Unintentional Drownings Among New York State Residents, 1988–1994

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SYNOPSIS

Objective. This study examines situations in which drownings occur (environmental risk factors) and the victims' personal risk factors (age, gender, use of personal flotation device, medical condition, alcohol or drug use) to provide guidance for future drowning prevention efforts.

Methods. The authors investigated 883 non-bathtub drownings among New York State residents for the years 1988 to 1994 using medical examiner, coroner, police, and/or hospital records in addition to death certificate data.

Results. Males, children ages 0–4 years, and African American males ages 5–14 years residing in New York State outside New York City experienced the highest rates of drowning. The majority of drownings occurred in a natural body of water for all age groups, with the exception of children ages 0–4 years. Most drownings among children ages 0–4 years occurred in residential swimming pools. The child usually gained access to the pool via inadequate fencing, an open or ineffective gate, or a ladder (to an above-ground pool) left in the "down" position. Less than 10% of victims of watercraft-related drownings were wearing personal flotation devices. Blood alcohol concentration (BAC) tests were positive for 44% of 250 persons 15 years of age and older for whom valid toxicology results were provided; 30% had BACs of 100 mg/dl or more.

Conclusions. Suggested prevention efforts include stricter enforcement of fencing requirements for residential swimming pools and drowning prevention education stressing personal flotation device use while boating and the danger of mixing alcohol and water-related activities.

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Approximately 4000 unintentional drownings occur each year in the United States.[1] Deaths due to drowning and other injuries occur at younger ages relative to many other causes of death, resulting in the loss of a substantial number of years of productive life. The preventable nature of submersion injuries and death argues for attention to practicable actions that may be taken to reduce their occurrence.

To improve prevention efforts, it is important to understand the situations in which drownings occur (environmental risk factors) and the victims' personal risk factors (age, gender, use of personal flotation device, medical condition, alcohol or drug use). Death certificates alone do not provide information regarding many of these environmental and personal risk factors. Some epidemiologic studies of drownings have relied solely on death certificate data and others are limited to drownings among children. Relatively few population-based studies that describe drownings for all age groups have been published.[2–8] Also, observations made in one country or region of the United States may not represent the experience in another region due to demographic and geographic differences. For these reasons, the New York State (NYS) Department of Health (DOH) conducted a study of non-bathtub drownings among NYS residents using medical examiner, coroner, police, and hospital records as well as death certificates. This report discusses all drownings included in the study. A companion article in this issue focuses on boating safety issues.[9]

METHODS

The authors used the NYS DOH Death Certificate Statistical File to identify the study population. This study focuses on non-bathtub drownings of NYS residents that occurred in NYS from 1988 through 1994. 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 from 1988 through 1994, were selected to be included in the study. Motor vehicle-related drownings coded as transport incidents, and suicide- or homicide-related drownings (E codes 954 and 964) are not included in the study.

In the absence of centralized repositories for medical examiner and coroner (ME/c) reports and police investigation reports, we directed requests for records to each county ME/c office (or to the individual ME/c) and to the investigating police agency. If the drowning victim was admitted to a hospital and little or no information was available from ME/c or police records, hospital medical records were requested. The authors developed a data abstraction form to record demographic information, cause of death, location of drowning, body of water, whether a lifeguard was present at the site, activity at the time of the incident, weather and site conditions, presence of companions/others, whether the incident was witnessed, rescue attempt, police/emergency response, use of cardiopulmonary resuscitation (CPR), medical history, drug and alcohol consumption (both information from scene investigation and toxicology results), personal flotation device (PFD) use, supervision of children 14 years of age and younger, and residential swimming pool characteristics. For watercraft drownings, we collected data on the type of watercraft, number of occupants, and the manner in which the victim entered the water.

In this report, unwitnessed drownings of children 14 years of age and younger not known to have been swimming were classified as falls into water. Life jackets, life vests, buoyant foul weather gear, or a buoyant wet suit were classified as PFDs. Throwable flotation aids such as boat cushions and ring buoys were not included as PFDs, nor were inflatable tubes or "swimmies." It was assumed that a PFD was not used if a description of the victim did not include mention of a PFD.

A particular drowning incident may involve more than one drowning victim. Throughout this report, data are presented in terms of numbers of drowning victims.

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.[10]

We summarized the data using descriptive statistics and computed average annual drowning rates per 100,000 population using county population data from the 1990 United States Census.[11]

RESULTS

A total of 1,210 drownings among NYS residents and a total of 121 drownings among nonresidents were iden-

tified using NYS Vital Records data for the years 1988–1994. Six drownings that occurred in 1994 were not in the NYS Death Certificate Statistical files at the start of the study and were not included in the study, leaving 1204 drownings. Of the drownings among NYS residents, 109 were bathtub drownings; an additional 174 drownings reported to NYS Vital Records that occurred out-of-state were excluded. ME/c, police, and in some cases hospital records were requested for the remaining 921 drownings. Information obtained from records compiled for this study resulted in the exclusion of 38 subjects (three nonresidents, one out-of-state incident, 23 bathtub drownings, and 11 coding errors). The resulting study population consists of 883 drowning victims.

We obtained both ME/c and police records for 791 drownings, ME/c or police records for 86, and hospital records only for four. Information from the death certificate was used for the remaining two cases.

Demographic data

Overall, the age-adjusted annual drowning rate was 1.25 per 100,000 for males and 0.19 per 100,000 for females. The age-adjusted drowning rate was 1.24 per 100,000 white males, 1.26 per 100,000 African American males, 0.20 per 100,000 white females, and 0.16 per 100,000 African American females. Average annual drowning rates by age group, gender, and race are presented in Table 1. The small number of female drownings resulted in unstable and less meaningful rates when stratified by race. For this reason, data stratified by race are presented for males only. Of the 883 drowning victims in this study, race was recorded as white for 720, African American for 135, and "other" (e.g., American Indian, Asian) for 28. The average annual drowning rate for whites was 1.37 per 100,000 population for males and 0.21 per 100,000 population for females. The rate calculated for other races was 0.38 per 100,000 population for males and 0.08 per 100,000 population for females. The small number of individuals whose race was identified as other than white or African American may in part represent inadequacies in identifying "other" races on death records. Whereas census data on race rely on self-report, information in ME/c and police reports are based on the judgment of the recorder. Since individuals of "other" races are probably often recorded as white, we grouped persons of "other" race with whites in both the numerators and denominators used in calculating rates in Table 1.

Wide variation in drowning rates was observed by age group, gender, and race. For all ages combined, males had drowning rates 6.6 times those of females. The male vs. female discrepancy in drowning rates ranged from two-fold among individuals 0–4 years of age to 20-fold among individuals 25–44 years of age. Differences were also observed when comparing rates for males by race. Among children 0–4 years of age, African American males had lower rates of drowning than white males (see Table 1), while for children 5–14 years old, African American males had higher rates than white males. Smaller differences were observed for other age groups, with African American males experiencing higher rates for some age groups and white males having higher rates for others.

Body of water

More than 79% of the drownings occurred in a natural body of water: 532 in freshwater sites such as lakes, ponds, rivers, and streams, and 171 in the ocean or a

Table 1. Unintentional drownings among New York State residents[a] by age, gender, and race, 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	69	1.53	77	0.93	171	1.83	284	1.41	95	0.81	65	1.01
Female	40	0.93	16	0.20	12	0.13	15	0.07	22	0.17	17	0.17
Race (males)[b]												
African American	8	0.92	22	1.37	34	2.03	38	1.26	17	1.12	4	0.71
White[c]	61	1.68	55	0.82	137	1.79	246	1.44	78	0.77	61	1.04

[a]Bathtub drownings and drownings that occurred outside New York State are excluded.

[b]Rates stratified by age, gender, and race are listed for males only due to the small number of female drownings.

[c]Individuals whose race was identified as other than white or African American are grouped with whites (*n*=28).

Table 2. Drownings by site and age group—New York State, 1988–1994

Age (years)	0–4		5–14		15–24		25–44		45–64		65+		Total	
	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent
Body of water														
Nonresidential pool/spa	2	1.8	12	12.9	12	6.6	2	0.7	2	1.7	3	3.7	33	3.7
Residential pool	77	70.6	8	8.6	8	4.4	9	3.0	10	8.5	11	13.4	123	13.9
Natural body of water	22	20.2	71	76.3	161	88.0	281	94.0	102	87.2	66	80.5	703	79.6
Miscellaneous[a]	8	7.3	2	2.2	2	1.1	7	2.3	3	2.6	2	2.4	24	2.7

[a]Miscellaneous includes temporary standing water (e.g., puddle, drainage ditch, bucket, vat, sump pump, flooded basement); drownings in liquids other than water are also included in this catergory (e.g., manure pit, septic tank, vat).

saltwater bay, inlet, or sound. Residential swimming pools were the location of 123 drownings (13.9%), while nonresidential swimming pools and spas accounted for 33 drownings (3.7%). Twenty-four drownings (2.7%) occurred in another body of water such as a well, bucket, drainage ditch, or sewer. The drowning site varied by age (see Table 2). An analysis of drownings by body of water and age showed the majority of drownings among children 0–4 years old occur in residential swimming pools, and drownings for all other ages most often take place in a natural body of water.

Of the 109 drownings among children 0–4 years of age, 77 (70.6%) occurred in residential swimming pools. Thirty-two of the swimming pool drowning victims were 2 years old. Among the 76 drownings for which the relation of the victim to the property owner was known, the majority took place at the child's own home (43; 56.6%). The next most frequent sites were the home of another relative (17; 22.4%) and home of a neighbor (8; 10.5%). Of the swimming pools involved, 36 were above-ground pools, 33 were in-ground, one was a "kiddie" pool, and the remaining seven were unspecified.

Information on the presence and type of fencing was available for 25 in-ground pools (after excluding two drownings that occurred when a child was known or allowed to be in the pool area). Of these, four-sided fencing was in place for 11 pools (44.0%). For the remaining 14 pools, fencing status was reported as three-sided fencing with access from the house or garage (4), yard fenced with no separate pool fencing (4), fence in disrepair (1), or no fence in place (5).

Among above-ground pool drownings, information on fence and/or gate was available for 28 drownings that took place when the child was not known or allowed to be in the pool area. In eleven instances, four-sided fencing was in place or a fence and gate separated the deck from the pool. The remaining 17 pools had either no fence, three-sided fencing (with access from the deck or house), or a fenced yard with no pool fencing.

Information on how the child accessed the pool was available for 67 of the 77 residential swimming pool drownings (see Table 3). Seven drownings occurred when the child was known or allowed to be in the pool area or had been in the pool and re-entered without the responsible person's awareness. Of the remaining 60 incidents, access was most commonly attributed to one of the following situations: open/unlocked gate or ineffective gate latch (17); no fence, no separate fence, or fence in disrepair (10); access directly from the house (10); ladder to above-ground pool left down (10); or climbed over fence, gate, or side of pool (9). When drownings occurred in swimming pools with four-sided fencing or in above-ground pools with a fence and gate separating the deck from the pool, either the gate was left open, the child was able to open the gate, or the child was able to climb over the gate or fence.

Section AG105 of the New York State Uniform Fire Prevention and Building Code states that the wall of a dwelling can serve as part of the pool enclosure if a door in the wall has a self-closing and self-latching device or an alarm, or if the pool has a powered safety cover.[12] Seven of the drownings mentioned above involved three-sided fencing with access from the house or garage. In six of the seven cases, the child was believed to have accessed the pool through a door that was open or unlocked. In the seventh incident it was uncertain whether the child entered the pool area via a gate or through a door from the house. None of the reports describing these seven incidents included any mention of the door having a self-closing or self-latching device.

A solar cover was in place at the time of the incident for 10 of the 77 residential swimming pool

Table 3. Residential swimming pool drownings among children 0–4 years of age: means by which the victim accessed the pool area—New York State, 1988–1994

Access	*Number*	*Percent*[a]
Open/unlocked gate or ineffective latch	17	28.3
No fence, no separate fence, or fence in disrepair	10	16.7
Access directly from house	10	16.7
Ladder to above-ground pool left in down position	10	16.7
Climbed over fence, gate, or side of pool	9	15.0
Automatic cover not in use	1	1.7
Neighbor child pulled down ladder	1	1.7
Fixed steps to above-ground pool, no gate	1	1.7
Gate broken (not mounted)	1	1.7
Child known/allowed to be in pool area	7	—
Unknown	10	—

[a]Excludes 17 children who were known/allowed to be in pool area, or for whom no information was available.

drownings (13.0%). In at least three of these situations, it was stated that the cover delayed discovery of the child's submersion. The pool was checked, the child was not observed, and other areas were searched before returning to recheck the pool.

Data on the time elapsed from when the child was last observed by the responsible person until the time when the child was realized to be missing or found submerged were available for 60 residential swimming pool drownings among children ages 0–4 years. The time reported to have elapsed was five minutes or less for 26 incidents (43.3%). The time elapsed was reported as between six and 20 minutes for 25 incidents (41.7%).

Activity at the time of the incident

The activity the person was involved in immediately prior to drowning is presented in Table 4. The classification of unwitnessed drownings of children not known to have been swimming as "falls into water" contributed to a relatively high proportion of children in that category and a low proportion in the "unknown" category. The most common activity at the time of the incident shifts from falls into water for ages 0–4, to swimming for ages 5–24, to watercraft-related activity for ages 25–64, and back to falls into water for ages 65 and older. Twenty-two individuals drowned while attempting to rescue a person or pet. In eleven cases, the person or pet being rescued did survive.

Twenty-five drownings happened while the victim was at work. Three of these 25 individuals (12.0%) had a history of seizures. Of the 16 job-related drownings for which adequate toxicology data were provided on alcohol or drug use, seven victims (43.8%) had been using alcohol or drugs (one of these individuals also had a history of seizures).

Rescue attempts

A rescue cannot take place unless someone is quickly alerted to the drowning in progress. As shown in Table 5, of the 861 drowning victims for whom information about the presence of a companion was provided, 527 (61.2%) had companion(s) or an authority figure in the immediate vicinity. An additional 102 had a companion at the site but a companion was not within view at the time of the incident. The remaining 232 victims (26.9%) did not have a companion at the site, although for 30 of these it was known that other people were within view of the drowning. Ten drownings among children 1–4 years old took place when a person supervising the child was not at the residence where the drowning occurred. However, seven of the 10 children left the site without the responsible person's awareness. A higher proportion of drownings among individuals 25 years and older took place when the victim was alone. Forty-four percent of drownings of victims 45–64 years old, and 65% of victims older than 65 years old occurred when the victim was alone, whereas 84% of drownings among individuals 15–24 years of age happened when one or more companions were present.

A companion or other person not also in distress witnessed 393 of the drownings (462 were not witnessed, 28 unknown). Rescue attempts were reported for 264 victims; a rescue was not attempted for 78 witnessed drownings, and was unknown for 49 (two victims who later died of submersion injuries left the water with little or no assistance). Of the 255 rescue

Table 4. Activity immediately prior to drowning, by age group—New York State residents, 1988–1994

Age (years)	*0–4*		*5–14*		*15–24*		*25–44*		*45–64*		*65+*		*Total*	
	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]
Activity														
Swimming[b]	9	8.3	48	52.2	106	61.3	76	28.4	30	29.7	12	17.9	281	34.7
Watercraft-related[c]	0	—	9	9.8	41	23.7	105	39.2	39	38.6	19	28.4	213	26.3
Falls[d]	98	89.9	29	31.5	8	4.6	25	9.3	15	14.8	24	35.8	199	24.6
Fishing, not from boat	0	—	3	3.3	2	1.2	20	7.5	12	11.9	8	11.9	45	5.6
Attempting rescue	0	—	0	—	4	2.3	15	5.6	3	3.0	0	—	22	2.7
SCUBA diving	0	—	0	—	3	1.7	12	4.5	0	—	1	1.5	16	2.0
Fleeing police/authority	0	—	0	—	7	4.0	7	2.6	0	—	0	—	14	1.7
Ice-related	2	1.8	3	3.3	1	0.6	4	1.5	1	1.0	1	1.5	12	1.5
Miscellaneous other	0	—	0	—	1	0.6	4	1.5	1	1.0	2	3.0	8	1.0
Unknown	0		1		10		31		16		15		73	
Total	109		93		183		299		117		82		883	

[a]Percents are based on individuals for whom information was available.

[b]Jumping/diving into water, surfing, wading, general "playing in water" are also included in this category.

[c]Three additional watercraft-related drownings are classified under "attempting rescue" (two) and "fleeing police/authority"(one).

[d]Includes falls not elsewhere classifiable (e.g., as watercraft-related or associated with fishing); also includes unwitnessed drownings of children not known to have been swimming.

attempts for which the type of rescue was described, 208 (81.6%) involved individual(s) entering the water to assist the victim. Forty-seven rescue attempts (18.4%) were carried out from shore or from a watercraft.

Descriptions were available for 253 rescue attempts. Many difficulties hampered rescue efforts and multiple impediments often existed in a single situation. The most common difficulties included: rescuer could not locate the victim (47); rescuer could not reach the victim before the victim submerged (44); victim was struggling, "fighting," or pulling the rescuer under (39); limited skills or strength of the rescuer (25); water depth (13); and water clarity (13). In 21 instances, rescues were delayed or not attempted because the would-be rescuer believed the victim was playing or "kidding around." For 36 drownings for which rescue attempts were described, no mention was made of factors delaying the rescue attempt. In most of these incidents, the victim was reportedly submerged for only one or two minutes. Injury, known or suspected myocardial infarction or other heart problem, or seizure was noted for at least 15 of these drownings and may have accounted for the poor outcome.

The use of CPR was reported at the scene of the

Table 5. Presence of a companion at the time of drowning—New York State, 1988–1994

Age (group)	*0–4*		*5–14*		*15–24*		*25–44*		*45–64*		*65+*		*Total*	
	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]	n	*Percent*[a]
Presence of a companion														
In immediate vicinity	28	26.4	75	81.5	148	84.1	198	67.6	56	49.1	22	27.5	527	61.2
On site, not within view	67	63.2	13	14.1	8	4.5	9	3.1	3	2.6	2	2.5	102	11.8
Alone/others not reported	10	9.4	3	3.3	17	9.7	70	23.9	50	43.9	52	65.0	202	23.5
Others within sight	1	0.9	1	1.1	3	1.7	16	5.5	5	4.4	4	5.0	30	3.5
Unknown	3		1		7		6		3		2		22	
Total	109		93		183		299		117		82		883	

[a]Percents are based on individuals for whom information was available.

drowning for 394 victims, was not attempted for 453, and was unknown for 36. The length of submersion was 30 minutes or more for 97% of victims for whom CPR was not attempted (428 of the 439 for whom submersion time was available). In 185 of the 394 circumstances in which CPR was used, the first person attempting CPR was a companion or another person at the scene; for the remaining 162 incidents, the person initiating CPR was reported to be an emergency responder such as police officer, firefighter, or emergency medical technician. Information on CPR training was available for 69 of the 185 individuals who were not emergency responders. Fifty-six were reported to have been trained in CPR and 13 were reported not to be experienced in CPR. For three incidents in which the submersion time was 20 minutes or less, the rescuers reportedly checked for and could not find a pulse and therefore did not start CPR. In another 24 incidents in which the submersion time was 20 minutes or less, CPR was apparently delayed while the rescuer(s) either left to call for help, waited for someone experienced in CPR to arrive, or carried the victim to a neighbor or another area where CPR was initiated.

Personal flotation device use

For 12 victims, sufficient description was not provided to determine whether they were wearing a PFD at the time of the drowning. Among the total number of drowning victims (883), 22 (2.5%) were reported to have been wearing a PFD. In addition, two victims had been using flotation cushions and two children were in small inflatable tubes (neither of which are considered to be PFDs). Also, four victims had been wearing PFDs or "swimmies" and had removed them just prior to the incident.

Of the 22 drownings of individuals wearing PFDs, 19 were watercraft-related. Injury, hypothermia, or a very strong current causing submersion were factors in most of these cases. Of the three drownings of victims wearing PFDs categorized as non-watercraft-related, one involved a snowmobile, one a surfboard, and one was a child whose PFD came off while swimming unattended.

Medical conditions and other personal risk factors

A joint cause of death, contributing condition, or significant condition (other than alcohol or drug abuse) was reported for a total of 139 drowning victims (15.7%). Medical conditions reported as a joint cause of death, contributing condition, or significant condition are listed in Table 6. Four individuals were reported to have two conditions. Injury was noted in addition to seizure in three drowning victims, and in addition to mental illness in one. Among 47 individuals for whom injury was a joint cause of death, a contributing condition, or significant condition, the most common causes of injury were falls from shore, a dock, or bridge (11); boat crashes (8); and boat propellers (5).

Table 6. Medical or other conditions listed as a joint cause of death, contributing condition, or significant condition for drowning victims—New York State, 1988–1994

Condition	*Number*	*Percent*[a]
Injury	47	5.3
Hypothermia	18	2.0
Seizure	35	4.0
Heart disease	31	3.5
Other[b]	12	1.4

[a]Percent of total drowning victims (*N*=883). Since more than one condition was noted for some cases, percents will total to greater than the 15.7% of individuals for whom at least one condition was reported.

[b]"Other" conditions include diabetes, nitrogen narcosis, transient loss of consciousness, and mental illness.

Thirty-five drowning victims (4.0%) had a history of seizure disorder. Three individuals reportedly had a recent change in medication, two others had a history of erratic medication use, three were reported not to have taken their usual medications that day, and toxicology screens for four other victims showed either no medications or sub-therapeutic drug levels. Toxicology data were available for 23 of the 35 individuals with history of seizure disorder.

Alcohol and drug use

Toxicology reports were received for 528 of the 681 drowning victims who were 15 years of age or older. Results are reported for the 250 individuals who met criteria based on length of survival and sampling time (see Methods). One hundred ten victims (44.0%) tested positive on blood alcohol concentration (BAC) analysis, and 76 (30.4%) had BACs of 100 mg/dl or more. BAC levels are presented by age, gender, race, and activity at the time of the incident in Table 7. The percentage of individuals for whom positive BACs were reported ranged from 24.1% among those 65 years of age and older to 60.0% among victims 45–64 years of age. A slightly higher proportion of males tested positive for blood alcohol (44.5%) compared to females (38.1%). A small difference was also observed by race, with positive BACs observed for 45.5% of whites and 35.9% of African Americans. The proportion testing

Table 7. Blood alcohol concentration (BAC) levels for drowning victims 15 years and older by age, gender, race, and activity at the time of the incident[a]—New York State, 1988–1994

BAC (mg/dl)	0/ND[b]	1–49	50–99	100–199	200+	Total BAC ≥1	
	n	n	n	n	n	n	Percent[c]
Age							
15–24	52	3	4	8	6	21	28.8
25–44	50	11	7	15	25	58	53.7
45–64	16	4	2	2	16	24	60.0
65+	22	2	1	2	2	7	24.1
Gender							
Male	127	17	14	26	45	102	44.5
Female	13	3	0	1	4	8	38.1
Race							
White	115	16	14	22	44	96	45.5
African-American	25	4	0	5	5	14	35.9
Activity							
Intentionally entered water[d]	62	9	5	10	25	49	44.1
Watercraft-related	41	7	6	9	9	31	43.1
Fall into water	23	2	1	6	9	18	43.9
Miscellaneous/unknown	14	2	2	2	6	12	46.1

[a]BAC levels were reported and toxicology sampling criteria (see Methods) were met for 250 drowning victims.

[b]BAC reported as zero, negative, or "none detected."

[c]Row percent: percent with a positive BAC (greater than zero) out of number tested.

[d]Swimming, jumping/diving into water, surfing, wading, SCUBA diving, and attempting rescue included in this category.

positive was similar for the most common activity categories (see Table 7).

Of the 250 drowning victims for whom valid toxicology analyses were available, 26 tested positive for illicit drug use. Thirteen tested positive for both alcohol and illicit drug use and 13 tested positive for illicit drugs only. Thus, a total of 123 persons 15 years of age and older tested positive for alcohol or drug use (49.2% of those meeting toxicology sampling criteria for blood alcohol).

DISCUSSION

In this study, we observed disparities in drowning rates by age, gender, and race. The patterns observed in the NYS data are consistent with other studies. Peak drowning rates have generally been observed at ages younger than 5 years and from 15–24 years of age,[2,13] with drowning rates for males three to six times the rates for females.[2,3,13,14] Rates for African Americans are often higher than for whites with the exception of children between the ages of 1 and 4.[2,15] While the difference in risk by gender may be attributed to increased time spent in water-related activities and risk-taking behaviors among males,[3,14] the reasons for differences by race are less clear. Suggested explanations include lack of early exposure to recreational swimming and acquisition of swimming skills.[10]

The use of the number of residents as the denominator rather than number of people at risk limits interpretation of drowning rates presented. For example, among 162 individuals who drowned while swimming in a natural body of freshwater, only seven were at a beach with lifeguards. Eleven of 64 victims who drowned while swimming in the ocean or sound were at a beach with lifeguards (a strong current or rough surf was reported for many of these). Although we can document that relatively few drownings occurred at beaches with lifeguards, without data on usage, comparisons cannot be made of the risk of drowning based on exposure frequency for beaches with lifeguards vs. unguarded beaches and swimming holes.

This discussion focuses on some of the conditions under which drownings occur with an eye toward prevention strategies. The prevention approaches described might be considered "common sense" or generally known methods for avoiding submersion injuries. Nevertheless, this study demonstrates that many drownings could have been prevented by implementing these strategies.

A combination of circumstances may play a role in a drowning incident. For example, lack of effective fencing and a lapse in parental supervision may each contribute to a child drowning in a residential swimming pool. Similarly, boater inexperience, bad weather, and not wearing a PFD may each contribute to a watercraft-related drowning. It is important to determine which "links" can be most effectively blocked. We hope that our observations will support regulatory initiatives and community education efforts.

General drowning prevention education programs should stress the danger of swimming alone or engaging in other water-related activities (fishing, boating) without a companion. It is essential to have someone in the immediate area who will be able to offer assistance if needed. Approximately 40% of drowning victims in this study did not have a companion in the immediate area at the time of the incident.

The risks and preferred methods of rescuing someone who is drowning should be addressed in education programs. In this study, 22 individuals drowned while attempting a rescue. The majority of rescue attempts involved individual(s) entering the water to aid the victim. This type of rescue involves the greatest amount of risk to the rescuer. Whenever possible, rescuers should assist the drowning person from shore or from a boat (e.g., by reaching out to the person with a pole, boat hook, or other object; or by throwing a buoyant aid).

Also, it is important to educate people on the nature of drownings. Drownings can occur quickly and often quietly. A brief lapse in supervision or a delay in response can result in a disastrous outcome. Among children 0–4 years old, a lapse in supervision of five minutes or less was reported for 43% of residential swimming pool drownings for which this information was available. In a number of incidents, family members were nearby, the victim wandered away, was realized to be missing a short time later and was found submerged in the homeowner's pool or a neighbor's pool.

For at least 21 drownings (all ages), rescues were delayed or not attempted because the victim was believed to be "kidding around." In some of these cases, it was believed by companions that the victims were feigning distress. In others, the companion was unable to recognize that the victim was in trouble. One witness reported that the victim waved to her but she did not take the wave as an indication of distress. There may be an expectation that a person who is drowning will call out for help. However, a person who is drowning is struggling to breathe and usually will not be able to call for help.[17,18]

Physical features of natural bodies of water

A natural body of water was the most frequent site of drowning for all ages except children younger than 5 years. A swift current, deep water, or sudden drop-off can increase the likelihood that an individual will run into difficulty while in the water. Often drownings occur in a body of water that the victim is not familiar with. In this study, one-third of the victims drowned in a NYS county other than their county of residence. Although it may not be feasible or desirable to prevent access or otherwise modify areas that pose special risks, attempts can be made to discourage recreational activities in these areas. Possible measures include posting signs warning of hazardous conditions, patrolling "swimming holes," and providing safe alternatives such as designated beaches monitored by lifeguards.

Residential swimming pool drownings

Over 20 years ago, Milliner argued that, given evidence available at that time, "it seems indefensible that unfenced pools should be allowed to continue to claim children's lives."[19] Residential swimming pool drownings most commonly occur among children 0–4 years of age and the majority of these children gain access to the pool due to ineffective or nonexistent gating or fencing. This was the case for 50 of the 67 drownings in this study for which details on access were available. Appropriate fence construction is an important consideration. In seven incidents, three-sided fencing was in place and the child accessed the pool through an open or unlocked door. Of the nine drownings involving a child who climbed over a fence, gate, or the side of an above-ground pool, one fence was a wire and wood "snow fence" and another was a two-foot high lattice railing. Also, two children first climbed onto an object adjacent to the fence or the side of the pool that enabled them to climb over the barrier. These incidents point out the importance of keeping objects that might be used as stepping stones clear of the perimeter of above-ground pools and pool fences, as well as the need for four-sided pool fencing of adequate height and construction secured by well-maintained, self-locking gates.

A solar cover was in place in 13% of residential

swimming pool drownings. A young child may try to walk out onto the surface of the solar cover. In several incidents, the presence of a solar cover hindered attempts to locate the child.

In this study, among incidents for which the type of residential swimming pool was reported, 52% were above-ground pools. This is in contrast to a previous study that noted that only 4% of residential swimming pool drownings among children 0–4 years of age occurred in above-ground pools.[20] Often the ladder was left in the "down" position or there was direct access from the house to the swimming pool deck. Fencing with a self-locking gate should be in place between the deck and the pool.

Very few residential swimming pool drownings occurred when an adult knew that a child was in the pool area. In most cases, the child gained access to the pool during only a short lapse in supervision. This observation supports the need for effective barriers to prevent or at least hinder access to the pool area.

Medical conditions

The occurrence of a medical condition such as a heart problem, seizure, or diabetic event causing disability or transient loss of consciousness while in a water environment can result in drowning. Two persons in the study were diabetics who had experienced recent episodes of hypoglycemic shock. Each apparently suffered another hypoglycemic event at the time of the drowning.

Thirty-five drowning victims (4.0%) had a history of seizure disorder. This proportion is higher than the proportion of the general population suffering from seizure disorder (estimates range from 0.5 to 1.0%).[21] A recent change in medication, history of erratic medication use, or skipping medication that day (or evidence thereof by toxicology) was indicated for 12 individuals with history of seizure disorder. The use of alcohol or illicit drug use by seven others could have influenced the effectiveness of anti-seizure medications. Thus, inadequate medication or medication effectiveness influenced by drug or alcohol use may have been influential in more than half of victims with a history of seizure disorder. Patients should be warned about the special risks associated with activity near or in water during periods in which seizure activity is poorly controlled.

Several individuals with a history of seizure disorder were swimming in lifeguarded bodies of water but slipped underwater unnoticed. This argues for the need for direct supervision of seizure disorder patients (adults as well as children) by individuals who are aware of their medical history and capable of carrying out rescue. Lifeguards in a public swimming area cannot be expected to provide this level of supervision. It is important for physical education teachers and other swim instructors to be aware of a history of seizure disorder.

In a study of epilepsy and submersion injury in children younger than 19 years of age, Diekema et al.[22] observed a greater than 20-fold increase in risk of drowning in a swimming pool and a nearly 100-fold elevation in risk of drowning in a bathtub among children with epilepsy.[22] Authors of another paper on the subject of epilepsy and drowning noted, "None of the children with primary epilepsy who were supervised at the time of the accident died, suggesting that if children with epilepsy are supervised they have no greater risk of a drowning death than the general population."[23] In our study, however, a parent observed a child go into seizure, removed the child from the water immediately and began CPR (the victim survived five days). In another situation, a child was observed to be doing handstands at the bottom of a public pool. After what was apparently a very brief period of time, the child was observed on the bottom of the pool with bubbles coming from his mouth and nose (victim survived 10 days). Also, an adult with history of seizure disorder was observed by a lifeguard to start to sink to the bottom during lap swimming. The victim was immediately rescued, after one rescue breath the victim started breathing but expired four days later. Brief submersion during a seizure even with immediate and proper rescue procedures may have a fatal outcome, further emphasizing the need for caution in water environments for individuals with seizure disorder.

Alcohol and drug use

Among victims for whom samples that met study criteria were available, 44% of BACs were positive and 30% of BACs were 100 mg/dl or more. These proportions are similar to those reported in a meta-analysis of 15 drowning studies. Of subjects tested, 49% of BACs were positive and 34% of BACs were 100 mg/dl or above.[24] In our study, positive BACs were observed for 54% of tests of victims 25–44 and 60% of victims 45–64 years of age (see Table 7). Males were 17% more likely to test positive than females and whites tested positive 27% more often than African Americans. Although the proportion of positive tests was fairly similar for the most common activity categories, BACs of 100 mg/dl were associated with 32% of drownings in which the victim intentionally entered the water, 37% of falls into water, and 25% of watercraft-related drownings. Although toxicology results meeting our study

criteria were available for only 36.7% of drowning victims 15 years of age or older, examination of test availability according to personal characteristics did not reveal differences by sex, age group, or race.

COMMENTS

Based on the results of this study, we suggest the following: stricter fencing requirements and enforcement for residential swimming pools, and re-examination of boating-while-intoxicated laws with possible extension to include passengers as well as operators and/or other types of watercraft beyond motorboats. Drowning education programs should stress wearing a personal flotation device while boating (for adults as well as children), the danger of mixing alcohol and water-related activities, and recognition that drownings occur quickly and often silently (the victim is usually unable to call out for help). Also, physicians of individuals with seizure disorder should instruct the patients on the significance of direct supervision by someone who is aware of their medical history during water-related activities along with careful attention to medication use, especially when water-related activities are planned.

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