# Watercraft-Related Drownings Among New York State Residents, 1988–1994

Marilyn L. Browne, MS[a]
Elizabeth L. Lewis-Michl, PhD[a]
Alice D. Stark, MPH, DrPH[a]

## SYNOPSIS

**Objective.** To describe environmental and personal risk factors associated with watercraft-related drownings. This information may be useful in developing boating safety programs, regulations, and enforcement priorities.

**Methods.** A companion article in this issue (Unintentional Drownings Among New York State Residents, page 448) summarizes an investigation of 883 non-bathtub drownings among New York State residents for the years 1988 to 1994 using medical examiner, coroner, police, and hospital records in addition to death certificate data. This report details the environmental and personal risk factors associated with 216 watercraft-related drownings.

**Results.** Ninety-three percent of watercraft-related drowning victims were male, with the highest rate of drowning observed among males ages 15–44 years. Most commonly, the victim entered the water when the watercraft capsized (36%), the victim fell overboard (24%), or the victim intended to swim (11%). Personal flotation devices (PFDs) were known to be worn by only 9% of drowning victims, and in these cases other risks overwhelmed the effectiveness of the PFD. Of 73 individuals 15 years of age or older for whom adequate blood alcohol concentration analyses were provided, 44% were positive for blood alcohol.

**Conclusions.** Based on this study, increased use of PFDs, avoidance of dangerous currents, and less alcohol use by operators and passengers of all types of watercraft would result in a reduction in watercraft-related drownings. In addition to continued education efforts, boating safety measures that deserve consideration include enforcement of current PFD and boating while intoxicated (BWI) regulations and expansion of BWI laws to apply to all boaters.

[a]Bureau of Environmental and Occupational Epidemiology, New York State Department of Health, Troy, NY

Address correspondence to: Marilyn L. Browne, MS, Flanigan Sq., 547 River St., Rm. 200, Troy, NY 12180; tel. 518-402-7990; fax 518-402-7769; e-mail <mlb10@health.state.ny.us>.

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Watercraft-related activities necessarily involve the potential for submersion, and therefore the possibility of drowning. Water depth, water current, distance from shore, and water temperature, as well as personal factors such as personal flotation device (PFD) use, swimming skills, and safe boating practices influence risk of drowning. Alcohol or drug use may affect both the likelihood of entering the water and the ability to avoid drowning once in the water. Data on these environmental and personal risk factors are useful in developing boating safety programs, regulations, and enforcement priorities.

The New York State (NYS) Department of Health (DOH) conducted a study of non-bathtub drownings among NYS residents utilizing medical examiner, coroner, police, and hospital records as well as death certificates. A companion article addresses all drownings included in the study.[1] This report details some of the environmental and personal risk factors associated with watercraft-related drownings.

## METHODS

The methods of this study appear in detail in the companion article.[1] In brief, we used the NYS DOH Death Certificate Statistical File to identify the study population. All NYS residents for whom the cause of death was International Classification of Diseases 9th revision (ICD-9) E code 830-832 or 910, excluding 910.4 (drowning in a bathtub), and whose deaths occurred in NYS during the years 1988 to 1994 were selected to be included in the study. We considered an incident to be watercraft-related if the victim entered the water from a watercraft (including jumping into the water to swim) or was trying to board or disembark from a watercraft. A total of 883 drowning victims was included in the main study, with 216 of these drownings identified as watercraft-related. In this report, "drownings" or "incidents" will be used to refer to watercraft-related incidents unless otherwise specified.

In examining toxicology results, we used Wintemute's criteria for analysis of blood alcohol results:

> (i) death must occur within six hours of the onset of immersion (to exclude spuriously low [blood alcohol concentration] values associated with antemortem catabolism), unless antemortem results from within that time are available; (ii) without evidence to the contrary, death can be assumed to have occurred shortly after immersion; (iii) blood sampling must occur within 24 hours of death (to exclude spuriously high values due to putrefaction); (iv) the time of immersion must be established precisely enough to allow these criteria to be applied; (v) if not otherwise specified, the time of blood sampling should be taken as the time of autopsy.[2]

Descriptive statistics were used to summarize the data. We computed average annual drowning rates per 100,000 population using county population data from the 1990 United States Census.

## RESULTS

From 1988 through 1994, 216 NYS residents died in watercraft-related incidents that occurred in NYS. Twenty-four incidents involved more than one person and resulted in 51 of the drowning victims. Of the 216 drowning victims, 201 (93.1%) were male. The highest rates of watercraft-related drownings were observed among males 15 to 44 years of age (see Table 1). Very few drownings occurred among children 14 years of

**Table 1. Watercraft-related drownings among New York State residents[a] by age, gender, and race,[b] 1988-1994 (Rates are average annual rates per 100,000 population.)**

| *Age (years)* | *0–4* | | *5–14* | | *15–24* | | *25–44* | | *45–64* | | *65+* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | *rate* | n | *rate* | n | *rate* | n | *rate* | n | *rate* | n | *rate* |
| Sex | | | | | | | | | | | | |
| Male | 0 | – | 6 | 0.07 | 41 | 0.44 | 103 | 0.51 | 34 | 0.29 | 17 | 0.26 |
| Female | 0 | – | 3 | 0.04 | 1 | 0.01 | 4 | 0.02 | 5 | 0.04 | 2 | 0.02 |
| Race (males) | | | | | | | | | | | | |
| African-American | 0 | – | 0 | – | 4 | 0.24 | 5 | 0.17 | 5 | 0.26 | 3 | 0.54 |
| White | 0 | – | 6 | 0.09 | 37 | 0.48 | 98 | 0.57 | 30 | 0.29 | 14 | 0.24 |

[a]Drownings that occurred outside New York State are excluded.

[b]Individuals whose race was identified as other than white or African-American were grouped with whites (*n*=28). Rates stratified by age, gender, and race are listed for males only due to the small number of female drownings.

age or younger, or among females of any age. For this reason, rates stratified by race are presented for males only. The rate of drowning was generally higher for white males compared to African American males. Rates for African American males are based on small numbers.

Of 214 drowning victims for whom information was available, 184 (86.0%) had companion(s) in the immediate vicinity at the time of the incident. In most cases, the companion(s) were in the watercraft with the victim and also entered the water. For 95 of 140 drowning incidents in which more than one person was in the watercraft, all of the individuals in the watercraft entered the water. Due to multiple drownings, these 95 drowning incidents represent 116 drowning victims.

The type of boat was unknown for 13 drowning victims and was reported only as a "small fishing boat" for six others. Eighty-nine of the remaining 197 watercraft were recreational motorboats and 10 were commercial motorboats, for example, fishing boat, tugboat, barge, tanker (see Table 2). The distance from shore was noted for 119 cases; 81 (68.1%) were 100 feet or more from shore at the time of the incident.

The conditions under which the victim entered the water are also presented in Table 2. Among the 210 individuals for whom information was available, the most frequently cited circumstances were: 76 (36.2%) entered the water when the watercraft capsized, 50 (23.8%) fell overboard, and 24 (11.4%) voluntarily or intentionally entered the water to swim. For 11 watercraft-related drownings, the incident was job-related. Six watercraft-related drownings, plus one would-be rescuer of one of the six victims, were associated with dams, falls, and spillways.

**Table 2. Watercraft-related drownings by type of watercraft and circumstances under which the victim entered the water—New York State, 1988–1994**

| | *Number* | *Percent*[a] |
|---|---|---|
| Type of watercraft | | |
| Recreational motorboat | | |
| < 19 feet | 48 | 23.6 |
| 19 feet plus | 16 | 7.9 |
| Unknown length | 25 | 12.3 |
| Canoe | 38 | 18.7 |
| Rowboat or "small fishing boat" | 38 | 18.7 |
| Raft or tube | 19 | 9.4 |
| Commercial motorboat, tug or barge | 10 | 4.9 |
| Paddleboat | 5 | 2.5 |
| Sailboat | 4 | 2.0 |
| Unknown | 13 | — |
| Circumstances | | |
| Watercraft capsized | 76 | 36.2 |
| Victim fell overboard | 50 | 23.8 |
| Victim voluntarily entered water | 24 | 11.4 |
| Watercraft swamped/sank | 19 | 9.0 |
| Collision with another watercraft, rock, other | 16 | 7.6 |
| Structural problem with watercraft | 12 | 5.7 |
| Caught in undertow at base of dam | 6 | 2.9 |
| Attempting rescue | 5 | 2.4 |
| Fleeing boat owner | 2 | 0.9 |
| Unknown | 6 | — |

[a]Excludes individuals for whom information on type of watercraft/circumstances were unavailable.

In this report, personal flotation device (PFD) refers to wearable PFDs including life jackets, life vests, buoyant foul weather gear, or a buoyant wet suit. Throwable flotation aids such as boat cushions and ring buoys were not included as PFDs. It was assumed that a PFD was not used if the description of the victim did not include mention of a PFD. In 10 cases, description was insufficient for making a determination. Among the remaining 206 drowning victims, 19 had been wearing PFDs and two were using flotation cushions. For six drownings in which a PFD was worn, injury was a cause or contributing cause of death. Hypothermia played a role in an additional five cases. For six others, a strong current was influential: three became caught in the current at the base of a dam, two were entangled in rope, and another was wedged under a tree. Two children wearing PFDs were trapped under a capsized, partially sunken motorboat. It was reported that a PFD was not worn or onboard for 51 drownings. For 36 victims, PFDs were known to be onboard the watercraft but were not worn. In at least four other incidents, the number of PFDs available was insufficient for each person to have one. Other occupants of the boat were wearing PFDs and survived. For the remaining 96 victims who were not wearing PFDs, the availability of a PFD onboard the watercraft could not be determined.

Information on swimming skills was available for only 90 victims who drowned in watercraft-related incidents. Fifty-seven (63.3%) were reported to be average-to-good swimmers, with 33 (36.7%) described as either weak swimmers or non-swimmers. The small proportion of individuals for whom information was available limits interpretation of these findings.

Toxicology reports were received for 159 of the 207 drowning victims who were 15 years of age and older.

Criteria for analysis of blood alcohol results were met for 73 victims (the criteria, based on length of survival and sampling time, are described above). Of these 73 victims, 32 (43.8%) tested positive for blood alcohol. Eighteen (24.7%) of the 73 had blood alcohol concentrations (BACs) of 100 mg/dl or more. Four drowning victims with valid blood alcohol results tested positive for illicit drug use, with three of these testing positive for both alcohol and illicit drug use and three testing positive for illicit drugs only.

## DISCUSSION

A variety of factors can contribute to a delay in rescuing someone involved in a watercraft-related incident. Often the watercraft is far from shore and/or rescuers. Frequently more than one person from the watercraft is in the water, so rescue efforts are divided among those needing assistance. Also, the drowning person's ability to stay afloat may be compromised by injury or hypothermia. Use of a PFD can prevent the person who has entered the water from submerging before rescue can be carried out.

In only 19 drownings did victims drown despite the use of a personal flotation device (PFD). In these cases, other risks overwhelmed the effectiveness of the PFD. In most of these cases, injury or hypothermia was a cause or contributing cause of death, or a very strong current caused submersion.

To estimate how many watercraft-related deaths might be prevented by the use of PFDs, we can look at the number of drownings that did not involve a swift current, injury, or hypothermia. One or more of these factors were reported for 56 of the 216 drownings in this study. Thus, around 160 drownings might have been prevented by the use of PFDs. This should be considered a rough estimate because information was missing on current for 73 victims (33.8%), on injury for 18 victims (8.3%), and hypothermia was inconsistently noted as a contributing factor. Also, it is likely that some of the 56 drownings associated with injury, hypothermia, and/or a strong current might have been averted if a PFD was worn.

Hydraulic currents at the base of dams, falls, and spillways pose a significant hazard to boaters. Small, low-head dams are especially hazardous because the dam may not be obvious from upstream or may not appear to pose a threat. Boating safety courses should warn boaters to stay clear of dams and spillways, and signs and buoys should be put in place to advise boaters and swimmers of the dangerous current.

In a recent population-based case-control study conducted in Maryland and North Carolina, Smith et al. were able to demonstrate a clear dose-response relationship between BAC and risk of a watercraft-related fatality, ranging from an odds ratio of 2.8 (95% confidence interval [CI] 1.6, 4.8) for a BAC of 1–49 mg/dl to an odds ratio of 37.4 (95% CI 16.8, 83.0) for a BAC of 150 mg/dl or greater.[3] Without data on frequency of alcohol use while boating among NYS residents, we are not able to produce good estimates of the excess risk of drowning while boating under the influence of alcohol for our population. Smith et al. evaluated alcohol use on a multistage probability sample of boaters (both operators and passengers) using breath samples. The unweighted proportion of controls with a positive BAC was 17%.[3] Several national surveys have examined alcohol use while boating, with 29% to 32% of respondents reporting alcohol use during or within two hours prior to a recent or typical outings.[4–6] In our study, among those with valid BAC data, approximately 44% of watercraft-related drownings were associated with alcohol use. This is about 1.4 times the frequency of alcohol use among boaters estimated by the national surveys cited in this article, and approximately 2.6 times the frequency observed among controls in Smith et al.'s study.[3]

Many of the drowning victims in our study would not have been subject to NYS navigation regulations regarding boating while intoxicated (BWI). New York State Navigation Law applies only to the operator of a watercraft propelled by mechanical power. In addition, the watercraft must be "underway" (not docked or anchored). Among victims 15 years of age or older for whom the type of watercraft was noted, the watercraft was a private or commercial motorboat, tug, or barge in 97 of 194 cases (50%). Of these 97 drowning victims, operator/passenger status was noted for 72, with 39 reported to be operators. Accordingly, among those drowning victims for whom information was available, slightly more than one-quarter would have been prohibited from boating while intoxicated in keeping with New York State Navigation Law. Boating while intoxicated should be discouraged for passengers as well as operators of any watercraft through education or limited via regulation. In addition, enforcement of current regulations is imperative. While only 12 victims could be identified as operators of motorboats for whom valid toxicology data were available, eight of the twelve (67%) had positive BACs.

In summary, the results of this study suggest that increased use of PFDs, caution in or near dangerous currents, and avoidance of alcohol use by operators and passengers of all types of watercraft may reduce watercraft-related drownings. In addition to continued education efforts, boating safety measures that

deserve consideration include: enforcement of current PFD and BWI regulations, expansion of BWI laws to apply to all boaters, and posting requirements for dams and spillways.

## REFERENCES


1. Browne ML, Lewis-Michl EL, Stark AD. Unintentional drownings among New York State residents, 1988–1994. Public Health Rep 2003;118:448-58.
2. Wintemute GJ, Teret SP, Kraus JF, Wright M. Alcohol and drowning: an analysis of contributing factors and a discussion of criteria for case selection. Accid Anal Prev 1990;22:291-6.
3. Smith GS, Keyl PM, Hadley JA, Bartley CL, Foss RD, Tolbert WG, McKnight J. Drinking and recreational boating fatalities: a population-based case-control study. JAMA 2001 Dec 19;286(23):2974-80.
4. American Red Cross. American Red Cross national boating survey: a study of recreational boats, boaters, and accidents in the United States. Washington: American Red Cross; 1991.
5. Alcohol use and aquatic activities—United States, 1991. MMWR 1993;42(35):675, 681-3.
6. Logan P, Sacks JJ, Branche CM, Ryan GW, Bender P. Alcohol-influenced recreational boat operation in the United States, 1994. Am J Prev Med 1999;16:278-82.