

# Swimming Pool Drownings Among US Residents Aged 5–24 Years: Understanding Racial/Ethnic Disparities

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Drowning is a leading cause of death among US youths. In 2002, 1158 youths younger than 20 years died as a result of an unintentional non–boat-related drowning.<sup>1</sup> Additionally, more than 300 youths aged 20 to 24 years drowned that year.<sup>1</sup> Children aged 1 to 4 years and males aged 15 to 24 years have the highest risk for drowning. Among males aged 10 to 19 years, Black males have much higher rates of drowning compared with White males.<sup>2–4</sup>

Previous research has shown that the circumstances surrounding drowning events vary with regard to victim characteristics. Children aged 1 to 4 years are most likely to drown in swimming pools, whereas older children and adolescents are most likely to drown in natural freshwater sites.<sup>5</sup> Our earlier research found that among Black males aged 5 to 19 years, 37.2% of drowning deaths with known location of drowning were in swimming pools, while only 10% of similar drownings among White males occurred in pools.<sup>5</sup> Although rates are higher among Black youths, studies have not adjusted for income or provided details about drowning circumstances, such as where drownings occur. All drowning deaths are potentially preventable, and pool drownings among older children are especially so because pools lack the intrinsic risks associated with natural bodies of water (e.g., currents, riptides, and poor visibility), and lifeguards and early rescue are accepted prevention strategies.

We examined the circumstances surrounding swimming pool drownings among US residents aged 5 to 24 years to elucidate factors that place some racial/ethnic groups at higher risk than other groups and to provide guidance for developing prevention strategies. Although the goal of our study was to investigate the differences in drowning circumstances between Black and White males, we suspected that there were differences among other groups as well. Therefore, we examined rates and circumstances of swimming pool drownings among other racial/ethnic

**Objective.** We examined circumstances surrounding swimming pool drownings among US residents aged 5 to 24 years to understand why Black males and other racial/ethnic groups have high drowning rates.

**Methods.** We obtained data about drowning deaths in the United States (1995–1998) from death certificates, medical examiner reports, and newspaper clippings collected by the US Consumer Product Safety Commission.

**Results.** During the study period, 678 US residents aged 5 to 24 years drowned in pools. Seventy-five percent were male, 47% were Black, 33% were White, and 12% were Hispanic. Drowning rates were highest among Black males, and this increased risk persisted after we controlled for income. The majority of Black victims (51%) drowned in public pools, the majority of White victims (55%) drowned in residential pools, and the majority of Hispanic victims (35%) drowned in neighborhood pools (e.g., an apartment complex pool). Foreign-born males also had an increased risk for drowning compared with American-born males.

**Conclusions.** Targeted interventions are needed to reduce the incidence of swimming pool drownings across racial/ethnic groups, particularly adult supervision at public pools. (*Am J Public Health.* 2006;96:728–733. doi:10.2105/AJPH.2004.057067)

groups and foreign-born versus American-born youths. Finally, we examined the joint effects of race/ethnicity and income to determine whether they are independently associated with risk for drowning.

## METHODS

### Data Sources

Death certificates provide details that are not routinely coded or available in national data sets. We obtained data from the US Consumer Product Safety Commission (CPSC) because each year the commission purchases copies of death certificates for drowning victims from each of the 50 states and 2 major health jurisdictions (Washington, DC, and New York City). These include drownings that occur in homes, sports/recreation venues, streets, public buildings, and residential institutions (including neighborhood and apartment pools). The CPSC does not collect information on drownings that occur at farms, mines/quarries, industrial locations, or other specified and unspecified locations.

The CPSC also collects copies of medical examiner reports and newspaper articles

related to drowning events. These are referred to as Injury and Potential Injury Incidents (IPII) files. Although these files are not available for every death, they frequently contain detailed information that is not included on death certificates. We obtained data from computerized files that contained abstracted death certificate information and from copies of corresponding death certificates. We also obtained supplemental data from computerized files containing abstracted IPII information and from copies of IPII files.

We reviewed documents for all cases when the External Cause of Injury Code (E-code as coded by the *International Classifications of Diseases, Ninth Revision*<sup>6</sup>) on the death certificate was E910.0 – E910.9 (unintentional drowning/submersion) and when the CPSC-assigned product code indicated a whirlpool/hot tub, wading pool, diving/diving board, above-ground swimming pool, built-in swimming pool, or swimming pool not specified.

### Procedures

We reviewed copies of death certificates for 738 potentially eligible swimming pool drowning deaths among US residents aged 5

to 24 years. We excluded 36 cases (5%) that had been mistakenly included (e.g., drownings at locations such as a lake or river, deaths due to blunt head trauma caused by diving, or electrocution). Of the remaining 702 cases, we excluded 24 (3%) that were not US residents. The remaining 678 cases drowned in swimming pools in the United States between 1995 and 1998.

We matched cases in the death certificate files with IPII files by date of death, state in which the death occurred, and age and gender of the victim. Of the 678 eligible cases, matching IPII files were available for 198 (29%) cases. After matching all files, we extracted data on each case. In addition to pre-coded data (age, race, and gender), we extracted data from death certificates on the location of drowning (e.g., residential pool or public pool), the time of drowning, the race/ethnicity of the victim, and other contributing factors (e.g., disabilities, health conditions, and swimming ability). We used IPII files to supplement data not included on death certificates. For example, if the time of drowning was listed as unknown on the death certificate, the IPII file sometimes included this information.

Although the race of the victim was included as a specific pre-coded field on death certificates, we observed that the manner in which it was coded masked some demographic variation. For example, those who were of Mexican or other Latino origin were usually coded as White. Thus, we more specifically coded for place of birth and ethnicity. To determine ethnicity, we used data on death certificates about place of birth, nationality, and country of origin. If a death certificate stated that a case was born in the United States and was of Mexican origin, we coded that case as Mexican American. If a case was born in Mexico, we coded them as Mexican. We further coded cases as Hispanic, regardless of their race, if they originated from a Spanish-speaking country.

### Analysis

To estimate the completeness of ascertainment, we compared the CPSC data with data reported by the National Center for Health Statistics for the same years. On the basis of these comparisons, we estimated that the CPSC received death certificates for more

than 90% of all drowning deaths in our age group (5–24 years) and for more than 90% of all swimming pool drownings.

We calculated proportional distributions of drowning victim variables (age, gender, race/ethnicity, and nativity) and drowning event circumstances (location of swimming pool and time of drowning). To adjust rates by income, we estimated an income level for each case by matching the victim's residential zip code with census data on median household income for that zip code. Each victim was put into 1 of 3 household income categories: low (<\$35 400), middle (\$35 400–\$48 000), or high (>\$48 000). These categories were derived from calculations of tertiles for the median incomes of all US zip codes weighted by number of households. Thus, these categories represent the distribution of US household incomes, with one third of households represented in each tertile.

Drowning rates were calculated by age, race/ethnicity, gender, and nativity. Rates are reported as deaths per 100 000 among individuals aged 5 to 24 years. Numerators were derived from 1995–1998 CPSC data, and denominators were derived from US Census Bureau population data for the corresponding years.<sup>7</sup> Denominators for race and nativity were not mutually exclusive (e.g., foreign-born and American-born individuals also were classified as Black or White); thus, we did not make direct comparisons between these groups.

We calculated rate ratios to examine the effects of race and ethnicity. We used Poisson distribution to determine confidence intervals for rate ratios, and we used a Poisson regression analysis to determine the association between race, age, gender, and income and the risk for drowning. Number of drowning deaths was used as the dependent variable, with the population data for the corresponding group used as an offset.<sup>8</sup> A multiple regression model was constructed to determine the independent effect of age, gender, race, and income group. Because of small numbers, we did not include Hispanic victims in these models. Interaction terms entered into the model included interactions between age and income and age and race. Calculations were performed with SAS software, version 8 (SAS Institute Inc, Cary, NC).

**TABLE 1—Characteristics of US Swimming Pool Drowning Victims: 1995–1998**

	Number (%)
Gender	
Males	507 (75)
Females	171 (25)
Age, y	
5–9	267 (39)
10–14	160 (24)
15–19	157 (23)
20–24	94 (14)
Race/ethnicity	
White, non-Hispanic	222 (33)
Black, non-Hispanic	316 (47)
Hispanic	81 (12)
Native American	18 (3)
Other	41 (6)
Income	
Low	313 (49)
Middle	185 (29)
High	140 (22)
Total	638 <sup>a</sup> (94)

<sup>a</sup>Income group percentages do not sum to 100 because information was missing for 40 cases.

## RESULTS

Between 1995 and 1998, 678 US residents aged 5 to 24 years drowned in swimming pools. The highest proportion of drownings was among children aged 5 to 9 years (39%), and the lowest was among those aged 20 to 24 years (14%) (Table 1). The majority of drowning victims (75%) were male, 33% were White non-Hispanic, 47% were Black non-Hispanic, and 12% were Hispanic (includes Black and White individuals). Most (85%) of the drowning victims were born in the United States, and all were US residents. Zip code of residence was available for 94% of cases. We used zip codes to estimate families' income levels; thus, we had income information for 94% of cases. Among these 638 households, 49% were classified as low income, 29% as middle income, and 22% as high income (Table 1).

### Drowning Circumstances

The location of the pool was recorded for 77% of the drowning cases. Of these, 37% occurred in public pools, 35% occurred in

**TABLE 2—US Swimming Pool Drownings by Type of Pool and Race/Ethnicity Among Victims Aged 5–24 Years: 1995–1998**

Type of Pool	Number (%)			
	Population Total <sup>a</sup>	Black, Non-Hispanic	White, Non-Hispanic	Hispanic
Residential	186 (35)	54 (23)	98 (55)	21 (35)
Home	114 (61)	31	65	9
Neighbor's pool	20 (11)	8	10	2
Friend's pool	10 (5)	4	4	1
Relative's pool	7 (4)	2	5	0
Grandparent's pool	3 (2)	0	2	1
Unspecified	32 (17)	9	12	8
Neighborhood pools	109 (21)	53 (22)	19 (11)	21 (35)
Housing community	13 (12)	5	3	4
Apartment community	96 (88)	48	16	17
Public pools	192 (37)	122 (51)	44 (25)	14 (23)
Hotel/motel	104 (54)	74	16	7
Public pool (camp, church, city)	67 (35)	39	18	5
Club pool (YMCA, etc.)	21 (11)	9	10	2
School pool	13 (2)	3 (1)	4 (2)	2 (3)
Private, unspecified	5 (1)	5 (2)	0	0
Other pool	3 (1)	0	2 (1)	1 (2)
Whirlpool	17 (3)	2 (1)	12 (7)	1 (2)
Total <sup>b</sup>	525	239	179	60

<sup>a</sup>Population total does not reflect the sum of the other columns, because those categories were not mutually exclusive and do not include cases who were classified under other racial/ethnic groups.

<sup>b</sup>Total denotes total that were specified; it does not include 153 pools where location was not specified.

residential pools, and 21% occurred in neighborhood pools (Table 2). Hotel/motel pools accounted for 54% of the public pool drownings. The majority of residential pool drownings (61%) took place at victims' homes; however, 22% took place at the homes of neighbors, friends, and relatives (other residential locations were unspecified). Of the 486 drownings for which the time of submersion was documented, 373 (77%) occurred between the hours of 12:00 noon and 8:59 PM, with the highest proportion occurring between 3:00 PM and 5:59 PM. Sixty-three (13%) occurred between 9:00 PM and 6:00 AM.

The most common pool location varied with the age of the victim. Among children aged 5 to 9 years, the highest proportion (50%) drowned in residential pools, 26% drowned in public pools, and 20% drowned in neighborhood pools. Among victims aged 10 to 14 years, 50% drowned in public pools, 31% drowned in residential pools, and 11% drowned in neighborhood pools. This pattern

held true among victims aged 15 to 19 years (47%, 24%, and 20%, respectively). Forty-two percent of victims aged 20 to 24 years drowned in neighborhood pools, 25% drowned in public pools, and 22% drowned in residential pools.

### Black and Hispanic Drowning Victims

Black non-Hispanic males had higher swimming pool drowning rates compared with White non-Hispanic males of comparable age, with risk ratios ranging from 5.5 to 12.1 (Table 3). Although the same patterns were seen among females, rates and rate ratios were lower. Hispanic males had higher rates of pool drownings compared with White non-Hispanic males, but they had lower rates compared with Black non-Hispanic males of comparable age. The drowning rates among Hispanic females were similar to those of White non-Hispanic females.

The distribution of locations where victims drowned varied by race/ethnicity. More Black

non-Hispanic victims drowned in public pools (51%) compared with White non-Hispanic (25%) and Hispanic victims (23%). The majority of drownings among Black non-Hispanic victims occurred in hotel/motel pools. In contrast, White non-Hispanic victims were more likely to drown in residential pools (55%) compared with Black non-Hispanic victims (23%) and Hispanic victims (35%). Hispanic victims were more likely to drown in neighborhood pools (35%). Separate analyses found that there was little variation by race in the time of day during which drowning occurred (data not shown).

Poisson regression analysis showed that race ( $P<.0001$ ) but not income ( $P=.60$ ) was an independent predictor of drowning rates in models that included age, gender, race, and income. However, when race was removed from this model, income was significantly associated with higher drowning rates among the low-income groups ( $P<.0001$ ). This shows that in addition to being partially reflective of income, the effects of race have additional explanatory power. Additional independent predictors were age ( $P<.0001$ ) and gender ( $P<.0001$ ). Neither of the interactions with age was significant.

### Foreign-Born Drowning Victims

The drowning rates among foreign-born victims were higher than among American-born victims (Table 4). This was true for both males and females and across age categories. It is notable that the classification of race and nativity were not mutually exclusive. According to the race categories listed on death certificates, the majority of foreign-born victims (59%) were classified as White, 14% were classified as Black, and the remaining victims were classified in other categories. Foreign-born males aged 5 to 9 years had a particularly high risk for drowning (1.6/100 000) compared with American-born males of comparable age. Among American-born victims, the largest proportion were Black (52%), and among foreign-born drowning victims, the largest proportion were Latino (43%).

### Special Circumstances

Overall, 28 of the victims drowned in 14 double-drowning incidents, i.e., 2 individuals drowned together. In most of these cases, 2

**TABLE 3—US Swimming Pool Drowning Rates Among Blacks, Whites, and Hispanics, by Age and Gender: 1995–1998 (Rates/100 000 Population)**

	White <sup>a</sup>	Black <sup>a</sup>	Rate Ratio (95% CI)	Hispanic	Rate Ratio (95% CI)
<b>Women and girls</b>					
Age, y					
5–9	0.13	0.66	5.1 (3.2, 8.2)	0.11	0.8 (0.4, 2.0)
10–14	0.11	0.27	2.5 (1.3, 4.8)	.04	0.4 (0.1, 1.6)
15–19	0.04	0.18	4.5 (1.9, 10.7)	.06	1.5 (0.4, 5.5)
20–24	0.03	0.02	0.6 (0.1, 4.6)	.06	1.8 (0.5, 6.9)
<b>Men and boys</b>					
Age, y					
5–9	0.25	1.36	5.5 (4.0, 7.6)	0.36	1.5 (0.9, 2.4)
10–14	0.12	1.08	8.9 (5.8, 13.6)	0.23	1.9 (1.0, 3.7)
15–19	0.11	1.39	12.1 (8.0, 18.5)	0.26	2.3 (1.2, 4.3)
20–24	0.07	0.63	8.4 (4.7, 15.1)	0.39	5.2 (2.7, 9.8)

Note. CI = confidence interval. Rate ratios were based on a comparison with White victims.  
<sup>a</sup>Does not include Hispanics (Black non-Hispanic and White non-Hispanic).

children of similar ages drowned together; however, in some cases, a child drowned with a much older person, perhaps in a failed rescue attempt. At least 6 of these events occurred in hotel/motel pools.

Health conditions and substance use data were not consistently reported. However, 26 (4%) victims had a documented seizure disorder, 22 (3%) had a documented developmental and/or physical disability (e.g., autism, mental retardation, or quadriplegia), and seven (1%) had documented alcohol or other substance use.

**DISCUSSION**

Previous research has focused on high rates of swimming pool drowning among young children<sup>9,10</sup>; however, our study is the first to focus on pool drownings among older children and young adults. Black males aged 5 to 24 years had much higher risks for drowning in swimming pools than White or Hispanic males. This risk was independent of income. Black victims were more likely to drown in public pools, Hispanic victims were more likely to drown in neighborhood/apartment pools, and White victims were more likely to drown in residential pools. Black victims drowned in hotel/motel pools more often than they drowned in any other type of pool. Foreign-born males also had an

increased risk for drowning compared with American-born males of comparable age.

Previous research has highlighted the discrepancy in swimming pool drowning rates between Black and White victims, but this research did not fully explore the types of pool in which victims drowned<sup>5</sup> and whether racial differences were simply a surrogate for socioeconomic differences. Our study confirms previous findings and adds important new information about pool type, which has important implications for developing prevention strategies. Among female victims, those classified as Black had significantly greater pool drowning rates. Among male victims, the rates and the disparities were even greater, with rate ratios ranging from 5.5 to 12.1. Furthermore, our multivariate analyses suggest

that income is only partially responsible for the discrepancy in drowning rates between Black and White victims. Lower-income families may have an increased risk because they have fewer opportunities to participate in swimming lessons and thus lack swimming skills and experience in the water. However, the persistence of racial differences after we adjusted for income suggests that cultural factors also may be important when examining drowning risks. These factors need to be defined, understood, and targeted toward drowning prevention efforts.

An important finding from our study was that swimming pool drowning rates were much higher among Black males and that a large number of these deaths occurred during the day in public pools rather than during higher-risk situations (e.g., swimming at night or in private pools, which are less likely to be guarded).

Previous research on swimming ability has shown marked differences among racial groups, with Blacks reporting more limited swimming ability than Whites.<sup>11</sup> Other research has suggested that these racial differences might be the result of differences in accessibility to swimming lessons.<sup>12</sup> Factors that contribute to pool drowning deaths in addition to swimming ability include supervision of the pool and the speed at which the submerged victim is removed from the water and resuscitated.<sup>4,5,8,12–14</sup> When we reviewed the case files, there was no documentation about how quickly efforts were made to rescue the drowning victims; however, quicker resuscitation efforts are more likely at guarded pools. Hotel/motel pools represent a particular hazard, because many do

**TABLE 4—US Swimming Pool Drowning Rates Among American-Born and Foreign-Born Victims, by Age and Gender: 1995–1998 (Rates per 100 000 Population)**

Age, y	Women and Girls			Men and Boys		
	American Born	Foreign Born	Rate Ratio (95% CI)	American Born	Foreign Born	Rate Ratio (95% CI)
5–9	0.20	0.50	2.5 (1.0, 6.1)	0.42	1.58	3.7 (2.2, 6.3)
10–14	0.12	0.23	1.9 (0.7, 5.4)	0.27	0.72	2.7 (1.5, 4.8)
15–19	0.07	0.12	1.7 (0.5, 5.5)	0.29	0.76	2.6 (1.6, 4.1)
20–24	0.03	0.11	3.4 (1.1, 11.0)	0.16	0.77	5.0 (3.1, 7.8)

Note. CI = confidence interval. Rate ratios were based on a comparison with American-born victims.

not have lifeguards and thus are often the site where Black victims drown.

Because most individuals of Hispanic origin are coded as White on their death certificates, previous studies have not examined drowning rates by Hispanic ethnicity. In our study, Hispanic females did not differ significantly from White females with regard to drowning rates; however, drowning rates among Hispanic males aged 15 to 24 years were 2 to 5 times greater than among White males of comparable age. These findings are consistent with other studies that found Hispanic males were at increased risk for drowning compared with White non-Hispanic males, although these studies did not focus on swimming pools.<sup>13,14</sup> Research on other injuries also has found Hispanic children had an increased risk compared with White children.<sup>15</sup>

Foreign-born children in our study experienced unexpectedly high rates of drowning, particularly among males aged 5 to 9 years. To our knowledge, this is the first study that examined drowning rates among foreign-born versus American-born victims. One could speculate that these children and their caregivers were unaware of the risks presented by swimming pools, because foreign-born children may be less likely to have opportunities to participate in swimming lessons. Interestingly, research on mortality rates among foreign-born individuals has shown a decreased rate of overall mortality for many causes, including unintentional injuries.<sup>16,17</sup> These studies did not focus specifically on drowning, and one reason for the elevated drowning rate in our study was the large number of Hispanic victims, a group whose experience may not be comparable to foreign-born residents as a whole.

Although some drowning cases were likely to be missing from our data set, this is the largest and most complete national database on US swimming pool drownings. We estimate that we have captured at least 90% of drowning deaths and that the cases are representative of all drownings. Furthermore, because of our access to the death certificates, we were able to extract information that allowed us to code ethnicity, nativity, and the type of pool in which the drowning occurred. However, because death certificates were our primary data source, other

potential contributing factors were not consistently reported (e.g., substance use). Also, lack of exposure data allowed us to only make a general estimate on the risk for drowning. More information on how much time children in different ethnic groups spend in pools is necessary to calculate a true determination of risk. Finally, because we used a proxy indicator of income, we were unable to adjust for individual income to determine the extent to which income as a proxy for socioeconomic status mediated the association between race and drowning.

Our findings highlight several important areas for drowning prevention. First, many of the swimming pool drownings occurred in pools that are accessible to the public. Although studies about the effectiveness of lifeguards at swimming pools are lacking, studies have shown that lifeguards are effective at preventing death from drowning in open bodies of water.<sup>18,19</sup> It is reasonable to assume that lifeguards may be even more effective in a more controlled environment, such as a swimming pool. However, many hotel/motel pools do not have lifeguards. When it is not possible for lifeguards to be present, guidelines for prevention of drowning in public pools should be followed, specifically a requirement for adult supervision.<sup>20</sup> Hotel/motel pools represent a particular hazard for Black victims, who comprised 71% of these drownings; it is unknown how many of these drownings may have occurred while on vacation among those who did not usually have access to pools. Theoretically, most pool drowning deaths can be prevented if victims are removed from the water immediately after submersion and resuscitated when necessary.<sup>4,18,21</sup>

Second, the American Academy of Pediatrics recommends that all children aged 6 years and older should learn to swim.<sup>4</sup> The drowning victims in our study were aged 5 years or older; therefore, most of the children in our study were of an age at which they could have been taught to swim. One argument for not advocating swimming lessons for all children is that more proficient swimmers might take greater risks (e.g., swimming at remote locations). However, the drownings in our study occurred in relatively controlled circumstances, and most occurred during the day. Therefore, these drownings do not

appear to reflect high-risk scenarios; however, it is likely that in the relatively controlled environment of a swimming pool, increased swimming ability would be protective.

Finally, our study identified 2 groups who appear to be at particularly increased risk for drowning: Black males aged 5 to 19 years and foreign-born males aged 5 to 9 years. The American Academy of Pediatrics has outlined a number of strategies for preventing drownings among children of different ages.<sup>21</sup> Emphasis on these strategies may be particularly relevant for these 2 groups, particularly supervision at high-risk public pools where many of these deaths occur. Further investigation into the circumstances surrounding drowning deaths is an important step toward understanding reasons for the discrepancies in drowning by race and nativity. ■

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#### Contributors

G. Saluja acquired and coded the data, oversaw data analysis, and drafted the article. R.A. Brenner originated the study and study design, supervised data analysis, and wrote/edited sections of the article. A.C. Trumble managed and analyzed the data and assisted with writing sections of the manuscript. G.S. Smith originated the study, provided methodological guidance, and contributed to writing/editing the article. T. Schroeder acquired the data, assisted with data analysis, provided input on study design, and edited sections of the paper. C. Cox provided statistical expertise, oversaw data analysis and assisted with writing sections of the article.

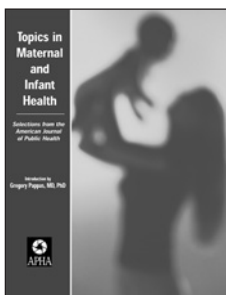
#### Human Participant Protection

This study was declared exempt from review by the National Institutes of Health office of human subjects research.

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