Drownings of Children and Youth in a Desert State

SALLY DAVIS, MEd; JUDY LEDMAN, MD, *and* JULIE KILGORE, *Albuquerque*

Despite the fact that New Mexico is a desert state, the drowning rate (4.3) is 40% higher than that nationally (3.0). More than half of those who drown are younger than 25 years, toddlers and adolescents being at greater risk than other age groups. In an epidemiologic study of a six-year period, male drowning victims outnumbered female and American Indian and Hispanic victims outnumbered whites. Other major risk factors were epilepsy, mental retardation and alcohol abuse. In most drownings in the under-25 age group, the victim was involved in recreation near the water or swimming, although many were partially or fully clothed. Most drownings occurred in lakes, ditches or rivers. Because New Mexico is not a water-oriented state, public awareness of drowning hazards needs to be increased and more intensive preventive efforts instituted.

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Drowning is a common cause of death in children and youth throughout the world.[1] In the United States it is second only to vehicle accidents as the most common cause of accidental death in persons younger than 25.[2] Most studies of drownings have looked at densely populated, water-oriented regions,[3-8] with the assumption that drowning is not as serious a problem in areas where fewer people participate in water sports and activities. The results of our study show that this assumption may be false.

Unlike Maryland,[8] Florida,[3] Hawaii[4] and Australia,[5-7] neither climate nor geography in New Mexico encourages water sports. This sparsely populated, rural state is arid and mountainous with few lakes and rivers. Irrigation by canals and ditches is common, however, and this water source has been thought to pose a significant threat to children. There have been no water-related catastrophes—that is, accidents in which five or more persons are killed[9]—in recent years, but spring thaw often creates flooding in places that are dry during the rest of the year.

This description of the state would suggest that mortality due to drowning should not be a major problem. However, New Mexico, with a population of 1,122,500 in 1975, had a drowning rate (deaths per year per 100,000 population) of 3.5 compared with the national rate for the same year of 2.5.[10] A systematic study was done to determine the specific patterns of drownings.

Methods

A list of all drownings of persons between 0 and 24 years of age for the years 1975 through 1980 inclusive was selected from records of the New Mexico State Office of the Medical Investigator, the central depository for all records of accidental death. This list was compared with the records of drowning from the New Mexico Health and Environment Department Vital Statistics Bureau. In a few cases, because the two listings were not identical, additional cases were added.

Each original case file was reviewed for pertinent information from the investigator's report and, when available, the autopsy and toxicologic and police reports. Records varied in completeness. Information such as activity before drowning, the body of water, supervision, alcohol consumption and ability to swim was incomplete in some cases.

Information on age, sex and county of death was available in all cases. Ethnicity was specified for American Indians and blacks, but Anglo* and Hispanic were usually grouped together as whites. Hispanic ethnicity was assigned according to the *1980 Census List of Spanish Surnames.*[11] Denominators were obtained using 1980 census figures by individual year of age, sex and ethnic groups.[12,13] Estimates for mid-1977 were obtained by "younging" the population. A detailed explanation of the denominator calculations may be obtained on request from the New Mexico Tumor Registry, 900 Camino de Salud NE, Albuquerque, NM 87131.

Results

Age, Sex and Ethnicity

A total of 329 drownings was reported in New Mexico

*Anglo designates a white inhabitant of the United States of non-Hispanic origin.

From the Department of Pediatrics, University of New Mexico School of Medicine, Albuquerque. Ms Kilgore is now affiliated with the University of New Mexico College of Education.

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Reprint requests to Ms Sally Davis, Dept of Pediatrics, Surge Bldg, University of New Mexico School of Medicine, Albuquerque, NM 87131.

TABLE 1.—*Number of Drownings in New Mexico by Age, Sex and Ethnic Group, 1975 Through 1980*

Age Years	Males					Females					Total
	Anglo	Hispanic	American Indian	Black	All Males	Anglo	Hispanic	American Indian	Black	All Females	
0-4	18	11	4	0	33	12	6	2	0	20	53
5-9	2	4	3	0	9	2	2	0	1	5	14
10-14	6	9	2	2	19	1	7	0	0	8	27
15-19	12	20	12	1	45	1	3	1	0	5	50
20-24	16	18	6	0	40	2	3	2	0	7	47
Total	54	62	27	3	146	18	21	5	1	45	191

All ages = 329

over a six-year period, 1975 through 1980 inclusive. More than half of the deaths, 191 (58%), were of persons younger than 25 years. The highest rate of drowning (8.2 per 100,000 annually) occurred in the 0 to 4 years age group, closely followed by those in the 20 to 24 (6.5) and 15 to 19 (6.4) years age groups. The total number of drownings by sex, age and ethnicity for the six-year period are shown in Table 1.

A disproportionate 76% of the drownings of persons younger than 24 years involved male victims. As both Table 1 and Figure 1 show, male victims outnumbered female victims for all ages.

Rates by sex and ethnicity are given in Figure 2. The highest rates are those for male victims in the following order: American Indians (14.9), Hispanics (8.4) and Anglos (6.5).

Location and Activity Before Drowning

Figure 3 gives the frequency by body of water in which a drowning occurred and by the activity of the victim before the drowning. In New Mexico, most drownings (71%) occurred in lakes, ditches or rivers.

Immediately before their deaths, 74 of the victims were playing, fishing, picnicking or involved in other recreation near but not in the water. Another 55 were reported to be swimming. Many of these victims were found fully or partially dressed, indicating that swimming may not have been a planned activity. Swimming was the most frequent activity before the accident only for lake, pool and pond drownings. In river and ditch drownings, most victims were involved in activities near but not in the water.

There were seven multiple drownings. In each of six cases, two persons died and, in another, three adolescent girls drowned after they fell from a dam into a river and were washed through flood gates. Of the two-person drownings, two involved scuba divers, two were related to acute alcohol abuse and two were rescue attempts.

In addition to the two multiple drownings, there were three single drownings during rescue attempts. There were also several cases in which a rescue was attempted, and the victim, in his or her panic, endangered the rescuer and caused the attempt to be abandoned.

Predisposing Factors

In some drownings important predisposing factors were present and may have contributed to the drowning. For example, 12 victims had a history of seizures or mental retardation (or both), which may have compromised their ability to protect themselves in water. The most common factor that may have compromised victims was the use of alcohol. It was difficult to determine the exact prevalence of alcohol use in association with drowning because blood alcohol determinations were not done routinely. For the most part, blood alcohol concentrations seemed to have been measured when the circumstances surrounding the drowning were suggestive of

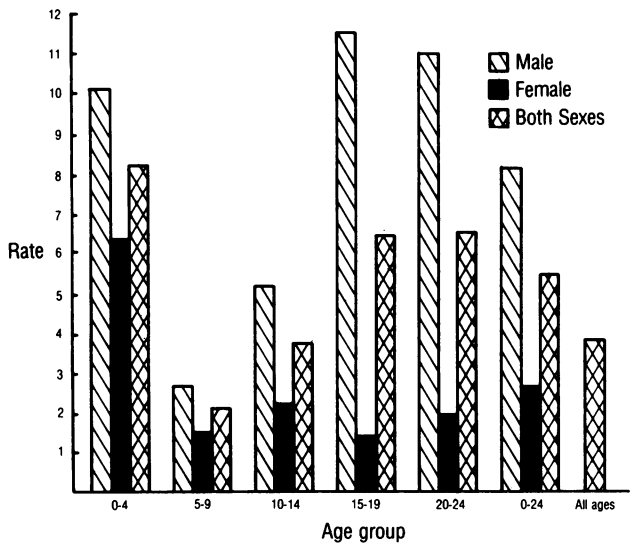


Figure 1.—Drowning rates by age and sex. The rate is the age-adjusted rate per year per 100,000 based on the 1977.5 adjusted census.

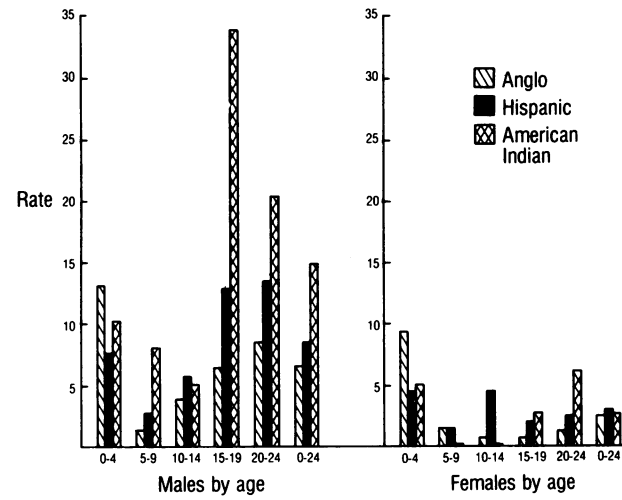


Figure 2.—Incidence of drowning by ethnic groups. The rate is the age-adjusted rate per year per 100,000 based on the 1977.5 adjusted census.

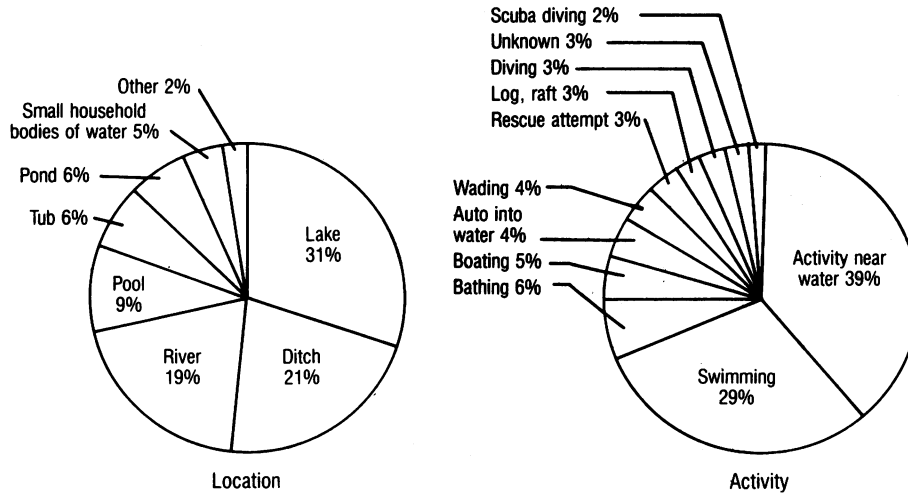


Figure 3.—Frequency of drowning by activity and location.

alcohol use. In several cases in which alcohol determinations were not made, however, eyewitness reports that the victim had been drinking were present in the file. Because all those drownings in which an alcohol level was not determined were assumed not to be alcohol related, the prevalence of alcohol use in relationship to drownings is thought to be underreported.

Of the 191 victims listed by the Office of the Medical Investigator, 90 had alcohol determinations. Of the 43 who had evidence of alcohol use, 25 had an alcohol concentration of greater than 0.1 mg per dl and 18 had a value of 0.01 to 0.1 mg per dl. These 43 cases are classified as alcohol-related drownings. They were compared with those in which alcohol concentrations were not determined plus those in which alcohol determinations gave negative results.

All alcohol-related drownings occurred in persons 15 years or older: 20 were in the 15 to 19 years age range and 23 were in the 20 to 24 years age range. In the 15 to 24 years age group, 44% of all drownings were alcohol related. Only four of the alcohol-related drownings involved female victims.

Rescue and Resuscitation

Of the 91 drownings, resuscitation attempts were recorded in 46 (24%). Six victims were still being resuscitated when they reached the hospital. Five lived from a few minutes to a few days, and one person survived in a coma for 4½ months. It is noteworthy that 13 of the 46 resuscitation attempts occurred at swimming pools. This represents 13 of 18 of the pool drownings. Only 9 of 97 drownings in lakes, reservoirs and rivers resulted in resuscitation attempts. In 4 of 9 bathtub drownings, 3 other home drownings, 1 car submersion and 15 other drownings in small bodies of water, resuscitation was attempted. No data on successful resuscitations were available.

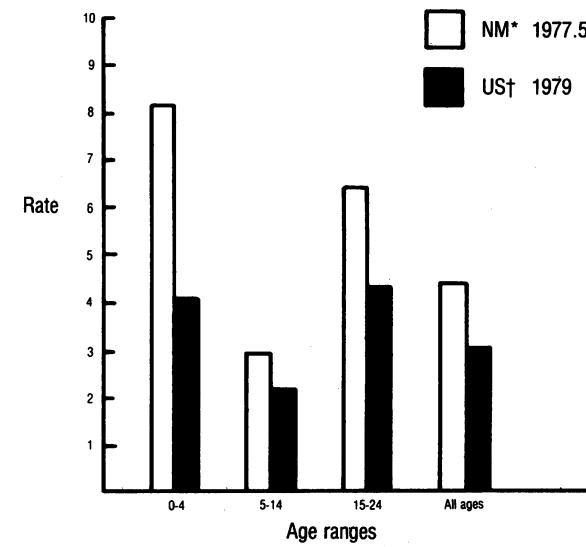
Discussion

There may be a false assumption that drowning is a problem only in water-oriented regions. The New Mexico drowning rate for all ages was 4.3, calculated for the midpoint between 1975 and 1980, whereas the rate for the whole United States was 3.0 for 1979.[2] Figure 4 shows that drowning rates in New Mexico were higher than national figures for toddlers, children and adolescents/young adults as well.

Other states that report a high incidence of drowning such as Florida,[3] Hawaii[4] and Maryland[8] are characterized by the universal presence of bodies of water and may have climates that allow water-related activities to be pursued year round. In contrast, the climate of most of New Mexico is warm only in the summer and there are fewer than 20 lakes with state recreational facilities in a state of more than 77,866,240 acres.[14] Because this is not an environment that fosters water sports to any major degree, other factors contributing to the substantial loss of life due to drowning should be considered.

Human Factors

Sex, age and ethnicity. We found that the distribution of drownings by sex and age was similar to that in other studies and that reported in national and international statis-



*Age-adjusted rate per year per 100,000 based on the 1977.5 adjusted census.
†Figures from National Safety Council.[2]

Figure 4.—Comparison of drowning rates for New Mexico and for the United States.

tics.[1-5,7,8,15-17] Drowning victims of all ages are more likely to be male than female.[3-5,15-17] This may be due to the greater level of exploration and risk taking exhibited by and encouraged in men and boys. In addition, male children may be less closely supervised than female children.[17] Another familiar pattern is the age distribution of the victims. Toddlers[1,2,4,7,15] and adolescents[2,8,15] are at greater risk than children in other age groups.

A third human factor in the New Mexico study was ethnicity. Although no other studies have specifically looked at drowning rates of Hispanics and American Indians, it is known that the overall accident rate for these groups is high.[18-21] Other studies have shown similar high rates for minority populations.[3,8] Socioeconomic and cultural factors obviously play an important role in the cause of accidents such as drowning.

Activity before drowning. Another important human factor is the activity of the victim before drowning. Nationwide, swimming and playing near water are the activities that pose the greatest threats for children and young people aged 0 to 24 years.[15-22] Of the two activities, the New Mexico study found recreation near the water (39%) more common before drowning than swimming (29%).

One study reports that nationally water sports other than swimming (including boating, rafting, skin and scuba diving) accounted for 13% of 3,303 drownings in the 0 to 24 years age group. In all, 7% of the total drownings in this age group were boating accidents.[15] In New Mexico 13% of the drownings in the 0 to 24 years age group were also attributed to water activities other than swimming or wading. Only 10 (5%) were accidents involving boats. One victim was a 3-year-old girl who disappeared from a houseboat. The other nine were all males and ranged in age from 12 to 24 years. Seven were fishing or boating in small boats on lakes or rivers when the boat was overturned or they fell into the water. Five of the seven either were reportedly drinking or had significant blood alcohol concentrations. None wore life jackets. Five other deaths occurred after falling from a raft, kayak or canoe. One of these five victims had a significant alcohol level. One, who was kayaking in river rapids, wore a life jacket. In addition, a 13-year-old boy on an inner tube and another 13-year-old boy on a log were nonswimmers who slipped from their makeshift device into the water and drowned. Four deaths (involving two pairs of divers) were reported among scuba divers. There were no deaths of water skiers. Most of these drownings are characterized by preventable human factors.

Multiple drownings and rescue attempts. Many drowning accidents are prevented by other people who are present and can assist the victim. However, occasionally multiple drownings occur either because neither person can handle the water conditions or because a person attempting rescue is lured into a dangerous situation. The *Statistical Bulletin of the Metropolitan Insurance Companies* reported 143/4,962 (3%) drowning deaths occurred during rescue attempts.[15] In the five-state study reported by Press and co-workers, 42/1,024 (4%) drownings occurred in persons who were trying to save someone else.[22] In the New Mexico data, 5/191 (3%) of the deaths were clearly associated with rescues. Rescue attempts, though not recorded as such, could have been a factor in several other multiple drownings.

There is little information on multiple drownings other than the association with rescue attempts. In one study multiple drownings were reported in skin and scuba divers but the occurrence was in only 5% of the total diver drownings.[23]

Predisposing factors. We and others[8,24,25] have identified a small group of victims with disabling conditions that may have contributed to their drowning. In our study, 12 victims had predisposing disabling factors other than alcohol consumption. Eleven had a seizure history, mental retardation or both. Five of these died in bathtubs. Another victim had a history of drug abuse and had head trauma a week before the accident.

Alcohol use is a known risk factor for injuries.[26,27] Several previous studies have specifically linked alcohol use with drowning.[8,28-30] Mackie[31] reviewed this literature and reported the alcohol-related drowning incidence to be from 14% to 79% of all drownings for various populations.

It is not surprising to find alcohol as a major risk factor in drownings in New Mexico. A recent study by the National Institute of Alcohol Abuse and Alcoholism found New Mexico to lead the country in the number of chronic health problems and number of casualties attributed to alcohol abuse.[32] Our study confirms a high incidence of alcohol-related drownings (44%) in the 14 to 24 years age group. Male victims predominate and there are differences in the incidence of alcohol-related drownings by ethnicity for both sexes.

In general, a high alcohol abuse rate in New Mexico adolescent and young adult populations appears to be a major factor for the excessive drowning rate in the state.

Environmental Factors

Lakes, rivers and ditches. As expected, the incidence of drowning by body of water varies widely depending on the availability of water sources in different areas.[22] In data compiled for all ages from the whole United States, most drownings occurred in lakes (23%), rivers (22%), swimming pools (13%) and salt water sources (9%).[33] In Florida most drownings occur in swimming pools followed by canals and then lakes or ponds,[3] whereas in Maryland drownings are most frequent in rivers, then lakes and then salt water sites.[8] In Honolulu the rank order of drowning sites is swimming pools, salt water sources and domestic bathtubs.[4]

The New Mexico data reflect the pattern of water site availability unique to this area. In the 0 to 24 years age range, most drownings occurred in lakes (31%), followed by irrigation ditches and canals (21%) and then rivers (19%). However, the age of the victim is an important factor in evaluating location of drowning. In the adolescent and young adult groups, 44% and 47%, respectively, died in lakes and 18% and 28% in rivers. In contrast, toddlers were most likely to drown in ditches (38%) or small bodies of water in or around the home (17%) and relatively few died in lakes (9%) or rivers (11%).

Swimming pools. Nationally, swimming pool drownings have increased in recent years, with more pool drownings occurring in Arizona, California, Hawaii and Nevada than in other areas of the country.[34] In New Mexico only 9% of the drownings occur in swimming pools. This is not surprising since there are few private or public pools in the state due to economics and the climate factors mentioned earlier.

Bathtub drownings and other household water sources. Bathtubs have previously been identified as an important site of infant drowning. Unlike other childhood accidents that show a male predominance, the sexes are equally affected in this case. Although most of these incidents involve infants, there is an occasional report of bathtub drowning in older persons with certain predisposing factors.[7,35,36]

In our study, 11 bathtub drownings fell into two categories. Five children younger than 25 months drowned after being left unattended in a bathtub. Six older children or young adults with predisposing disabling conditions such as seizures or mental retardation died in tubs. All but one of the bathtub drowning victims were female.

Nine other unattended toddlers died in small household bodies of water such as cesspools and stock troughs. Two of these children died in buckets containing only a few inches of water. Pail-immersion accidents have been reported by previous investigators[37-40] as well.

Rescue and resuscitation. The environment affects chances of rescue and resuscitation. Many of the drownings occurred in unsupervised bodies of water characterized by dangerous, steep and muddy banks; swift currents; cold temperatures; drop-offs, and murky water filled with debris—all factors making swimming unsafe and prompt rescue difficult or impossible.

If a victim was recovered quickly or if time submerged was unknown, resuscitation was usually begun at the scene and continued in transport by emergency personnel. The resuscitation attempt rate (24%) was low, reflecting the many victims who were not recovered immediately.

Of the 18 persons who died in swimming pools, 13 (72%) resuscitation attempts were recorded. Lifeguards were involved at only three sites, however. In addition, it is known that resuscitation was attempted in 5 of 11 bathtub drownings and in 3 other home drownings. In one case two persons drowned after their car left the road and plunged into water. They were easily found and resuscitation was attempted. Fifteen others who received resuscitation drowned in smaller bodies of water such as ditches, ponds or stock tanks. Thus, only 9 of the 46 victims in whom resuscitation was attempted were recovered from large bodies of water such as lakes, reservoirs and rivers. The resuscitation attempt rate at these sites was 9 in 97 (10%). As expected, the chance of a resuscitation attempt varied with the drowning site and seemed to be related to rapidity with which the victim could be found and recovered.

Summary

Distribution of immersion accidents by body of water in New Mexico varies from that described in different geographic areas.[3-5,8,22] The greatest number occurred in lakes, ditches and rivers. Almost as many drownings happened in bathtubs, ponds and small household bodies of water as occurred in swimming pools, each accounting for less than 10% of the total. Recreation near water and swimming were the most common activities before drowning. It is of interest to note, however, that victims were often fully or partially clothed, in some cases even wearing boots. This suggests that swimming may have been a spontaneous rather than a planned activity. In most cases, the location of drowning was not a supervised recreational area. The population is generally unaware of possible hazards and uneducated regarding aquatic sports and safety. It is ironic that New Mexico's lack of water may actually contribute to the high incidence of drownings.

While the distribution of drownings by body of water may be geographically specific,[22] the population groups at risk appear to be universal. Males,[1,3-5,15-17] toddlers,[1,2,4,7,15] adolescents[2,8,15] and minorities[3,8] appear more likely to drown no matter where the accident occurs. Similar factors predisposing to drowning such as epilepsy,[8,24,25] mental retardation[23,24] or alcohol abuse[8,26-31] have been reported in other studies.

Of the many factors that contribute to the cause of drowning, the role of human behavior appears most prominent. Socioeconomic and cultural factors reflected in the differences in death rates by ethnicity must also be taken into consideration. While it is not likely that a drowning prevention program could make many changes in social, political and economic environments, it is conceivable that changes can be made in human behavior and to some extent the physical environment. Efforts should be concentrated in these areas.

The first step should be a statewide media campaign to elevate public awareness regarding the hazards associated with drownings and the particular vulnerability of specific population groups. Particularly dangerous locations need to be publicized. Needed behavioral and environmental changes should be identified and preventive efforts in that direction reinforced. Committing public funds for barrier construction, supervised swimming areas, aquatic education and cardiopulmonary resuscitation should be encouraged. Coordinated efforts of public health, education, community recreation groups and the Red Cross should be visibly supported by publicly documenting their efforts.

Aquatic education should be included in every school program. Communities should join with the schools in combined recreational efforts that teach swimming, water safety and cardiopulmonary resuscitation. In one isolated rural area, children are bused during the summer to a larger community with a pool where they receive instruction in swimming and water safety. Similar efforts should be made in other areas where established programs are not available. Safety instruction should include the dangers of combining alcohol use and swimming and the hazards of swimming in unsupervised bodies of water. Physicians should not overlook the importance of one-to-one safety counseling. Persons should at least have adequate and accurate information with which to make informed decisions.

Drowning epidemiology should be examined by desert states as well as those states that encourage water activities. Data from such epidemiologic studies will focus preventive efforts in the appropriate direction. Without such studies we may overlook important causal factors and misdirect our efforts.

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