

Childhood Drownings and Fencing of Outdoor Pools in the United States, 1994

Pamela Logan, MD; Christine M. Branche, PhD; Jeffrey J. Sacks, MD, MPH; George Ryan, PhD; and John Peddicord, MS

ABSTRACT. *Objectives.* To determine the prevalence of proper fencing around outdoor swimming pools among US households and to describe this fencing in relation to demographic and other household factors. To estimate the number of drownings among children <5 years of age that might be prevented by having proper fencing around all residential pools in the United States.

Methods. A 1994, randomly dialed national telephone survey contacted 5238 adults who reported demographic information and household characteristics including whether the household had an outdoor swimming pool and the fencing around the pool. Data were weighted to obtain national estimates and percentages. The number of preventable drownings was estimated with a population-attributable risk equation.

Results. Approximately 18.5 million American households owned or had access to an outdoor swimming pool in 1994, and 76% (13.9 million) of them appeared to have had adequate fencing. Adequate fencing was associated with household income and type of home. We estimate that 19% of pool-related drownings among children <5 years of age in 1994 (88 drownings) might have been prevented if all residential pools in the United States were properly fenced.

Conclusions. Adequate pool fencing prevents a child from having access to a swimming pool if a responsible adult is not present and has been promoted as a method to prevent drowning. Our research suggests that even if all residential pools in the United States were properly fenced, most drownings among children <5 years of age would not be prevented. Thus, additional strategies to prevent drowning will be needed. *Pediatrics* 1998;101(6). URL: <http://www.pediatrics.org/cgi/content/full/101/6/e3>; *adequate fencing, swimming pools, drowning, children.*

From the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, US Public Health Service, Dept of Health and Human Services, Atlanta, Georgia.

The following are members of the ICARIS (Injury Control and Risk Survey) project, which designed and conducted the survey from which these data were obtained: principal investigator: Jeffrey J. Sacks, MD, MPH; project core group: Barbara Houston, Marcie-jo Kresnow, MS, Joann M. O'Neil, BA, and Suzanne M. Smith, MD, MPH, all of NCIPC; James Hersey, PhD, Rick Williams, PhD, and Aiman Zeid, MS, of Battelle; and Sherry Marcy, MPH, and Deborah J. Zivan, BA, of DataStat.

Project associates: Julie Bolen, PhD; Christine M. Branche, PhD; Peter Briss, MD; Terence Chorba, MD, MPH; Alex Crosby, MD, MPH; Yvette Davis, VMD, MPH; Jennifer Friday, PhD; Arlene Greenspan, DrPH, PT; James Mercy, PhD; Phil McClain, MS; Lloyd Potter, PhD, MPH; and Kenneth E. Powell, MD, MPH, all of NCIPC; and Thomas Matte, MD, MPH, of the National Center for Environmental Health.

Received for publication Jul 28, 1997; accepted Feb 4, 1998.

Reprint requests to (C.M.B.) National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 4770 Buford Hwy, NE (K-63), Atlanta, GA 30341.

PEDIATRICS (ISSN 0031 4005). Copyright © 1998 by the American Academy of Pediatrics.

ABBREVIATIONS. PAR, population attributable risk; RR, relative risk.

Every year in the United States, ~600 children <5 years of age drown, making drowning the third most common cause of unintentional injury death for children in this age category.¹ Studies show that young children are more likely to drown in residential swimming pools than in lakes or open bodies of water. The situation is reversed for older children and adults; they are more likely to drown in lakes or open bodies of water.²⁻⁴

Fencing that prevents direct access to a swimming pool from a house or yard has been suggested as a way of preventing young children from drowning, and it appears to be effective.^{5,6} A 2-year study conducted in Maricopa County, AZ, estimated that 51% of drownings could have been prevented by proper pool fencing.⁷

Because the prevalence of adequate pool fencing in the United States is unknown, we cannot estimate the number of drownings nationally that could be prevented by their universal use. In 1994, the Centers for Disease Control and Prevention conducted a national telephone survey, the Injury Control and Risk Survey, designed to estimate the prevalence of risk factors for injuries. The findings of that survey on pool fencing are summarized in this report.

METHODS

Telephone numbers of households from all 50 states and the District of Columbia were selected randomly from a proprietary database containing telephone exchanges with at least two listed telephone numbers. Telephone exchanges with >10% of households occupied by minorities were oversampled to increase minority representation. At least six attempts were made to reach each number. Random selection procedures were used to ensure equal sex distribution of respondents. For households with more than one eligible individual of the selected sex, the individual with the most recent birthday was asked to participate in the study. Participants were English- or Spanish-speaking individuals ≥18 years of age.

Computer-assisted telephone interviewing was used for questionnaire administration and data entry. Respondents reported on household and personal demographic information, including pre-tax household income, home ownership, highest level of education completed, and race. In addition, participants were asked whether they owned or had access to an outdoor swimming pool. Those who answered yes were asked whether there was a fence around the pool. Participants who had a fence around their pool were asked whether the fence had a self-closing and self-latching gate between their home and the pool.

In collapsing responses about pool ownership, "don't know" responses ($n = 8$) were classified as "no," and "refusal" responses

($n = 2$) were classified as "missing". To analyze whether participants had adequate pool fencing, we combined questions regarding whether participants had a fence around their pool and whether they had a fence or gate between their home and the pool. Adequate pool fencing was defined conceptually as fencing that surrounded the pool and prevented access to the swimming pool from inside the house or yard. For questions used to determine the adequacy of pool fencing, "don't know" and "refusal" responses were classified as "missing." In collapsing responses to questions on other behaviors, "don't know" responses were classified as "no," and "refusal" responses were classified as "missing."

Weights were used to adjust for unequal selection probabilities and to combine a sampling weight and a ratio adjustment. The ratio adjustment scales household records upward to represent fully all households within the same metropolitan statistical area with data from the March 1994 Current Population Survey. Weighted national prevalence estimates and 95% confidence intervals were obtained by using SUDAAN.⁸ Statistical significance of associations among variables was tested with the log likelihood χ^2 statistic.

We used a population attributable risk equation (population at risk [PAR] = ((P [population]) (relative risk [RR] - 1))/((P (RR - 1) + 1) to estimate the proportion of drownings among children <5 years of age that could have been prevented by fencing around all pools in the United States in 1994. The RR estimate was obtained from published studies^{5,7} and the prevalence of inadequate fencing in P was obtained from this study. The number of drowning deaths among children was obtained from the National Center for Health Statistics,¹ and the percentage of pool-related drownings was estimated from studies of drowning.^{7,9} We conducted a sensitivity analysis of the population attributable risk using low and high estimates of RR (low RR = 2; high RR = 3.76),^{5,7,10} the prevalence of inadequate fencing in the population (low prevalence = 21%; high prevalence = 27%, obtained from this study), and the percentage of pool-related drownings (low = 50%; high = 89%).^{9,11}

RESULTS

Questionnaires were completed for 5238 households, resulting in a response rate of 56.1% (response rate = 5238 completed interviews/(5238 completed interviews + 3630 refusals + 474 incomplete interviews)).

Of all households, 1055 (weighted 19% = 18.5 million households) reported owning or having access to an outdoor swimming pool. Swimming pool ownership increased with income and was associated with residence in the western or southern part of the country, renting a dwelling in an apartment house with greater than five units, and having completed some college education (Table 1).

Of all households with outdoor swimming pools, 76% (weighted 13.9 million) were estimated to have adequate pool fencing. Adequate fencing was associated with renting a dwelling and residing in an apartment house or an attached house (a one-family house attached to one or more homes, eg, townhouse) (Table). Individuals residing in detached houses and those with a household income exceeding \$50 000 were significantly less likely to report having adequate fencing than others. Households with children <5 years of age were not significantly more likely to have adequate pool fencing than were households without young children.

There were ~548 drownings among children <5 years in 1994.¹ From drowning studies, we estimated that 466 (85%) of the drownings were pool-related. Using a RR of 2 and a prevalence of 24%, we esti-

mated that 19% (88) of pool-related drownings among children in this age category were attributable to inadequate fencing and thus could have been prevented by proper fencing around all residential pools in the United States.

Sensitivity analysis revealed that PAR ranged from 17% to 43% and was most sensitive to the RR estimate.

DISCUSSION

Although urging parents and caregivers to be vigilant when supervising children playing in recreational water is important, it is insufficient to prevent all drownings. Many parents of children who drowned in swimming pools noticed that the child was missing for only a few minutes. Children can move quickly, escape the caretaker's notice, and drown within 30 seconds.¹² Furthermore, children do not usually splash when they are having difficulty; they slip silently into the water.¹³

Fencing is intended to prevent a child from having access to a pool unless a responsible adult is present. Fencing at least 4 feet high, with vertical openings <4-inches wide and with a self-closing and self-latching gate is considered adequate.^{3,12,14} The American Academy of Pediatrics recommends the installation of fencing at least 5 feet high.¹⁵ These characteristics distinguish pool fencing from property-line fencing, which merely separates yards with swimming pools from neighboring properties.

In our survey, 76% of respondents reported having access to an adequately fenced swimming pool. As a result, we estimated that 19% of pool-related drownings among children <5 years of age might have been prevented with adequate fencing. This estimate is similar to estimates of the percentage of drownings prevented by pool fencing in Australia and New Zealand in the late 1970s.⁶

Based on the highest documented RR estimate (3.76), our sensitivity analysis suggests that at most, 43% of pool-related drownings among children in this age group could have been prevented. However, most studies we reviewed reported RR of ~2.^{5,7} Using a RR of 2 with the low and high values for prevalence and the percentage of pool-related drownings, we obtained PAR estimates that ranged from 17% to 21%. Therefore, we believe our PAR estimate of 19% is reasonable.

Because of the effectiveness of pool fencing, some jurisdictions (eg, Maricopa County, AZ, and Contra Costa County, CA) require that it be installed around all newly constructed swimming pools. Few states, however, require retrofitting of existing pools. Laws regarding pool fencing vary among states and even among some counties within states; however, where isolation fencing legislation has been adopted, pool-related drownings among children have decreased dramatically.^{5,6} This is true even where isolation fencing is required for new construction alone.

The limitations of this survey must be considered. The response rate of 56% seems low; how-

TABLE 1. National Estimates of the Prevalence of Adequate Pool Fencing by Demographic Characteristic, 1994

Characteristic	Households With Pools			Household Pools With Adequate Pool Fencing		
	N	Weighted National Estimate	Weighted % (95% CI)	N	Weighted National Estimate	Weighted % (95% CI)
Overall	1055	18 481 890	19.0 (17.9–20.2)	798	13 939 693	76.0 (73.1–78.9)
Income group*†						
\$50 000+	317	5 646 911	24.2 (21.6–26.9)	200	3 692 975	65.8 (59.9–71.6)
\$35 000–\$49 000	200	3 559 996	21.6 (18.6–24.6)	165	2 928 265	82.6 (76.5–88.7)
\$20 000–\$34 999	234	3 932 426	18.7 (16.2–21.2)	188	3 005 318	77.1 (70.7–83.5)
<\$20 000	197	3 272 483	13.6 (11.6–15.6)	161	2 655 415	82.2 (76.0–88.3)
Highest household educational level*						
College graduate or more	365	6 575 888	24.6 (22.1–27.1)	281	5 194 742	79.2 (74.6–83.8)
High school graduate/some college	599	10 493 956	18.2 (16.7–19.7)	446	7 686 784	74.2 (70.1–78.2)
Less than high school	86	1 319 544	11.0 (8.5–13.5)	66	965 664	73.2 (61.9–84.4)
Child <5 years of age in household						
No	226	4 140 719	21.4 (18.6–24.2)	154	2 828 412	68.9 (62.1–75.8)
Yes	167	2 910 000	17.8 (15.0–20.6)	132	2 267 823	77.9 (70.8–85.1)
Home ownership*†						
Own	608	11 279 348	17.1 (15.7–18.5)	397	7 510 685	67.1 (62.9–71.3)
Rent	436	7 018 328	23.2 (21.1–25.4)	395	6 345 312	91.2 (88.4–94.1)
Census region*						
South	500	7 282 729	21.5 (19.6–23.4)	383	5 518 153	76.8 (72.5–81.1)
West	281	4 634 667	22.8 (20.1–25.4)	207	3 492 498	75.4 (69.8–80.9)
North Central	139	3 136 938	13.4 (11.2–15.7)	108	2 369 422	75.8 (67.9–83.7)
Northeast	135	3 427 556	17.6 (14.7–20.5)	100	2 559 620	75.6 (67.8–83.4)
Type of dwelling*†						
Building, 2–4 apartments	105	1 594 554	19.6 (15.8–23.4)	101	1 511 743	94.8 (89.5–100.1)
Building, ≥5 apartments	315	5 109 710	42.9 (38.8–46.9)	293	4 772 193	94.9 (92.4–97.3)
Mobile home	68	1 222 733	17.3 (12.9–21.6)	55	932 145	78.1 (65.8–90.3)
Attached house	104	1 838 373	25.6 (20.8–30.3)	94	1 665 741	91.2 (85.1–97.2)
Detached house	452	8 564 610	13.8 (12.5–15.2)	246	4 930 502	57.8 (52.6–62.9)

* $P < .05$, owning/having access to an outdoor swimming pool.

† $P < .05$, having adequate pool fencing for the outdoor swimming pool.

ever, comparisons of households included in this study with census data suggests that we obtained data typical of telephone surveys (income and highest educational level are slightly higher than in the general population).¹⁶ Given that the highest education category is overrepresented in our sample and that individuals in this category have greater pool access and are less likely to have adequate fencing, our total estimate of adequate fencing is deflated causing an overestimate of the percentage of preventable cases. Another limitation is that our survey did not clearly define the dimensions required for adequate pool fencing. We also did not differentiate between pool ownership and access to a pool.

The findings of this research suggest that even if all residential pools in the United States were fenced adequately, most of the pool-related drownings that occur among children <5 years would not be prevented. Other prevention strategies need to be considered (eg, pool covers and alarms). Research to evaluate and compare the effectiveness of new prevention strategies is warranted.

In addition, caretakers should be educated about water safety including the importance of constant monitoring of children at pools, the need for a telephone and rescue equipment at the pool, and the value of cardiopulmonary resuscitation training. In addition, caretakers should be instructed to remove toys from the pool after use so children are not tempted to retrieve them. Community education ef-

forts have proven to be an effective means to decrease drowning rates among children.³ Because households with young children are not more likely to have adequate fencing, caretakers should be cautious when allowing young children to visit households with swimming pools.

REFERENCES

1. National Center for Health Statistics (NCHS). 1994 Mortality Tapes. Hyattsville, MD: NCHS, Centers for Disease Control and Prevention; 1997
2. Brenner RA, Gordon S, Smith MB, Overpeck MD. Divergent trends in childhood drowning rates, 1971 through 1988. *JAMA*. 1994;271:1606–1608
3. Liller KD, Kent EB, Arcari C, McDermott RJ. Risk factors for drowning and near-drowning among children in Hillsborough County, Florida. *Public Health Rep*. 1993;108:346–353
4. Boyle WE, Bull MJ, Katcher ML, et al. Drowning in infants, children, and adolescents. *Pediatrics*. 1993;92:292–294
5. Pearn J, Nixon J. Prevention of childhood drowning accidents. *Med J Aust*. 1977;1:616–618
6. Fergusson DM, Horwood LJ. Risks of drowning in fenced and unfenced domestic swimming pools. *NZ Med J*. 1984;97:777–779
7. Centers for Disease Control and Prevention. Child drownings and near drownings associated with swimming pools—Maricopa County, Arizona, 1988 and 1989. *MMWR*. 1990;39:441–442
8. Shah BV. *SUDAAN Survey Data Analysis Software*. Release 6.34. Research Triangle Park, NC: Research Triangle Institute; 1993
9. O'Carroll PW, Alkon E, Weiss B. Drowning mortality in Los Angeles County, 1976 to 1984. *JAMA*. 1988;260:380–383
10. Pitt WR, Balanda KP. Childhood drowning and near-drowning in Brisbane: the contribution of domestic pools. *Med J Aust*. 1991;154:661–665

11. Quan L, Gore EJ, Wentz K, Allen J, Novack AH. Ten-year study of pediatric drownings and near-drownings in King County, Washington: lessons in injury prevention. *Pediatrics*. 1989;83:1035–1040
12. Branche CM. What is happening with drowning rates in the United States? In: Fletemeyer, ed. *The Etiology of Drowning With Perspectives in Intervention and Prevention*. Boston, MA: Jones and Barlett; In press
13. Pia F. Observations on the drownings of nonswimmers. *J Phys Educ*. 1974;71:164–167:181
14. US Consumer Product Safety Commission (CPSC). *Children and Pools: A Safety Checklist*. Publication 357. Washington, DC: US Consumer Product Safety Commission (CPSC); 1993
15. *The Injury Prevention Program (TIPP)*. Elk Grove Village, IL: American Academy of Pediatrics; 1988
16. Ikeda RM, Dahlberg LL, Sacks JJ, Mercy JA, Powell KE. Estimating intruder-related firearm retrievals in US households, 1994. *Violence Vict*. In press

Childhood Drownings and Fencing of Outdoor Pools in the United States, 1994

Pamela Logan, Christine M. Branche, Jeffrey J. Sacks, George Ryan and John Peddicord

Pediatrics 1998;101:e3

DOI: 10.1542/peds.101.6.e3

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/101/6/e3>

References

This article cites 9 articles, 2 of which you can access for free at:
<http://pediatrics.aappublications.org/content/101/6/e3#BIBL>

Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):
Injury, Violence & Poison Prevention
http://www.aappublications.org/cgi/collection/injury_violence_-_poison_prevention_sub
Home Safety
http://www.aappublications.org/cgi/collection/home_safety_sub

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://www.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:
<http://www.aappublications.org/site/misc/reprints.xhtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Childhood Drownings and Fencing of Outdoor Pools in the United States, 1994

Pamela Logan, Christine M. Branche, Jeffrey J. Sacks, George Ryan and John Peddicord

Pediatrics 1998;101:e3

DOI: 10.1542/peds.101.6.e3

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/101/6/e3>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 1998 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

