Characteristics of Drowning Deaths in North Carolina

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Synopsis

A retrospective study of 1,052 unintentional drowning deaths in North Carolina during the period from 1980 through 1984 was carried out, with emphasis on the victims' activity and alcohol consumption, and the settings of the accidents. The data suggest that many drownings are preventable, and reinforce the etiologic importance of ethanol consumption in such deaths.

ABOUT 6,000 DROWNINGS occur each year in the United States, the third most common cause of death by unintentional injury, surpassed only by motor vehicle accidents and falls.

The tragedy of drowning often is compounded by the premature nature of the death. For those aged 5 to 44 years, drowning is the second leading cause of unintentional injury (1,2). Despite the large number of deaths, relatively few epidemiologic studies have examined drownings in this country.

We studied drowning deaths in North Carolina, giving particular attention to the activity being engaged in by the victim, the victim's alcohol consumption, and the setting of the accident. North Carolina lends itself to studies of drowning because virtually every type of water setting is present, from ocean shoreline in the east to mountain lakes and streams in the west. Data for 1977 through 1979 show only 14 States with a The overall drowning rate for North Carolina residents during the period covered by the study was 3.2 per 100,000 persons. Nonwhite males had the highest rate, 8.8 per 100,000 population. The next highest rate was for white males, 4.7 per 100,000.

Swimming and wading, involved in 41 percent of the drowning deaths, was the most frequently associated activity. Fishing was involved in 15 percent of the deaths, and motor vehicle accidents with 8 percent. Most occurred in freshwater settings, notably lakes and ponds, 39 percent, and rivers and creeks, 29 percent.

Of the 752 victims 15 years and older tested for blood ethanol, 53 percent had positive tests and 38 percent had blood alcohol concentrations of 100 milligrams per deciliter or greater. Significant percentages of victims 15 years and older with blood alcohol concentrations greater than 100 milligrams per deciliter were found in all settings and activity groups.

higher drowning rate than North Carolina (1). The study benefited from a State medical examiner system that investigates drowning deaths and records the data and findings in a central repository.

Certain data from this study were published by Centers for Disease Control in 1986 (3).

Methods

We examined retrospectively unintentional drowning deaths in North Carolina in the period 1980 through 1984. Information about these deaths was obtained from the North Carolina Office of the Chief Medical Examiner. Study data included demographic information on the decedents, and their means and places of death; autopsy and toxicology findings; and narrative summaries of the circumstances.

Drowning rates were calculated for North Caro-

lina residents and were subdivided on the bases of sex, race, and age. The calculated rates are approximate because the study did not include North Carolina residents who drowned out of State. Nonresident victims were not included in the computation of rates. Cross tabulations were generated to see how demographic characteristics varied by activity and setting, using data on resident and nonresident victims. Only major differences are reported in the results for associated activities and accident settings. The binomial test of significantly different proportions was used to indicate which differences were not likely to be caused by random variations.

The toxicology laboratory of the North Carolina Office of the Chief Medical Examiner reports as negative those blood alcohol test results of 19 milligrams per deciliter (mg per dl) or lower. Positive results, those 20 mg per dl or higher, are reported in units of 10 mg per dl after rounding down to the lower unit of 10. For example, blood alcohol concentrations ranging from 90 to 99 mg per dl are reported as 90 mg per dl.

Results

During the period 1980 through 1984, 1,052 persons drowned unintentionally in North Carolina. Of these, 87 percent were males and 31 percent were males 15 to 24 years of age. Of the total number of victims, 953 were North Carolina residents, resulting in an approximate annual drowning rate of 3.2 per 100,000 population. The rate was higher for nonwhites (4.8) than whites (2.6) (table 1). Nonwhite males had the highest overall rate (8.8), and their rates were highest across all age groups. The 15- to 24-year-old group had the highest rate (5.1) of all combined race and sex groups (table 2).

Activity. Figure 1 shows the activity engaged in immediately prior to death by drowning. The most frequently associated activity was swimming and wading, followed by fishing. Drownings secondary to motor vehicle accidents was the third largest activity group. Most types of activity in the "all other" category were either unintentional falls into water (64 percent), or unknown activities (28 percent).

Activities associated with drowning which differed most by sex distribution from total drownings were fishing, motorboating, motor vehicle accidents, and baths. Males accounted for 98 percent of fishing deaths and 96 percent of

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Race and sex of victims	Number	Rate per 100,000 residents	
White male	521	4.7	
White female	76	0.7	
Total white	597	2.6	
Nonwhite male	309	8.8	
Nonwhite female	47	1.2	
Total nonwhite	356	4.8	
Grand total	953	3.2	

Table 2. Numbers and rates of drownings in North Carolina, by age of North Carolina residents, 1980-84

Age of victims in years	Number	Rate per 100,000 residents
0 to 4	63	3.1
5 to 14	107	2.3
15 to 24	287	5.1
25 to 34	171	3.4
35 to 44	98	2.6
45 to 54	80	2.6
55 to 64	77	2.6
65 and older	70	2.2
Total	953	3.2

motorboating deaths. Males were overrepresented in fishing fatalities in both racial groups. White males, who accounted for 55 percent of the total drownings, were overrepresented in motorboating deaths (71 percent). White males 25 to 59 years of age were victims in 49 percent of motorboating drownings and 24 percent of total drownings. White males accounted for 82 percent of other recreational drownings, such as canoeing, sailing, scuba diving, and water skiing. Females showed relatively high percentages of deaths while bathing (43 percent) and drownings secondary to motor vehicle accidents (27 percent). Most of the females who drowned in motor vehicle accidents were passengers.

Setting. Figure 2 shows that the majority of drownings occurred in natural settings, of which lakes and ponds were the most frequent sites. In the "all other" category, 37 percent of drownings were in incidental water, like water temporarily in a location such as a drainage ditch; 24 percent were in rock quarries. Variation was evident in the demographic characteristics of drowning victims

Figure 1. Drownings in North Carolina, percent by activity, 1980-84



Figure 2. Drownings in North Carolina, percent by accident setting, 1980-84



according to the setting of the accident. Children younger than 5 years accounted for 43 percent of private pool drownings, but only 6 percent of the total number of drownings. Persons aged 10 to 19 years accounted for 52 percent of drownings in public or motel pools, yet only 23 percent of the total drownings. While swimming and wading deaths accounted for 91 percent of drownings in public or motel pools, they were only 63 percent of private pool drownings. The difference was caused by the large number of children who fell into private pools. Children younger than 5 years accounted for 25 percent of bath deaths, a relatively high percentage.

Race and sex distributions in several settings differed from those for total drownings. Nonwhite males, who accounted for 32 percent of the total drownings, had a high percentage of drownings in ponds (50 percent) and in incidental water (47 percent). White males showed a high percentage of drownings in rock quarries (77 percent) and the ocean (75 percent). Alcohol consumption. Of the 869 persons drowning in North Carolina (residents and nonresidents) aged 15 and older, 752 (87 percent) were tested for ethanol in their blood. Typical reasons why some victims were not tested were because of prolonged survival following recovery from the water or advanced decomposition. Ethanol was detected in the blood of 53 percent of the victims tested. Of those tested, 38 percent showed a blood alcohol concentration (BAC) of 100 mg per dl (or 22 millimols per liter) or greater.

The variations in BAC by race and sex group, age group, associated activity, and accident setting are shown in figures 3-6. The population groups aged 15 and older with the highest percentages of BAC of 100 mg per dl or greater were nonwhite males (46 percent) and 25- to 34-year-olds (52 percent). The associated activity with the highest percentage of victims with BAC in this range was motor vehicle accidents (52 percent), although significant percentages were apparent for the whole range of activities. In all categories of accident setting, at least 20 percent of the victims had a BAC of 100 mg per dl or greater, with the highest percentages found in the setting categories of rivers and creeks (42 percent), and "all other" (46 percent).

Involvement of other individuals. Fifty-six percent of all drownings were witnessed. The percentage witnessed varied markedly according to the associated activity and ranged from 92 percent for those swimming in a group to 3 percent of those having a bath. Rescue and resuscitation attempts were reported in 33 percent of the witnessed drownings. In 24 instances, rescue attempts resulted in the death of the would-be rescuer. Of the 74 children younger than 5 years of age who drowned, 59, or 80 percent, were unattended. Of the 59, 29 fell into a body of water, such as a swimming pool or a lake, 8 were bathing, and 7 were swimming or wading in a swimming pool.

Preexisting illness. A history of a seizure disorder was reported for 7 percent of the victims. Significant cardiovascular disease was reported for 6 percent of the victims, and some degree of fatty liver was evident in 8 percent. However, the prevalence of cardiovascular disease and fatty liver many actually have been higher, since autopsies were performed in only 40 percent of the total cases. Fifty-three percent of those drowning while bathing had histories of seizure disorders. Otherwise, the percentage of drowning victims with the

Figure 3. Drowning victims in North Carolina age 15 years and older, by race, sex, and blood ethanol concentration, 1980-84



Figure 4. Drowning victims in North Carolina age 15 years and older, by age and blood ethanol concentration



health conditions noted did not vary significantly according to the activity engaged in at the time of the drowning.

Discussion

North Carolina drowning deaths were examined to identify particularly high percentages of drownings occurring in various population groups, accident settings, and associated activities. Age, race, and sex groups with the highest rates of drowning in North Carolina were similar to those reported nationally (1) and for other States (4-6). In the study we noted marked differences between drowning rates by sex as well as a particular overFigure 5. Drowning victims in North Carolina age 15 years and older, by associated activity and blood ethanol concentration



Figure 6. Drowning victims in North Carolina age 15 years and older, by accident setting and blood ethanol concentration



representation of nonwhite males. With regard to age, relatively high rates were evident for the young adult group (15 to 24 years of age). The 1980 through 1984 overall rate of drowning in North Carolina, 3.2 per 100,000 population, is the same as that reported for Georgia during the period 1981 through 1983 (5). The North Carolina rate, however, is higher than the national rate of 2.7 per 100,000 in 1982, and 2.4 per 100,000 in 1984 (2).

Natural freshwater settings were the sites of about 70 percent of all drownings, which emphasizes the risk of entering such water whether intentionally or not. Somewhat surprising is the relatively low proportion of saltwater drownings 'An important finding is the high proportion of positive blood alcohol tests of the victims. Of the 752 victims aged 15 years or older that were tested, more than half had positive results and more than a third had BACs of 100 mg per dl or higher.'

despite more than 300 miles of ocean shoreline in the State and the large numbers of persons who use the beaches during the warmer months. A relative risk of drowning cannot be assigned statistically without knowledge of overall use and exposure to the various settings. However, we noted what seems to be a particularly high percentage of drownings associated with farm or unspecified ponds.

The proportions of activities resulting in drowning are similar to studies conducted in other States (4-6) and nationally (2). While swimming and wading was the most frequently associated activity, about a half of the drownings occurred following unintentional entry into the water. Many of these drowning deaths might have been prevented by use of personal flotation devices (PFD), particularly the 205 drownings associated with boating. Although information on PFDs was not collected for this study, in a study of boating fatalities in North Carolina during the period 1980 through 1983, 69 percent of the victims were not wearing PFDs (unpublished presentation, "Boating Fatalities Can Be Reduced," Michael J. Shkrum and Page Hudson, North Carolina Office of the Chief Medical Examiner, American Academy of Forensic Sciences, Feb. 14, 1985).

An important finding is the high proportion of positive blood alcohol tests of the victims. Of the 752 victims aged 15 years or older that were tested, more than half had positive results and more than a third had BACs of 100 mg per dl or higher. Significant percentages of victims in all age groups 15 years and older had BACs of 100 mg per dl or greater, and evidence of alcohol consumption was associated with every type of setting and activity.

Prior studies of drownings in the United States, Australia, and New Zealand have revealed similar proportions of positive blood alcohol tests among drowning victims. Dietz and Baker reported that 21 of 45 Maryland drowning victims, 47 percent, had positive tests, and 17, or 38 percent, had BACs of 100 mg per dl or greater (4). Plueckhahn's 25-year study of drownings in the Geelong Coroner's District of Australia revealed that 39 of 135, or 29 percent, of drowning victims 15 years of age or older had BACs of 80 mg per dl (17 millimols per liter) or higher (7).

In a New Zealand study of unintentional drowning victims 16 years and older, Cairns, and coworkers found that 48 of 97 victims, or 49 percent, had positive tests, and 36 victims, or 37 percent, had BACs of more than 100 mg per dl (8). Ingestion of ethanol prior to entering the water has multiple potentially adverse effects, including impairment of judgment, orientation, reflexes, and motor activity. Ethanol can increase the likelihood of hypothermia from vasodilation, and there is evidence that alcohol can induce hypoglycemia in an exercising individual who has not eaten recently (9). The etiologic importance of alcohol in drowning deaths is reinforced by the current study with its relatively large sample of 752 victims aged 15 and older who were tested for blood alcohol.

We conclude from the data that some drownings could have been prevented if victims or witnesses had had better knowledge of water safety and techniques of rescue and resuscitation. There were 126 victims who were swimming or wading unaccompanied, a practice strongly discouraged by the American Red Cross (10). Rescue and resuscitation efforts were reported for only a third of the witnessed drownings, and 24 persons drowned while attempting rescue. These findings suggest that fewer drownings would have occurred if a higher proportion of the general population knew proper rescue techniques and first-aid procedures. Additional studies of the efficacy of water safety programs are needed to clarify this issue.

Information regarding swimming ability is absent from this study, although such information would have been useful in identifying what proportion of drowning victims were good, fair, poor, or nonswimmers. However, the data in the available records pertaining to swimming ability were too imprecise and too infrequently reported to be useful. Further, controlling the other circumstances of drowning when comparing swimming ability would have been difficult in a retrospective study.

The 74 drownings (residents and nonresidents) of those 5 years and younger are especially tragic. Drownings in swimming pools and bathtubs appear preventable by appropriate supervision or adequate fencing. The proportion of persons with a history of seizure disorder who drowned in a bathtub, 53 percent, is notable. Although data on populations at risk were not available for this study, our data and data from other studies suggest a higher risk of drowning among those with seizure disorders (3, 11).

In conclusion, most drownings probably are not "accidents" that are attributable to chance or unfortunate occurrences. We encourage the use of information from this study to further characterize hazardous situations and behaviors contributing to drownings, and to develop more effective strategies of drowning prevention. The premature deaths of about 6,000 Americans yearly warrant such attention.

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Use and Sources of Payment for Health and Community Services for Children with Impaired Mobility

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Synopsis

A survey was made of the parents of 380 children whose mobility impairments require the

use of a wheelchair, walker, or braces. They were asked about equipment, health services, related services, and family support services used during the previous year.

There was extensive use of equipment and traditional medical and health services, such as visits to primary care and specialist physicians; there was moderate use of related health services, such as physical or occupational therapy and child counseling; and there was very little use of community-based family support services, such as respite care, after-school care, homemaker services, and summer camp.

The cost of health care, particularly medical specialty care, was defrayed in large part by private insurance and public programs, such as Medicaid and Title V Programs for children with special health care needs, while financial support for related services, such as physical therapy and speech therapy, came largely through the schools. Compared to funding for health and related services, financial aid for community-based family support services is largely lacking.