereafter (*1*). Our data suggest that differences in aquatic activity behaviors, rather than differences in the type of aquatic activity participated in, may account for the sex differences in rates of drowning.

Third, we found that 23 percent of respondents who participated in aquatic activities during the month prior to the interview also reported drinking on that occasion. In contrast, the results of the 1986 national roadside breath testing survey found that 8.3 percent of weekend nighttime drivers had BACs of more than 0.05 percent (*11*). This suggests that social norms are more tolerant of drinking while engaged in recreational activities in aquatic environments than of driving after drinking.

One possible explanation for the sex differential in rates of drowning is provided by our finding that men were significantly more likely than women to report drinking alcohol in connection with aquatic activities. Thirty-six percent of male respondents and 11 percent of female respondents said that they drank during their most recent aquatic activity. These results raise questions about the magnitude of the contribution of alcohol to drowning. As mentioned, two of the best studies of alcohol exposure among drowning victims suggested different estimates, 29 percent and 49 percent (*6, 7*).

The degree to which drinking is a risk factor for drowning varies considerably, depending upon which study is believed to reflect most accurately the true estimate of alcohol exposure among drowning victims. Our

findings underscore the need for case control studies matching drowning victims to persons who have not drowned with respect to the amounts of alcohol consumed, locations, weather conditions, time of day and year, and other relevant circumstances.

The Coast Guard Authorization Act of 1984 (Public Law 98-557) amended Title 46, United States Code, Chapter 23 (Operation of Vessels Generally) in two important ways. First, that portion of the Code dealing with negligent operation was expanded to include a section specific to operating a vessel while intoxicated. Second, the new section provided for the Secretary of Transportation to develop regulations prescribing standards for determining intoxication.

Subsequently, the Coast Guard established both a behavioral and a BAC standard (0.10 percent for recreational vessels and 0.04 percent for commercial vessels). As of July 1988, all 50 States had laws pertaining to the use of alcohol and drugs while boating. Twenty-eight States had BAC standards for intoxication and 10 States had behavioral standards. Implementation of the new Federal standards, however, will have the effect of introducing BAC standards to many boaters throughout the nation because the Federal standards apply to all navigable waterways (over which the Federal Government maintains jurisdiction), and because the Coast Guard is a major enforcement agency for boating activities.

Boating incidents account for only about 17 percent of all drownings annually. More than three-quarters of these events occur on small bodies of water (*1*). Thus, even with perfect enforcement, the impact of drinking and boating laws on all alcohol related drownings will be limited. The strategies with which to approach non-boating, alcohol-related drownings require developing a base of knowledge about the epidemiology of such events and the characteristics of persons at risk. Further investigation will add to existing knowledge by establishing estimates of the frequency of various kinds of recreational aquatic activity engaged in by different age and sex groups in different regions of the country.

Although the new boating laws regarding alcohol consumption may have little measurable impact on the rates of drowning in the near term, the regulations may have important long-term effects on public attitudes about drinking in association with water-related activities. Our data suggest that drinking in association with aquatic activities is common. To date, there is little public education about the possible risks that alcohol consumption poses for persons engaged in aquatic activities. We suggest that the implementation of new boating legislation involving consumption of alcohol be accompanied by mass education aimed at changing norms about the propriety of drinking while participating in aquatic activities.

Table 4. Association among 209 subjects between drinking alcohol during most recent aquatic activity and having driven a motor vehicle during the past month at least once after drinking alcohol[1]

	Aquatic activities and drinking during past month		
	Yes	*No*	*Total*
Driving and drinking during past month:			
Yes	29	41	70
No	21	118	139
Total	50	159	209

[1]Excludes 11 subjects who did not drive during the month.
NOTE: Odds ratio = 3.97, *P* less than 0.000.

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