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/101/6/63; adequate fencing, swimming pools, drowning, children.

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(u = 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 χ² statistic.

We used a population attributable risk equation (population attributable 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 studies5,7 and the prevalence of inadequate fencing in the population (low prevalence) 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.9,10 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 1994.7 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 estimated 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.3,12,13 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 <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.3,6 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-
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).\textsuperscript{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 percentage of preventable cases. Another limitation is that our survey did not clearly define the

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 efforts have proven to be an effective means to decrease drowning rates among children.\textsuperscript{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


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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Households With Pools</th>
<th>Household Pools With Adequate Pool Fencing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Weighted National Estimate</td>
</tr>
<tr>
<td>Overall</td>
<td>1055</td>
<td>18 481 890</td>
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<tr>
<td>Income group*†</td>
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<tr>
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<td>$20 000–$34 999</td>
<td>234</td>
<td>3 932 426</td>
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<td>&lt;$20 000</td>
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<tr>
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<tr>
<td>Yes</td>
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<td>2 910 000</td>
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<tr>
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<td>Northeast</td>
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<tr>
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<tr>
<td>Detached house</td>
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<td>8 564 610</td>
</tr>
</tbody>
</table>

* P < .05, owning/having access to an outdoor swimming pool.
† P < .05, having adequate pool fencing for the outdoor swimming pool.


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