

# Childhood Drowning: Barriers Surrounding Private Swimming Pools

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**ABSTRACT.** *Objective.* To investigate the causes of child drowning and determine the need for changes in the legislation as well as improvements to the inspection and enforcement of current legislation related to barriers surrounding private swimming pools.

*Methods.* There were 3 stages to the study: a retrospective review of coroner's data, an audit of swimming pool inspections, and in-depth interviews with swimming pool inspectors in Western Australia. The incidence of childhood drowning (per population) and compliance rates of swimming pools (per 1000 swimming pools) to the legislation were measured.

*Results.* During the 12-year observational period (1988–2000) 50 children younger than 5 years drowned in private swimming pools in Western Australia with an overall incidence of drowning of 4.4 per 100 000 children per year. Sixty-eight percent of drownings occurred in pools that did not have 4-sided fencing with an almost 2-fold increased risk (incidence rate ratio: 1.78; 95% confidence interval: 1.40–1.79) of a child's drowning in a swimming pool with 3-sided versus 4-sided fencing. The compliance rate of swimming pools (compliance to the current legislation) at first inspection was approximately 400 per 1000 swimming pools.

*Conclusions.* Almost two thirds of the swimming pools in which children drowned had only 3-sided fencing. With a combination of a change in legislation, enhanced inspection processes, and public education, the incidence of drowning in private swimming pools in Western Australia could be reduced in the coming years. *Pediatrics* 2003;111:e115–e119. URL: <http://www.pediatrics.org/cgi/content/full/111/2/e115>; *childhood, drowning, swimming pools.*

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ABBREVIATION. IRR, incidence rate ratio.

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Although drowning-related mortality occurs across all age groups, the greatest overrepresentation is among children younger than 5 years.<sup>1–5</sup> In Australia, drowning is the most common cause of accidental death for children younger than 5 years, 70% of whom are aged between 1 and 3 years.<sup>6–9</sup> Thirty-five children younger than 5 years died (as a result of drowning) in Australia during the 12-month period between July 2000 and June 2001,

and for every drowning death an additional 3 children were admitted to the hospital after a serious immersion incident.<sup>10</sup> The consequence of serious immersion incidents is considerable, with up to 20% of children experiencing brain damage.<sup>10</sup>

An international comparison of the rates of “toddler” drowning (defined as children younger than 5 years) highlight that Australia has the second highest rate for childhood drowning after the Netherlands.<sup>3</sup> The overrepresentation of childhood drowning in countries with warmer climates, such as parts of Australia, the United States, and South Africa, can be explained, in part, by the higher increased rate of drowning in private swimming pools relative to natural bodies of water.<sup>3</sup>

The proportion of Western Australian children drowning in private swimming pools is the same as Australia as a whole; between 1987 and 1996, 81 children younger than 5 years drowned in Western Australia, with 54% of the drownings occurring in private swimming pools.<sup>3</sup> This is lower than in the United States, where between 60% and 90% of child drownings (younger than 5 years) occur in private swimming pools.<sup>2</sup> Child drowning in Western Australian private swimming pools increased as a percentage total of drowning from 38% in 1986 to 56% in 1996. It is interesting that during the same period, private swimming pool ownership increased almost 2-fold in Western Australia from 47 800 in 1988 to 80 000 in 1996.<sup>3</sup>

Encouraging the installation of pool fencing is 1 of the most commonly used approaches to prevent children from drowning. Other preventive approaches include water safety education and the teaching of resuscitation techniques.<sup>9,11</sup> The former includes media campaigns and educating parents and caregivers on the need for supervision. The installation of swimming pool fencing, however, is the most widely advocated strategy, and all Australian states require that pool fencing and gates comply with the relevant Australian Standard (AS 1926.1).<sup>12</sup>

The current legislation in Western Australia relating to barriers around private swimming pools states that if a swimming pool was installed before July 1992, then its enclosure may include a wall that contains a door or window permitting direct access between the enclosed area and the residence (before July 1992, 3-sided fencing). A swimming pool installed after July 1992 either can be isolated from the residence (4-sided fencing) or its enclosure may include a wall that contains a door or window permitting access if that door or window satisfies the re-

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Received for publication May 30, 2002; accepted Sep 30, 2002.

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quirements of the Australian Standard AS 1926.1,<sup>12</sup> namely that they have locks (after July 1992, 3-sided fencing). The inspection of swimming pool fencing has been mandatory in Western Australia since the introduction of legislation in 1992. However, recent Australian studies have found that in the majority of child drowning cases, the swimming pool fencing is in disrepair or the gate is not functioning correctly.<sup>6,9</sup>

This study aimed to elucidate the causes of child drowning in private swimming pools and to determine the need for change in the legislation as well as improvements to the inspection and enforcement of current legislation related to barriers surrounding private swimming pools.

## METHODS

The research was undertaken in 3 stages. The first stage involved a retrospective review of coroners' records for children younger than 5 years during the period 1988–2000 in Western Australia. The following detail was obtained from each record: demographics of the household; date and time of death; age of the deceased child; whether the child resided or was visiting the household; who was supervising at the time of the drowning; factors contributing to the incident; type of swimming pool; barrier type, namely 3-sided or 4-sided fencing; whether the barrier complied with current legislation; when the swimming pool was last inspected; and whether the pool was installed before or after July 1992 legislation. Objective data such as photographs of the swimming pools and their location were used to verify written documentation.

The second stage of the study involved an audit of swimming pool inspections whereby swimming pool inspectors from each shire or city council throughout the state randomly selected a sample of 20 inspection records (total records  $n = 500$ ); 68% of the shire or city councils in Western Australia participated. All shire and city councils were instructed on the process to select records randomly. The following information was obtained from the record: postal code; ownership status of the house; date of first swimming pool inspection; whether the pool met compliance standards; if not compliant, then the reasons for noncompliance; and number of days the property owner/occupier was given to meet compliance standards, along with details on the follow-up for the first and subsequent inspections. The purpose of the audit was 2-fold: first, to estimate whether the pools complied to the legislation introduced by the state government in 1992 and, second, to obtain an estimate of the average time it took to meet the statutory requirements when a swimming pool barrier was deemed not appropriate by an inspector.

The final stage involved face-to-face interviews with swimming pool inspectors. One nominated swimming pool inspector from each shire or city council throughout the Perth metropolitan area (population of 1.4 million; Perth is the capital of the state of Western Australia) and 8 selected rural shires were invited for interview (or telephoned for rural participants). Eighty-seven percent compliance was obtained in the metropolitan area, and 63% was obtained in the rural areas. The purpose of the interview was to obtain the inspectors' opinions about the effectiveness of the

current legislation and to make recommendations for change, if necessary.

The annual incidence of drowning in children younger than 5 years was calculated using the following formula: (number of child drownings in private swimming pools/total population of children younger than 5 years in Western Australia)  $\times 100\,000$  per year. Denominator data for the population estimates were obtained from the Australian Bureau of Statistics.<sup>13</sup> An incidence rate ratio (IRR) was also calculated,<sup>14</sup> which estimated the risk of a child's drowning in a swimming pool that had 3-sided versus 4-sided fencing. The IRR was calculated for the year 1999, as this was the only year with sufficient drowning cases. We reviewed photographic evidence in the coroner's record to verify whether the drowning occurred in a pool with 3-sided or 4-sided fencing in 1999. The denominator data for the swimming pool estimates were obtained from estimates provided by the shire or city councils and then weighted on the basis of the findings from a random survey of swimming pool owners undertaken in an additional study by us.<sup>15</sup>

Variations in proportions were assessed using the Pearson  $\chi^2$  test, with continuity correction where appropriate. Comparison of the means for continuous variables was undertaken using independent  $t$  tests. A compliance rate in relation to the swimming pool barrier legislation was calculated by the following formula: (number of compliant swimming pools/total swimming pools assessed for compliance)  $\times 1000$  per year with associated 95% confidence intervals. All analyses were undertaken using STATA<sup>16</sup> and SPSS<sup>17</sup> software.

## RESULTS

During the 12-year period 1988–2000, 50 children (younger than 5 years) drowned in private swimming pools in Western Australia. The average age of the deceased was 2 years 3 months (range: 7 months–4.2 years) with 68% ( $n = 34$ ) of the children being male. Three quarters of the drownings took place in the Perth metropolitan area (76%;  $n = 38$ ).

Nearly half of the drownings (44%;  $n = 22$ ) took place at the household where the child resided. More than half (58%;  $n = 29$ ) of the drowning events occurred during the summer months, December through March, with 45% ( $n = 20$ ) of drowning events occurring between 4 PM and 6 PM and 1 case occurring between 9 PM and 8 AM.

The incidence of drowning declined in 1988, remained relatively stable at 2.15 cases per 100 000 children (younger than 5 years) per year between 1989 and 1997, and an unexpectedly increased to 7.86/100 000 cases in 1999. The overall drowning rate in private swimming pools for Western Australia during the 12-year period was 4.4 per 100 000 children per year (see Fig 1). Children (younger than 5 years) who lived in or visited households with 3-sided fencing were almost twice as likely (IRR:

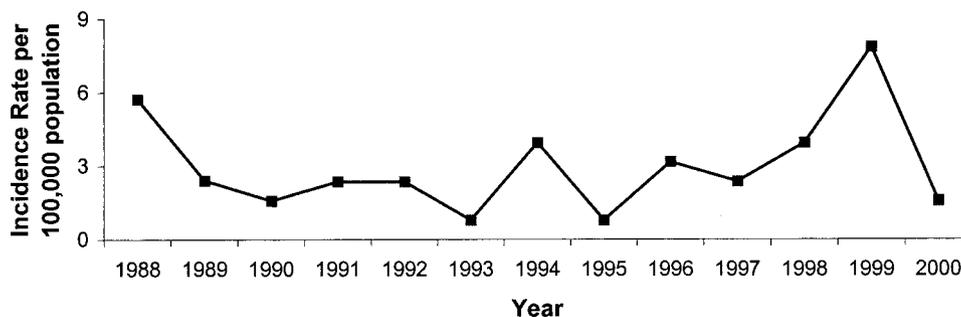


Fig 1. The incidence of drowning per child population: 1988–2000.

1.78; 95% confidence interval: 1.40–1.79) to drown compared with children who lived in or visited households with 4-sided fencing surrounding their swimming pools.

Figure 2 outlines the various reasons that the swimming pools did not meet compliance with the legislation. Fifty-two percent ( $n = 23$ ) of the pools that were inspected after a drowning event ( $n = 44$ ) were found to be compliant with the legislation on barrier fencing. However, of these compliant pools, 43% of the drowning cases (10 of 23) occurred by the child's gaining access to the pool through the house, suggesting that pre-1992 3-sided fencing was in place. In another 43% of the cases (10 of 23), the child obtained access to the pool through the pool gate's being propped open, and in 14% ( $n = 3$ ) of the drowning cases, inadequate supervision was listed as the contributing factor. It is noteworthy that of all the reported drowning cases (70% [35 of 50]) occurred in pools with 3-sided fencing. Of the cases that occurred in pools with 4-sided fencing (30%;  $n = 15$ ), all were the result of either a pool gate's being propped open or a fault with the self-closing/latching mechanism of the pool gate.

It was found from the audit of the randomly selected swimming pool inspection records that only 45% ( $n = 162$ ) of properties met compliance at first inspection. The most frequently reported reason for noncompliance was the access gate to the swimming pool not self-closing/latching (24%). Another 8% of pools did not meet compliance as a result of general problems with the gate. When the pool did not meet compliance it took the owner, on average, 1 month (mean: 37 days; range: 5–91 days) to comply. Compliance to the legislation increased to 57% at second inspection (4 years later) and 71% by the third inspection.

Compliance rates at first inspection were calculated for the years 1991/1992 through 2001. No rates were calculated for the years before 1991 because of

the small number of inspections in the sample. It is evident from Fig 3 that the compliance rates were highest (590 compliant pools per 1000 swimming pools) in the period after the introduction of the legislation in 1992. Since 1997, the rate has remained relatively stable at approximately 400 per 1000 swimming pools.

Overall, 89% ( $n = 25$ ) of the inspectors reported that the inspection process was effective in identifying swimming pools that did not meet compliance, and more than half of the inspectors (57%,  $n = 16$ ) believed that the inspection process investigated the necessary issues surrounding the legislation. However, more than three quarters of the inspectors (79%;  $n = 22$ ) did not think that the present legislation was adequate. Of these inspectors, more than half recommended uniform legislation (59%;  $n = 13$ ), and 50% ( $n = 11$ ) suggested that 4-sided fencing for all pools should be compulsory. A number of the inspectors (46%;  $n = 10$ ) believed that changes to the Australian Standards were necessary and that the frequency of pool inspections should increase (32%;  $n = 7$ ). The inspectors also believed that there needed to be a greater level of education of pool owners about the dangers of childhood drowning (65%;  $n = 17$ ) and greater public awareness of the legislation and pool safety (62%;  $n = 16$ ).

## DISCUSSION

The epidemiology of childhood drowning in private swimming pools in Western Australia reflects the findings in the literature. Namely, that boys are overrepresented in the statistics and that drowning events occur predominantly during the summer months, a period of greatest exposure to swimming pools. As might be expected, drowning events occurred most often between the hours of 4 PM and 6 PM, a period that reflects exposure time to the pool but also when supervision could lapse as a result of other activities, such as meal preparation.

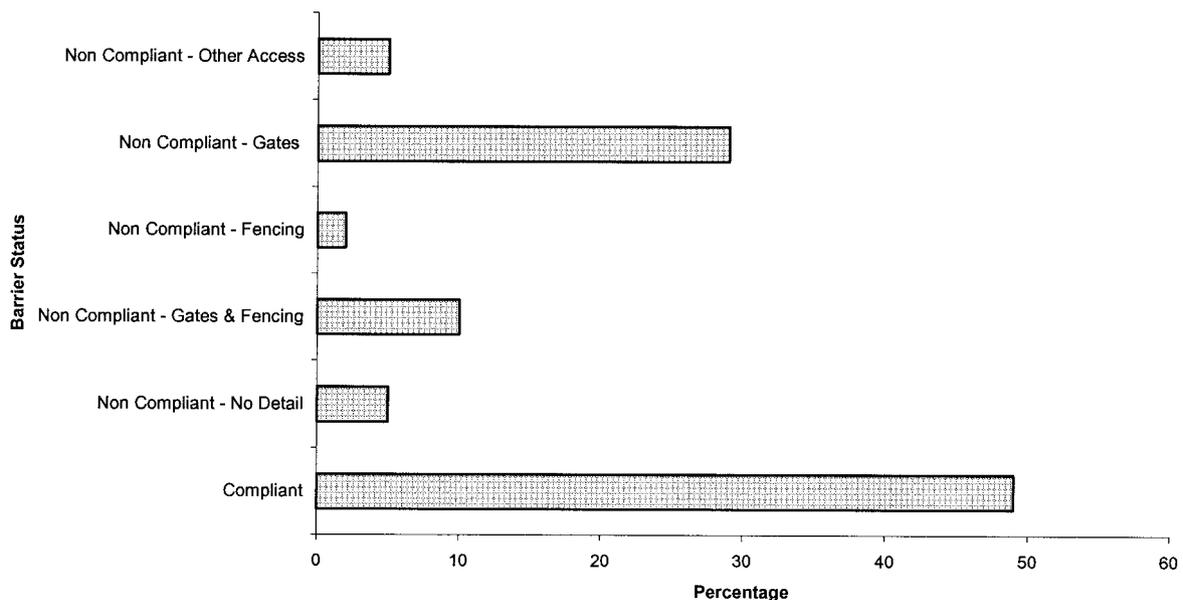


Fig 2. Swimming pool barrier status after childhood drowning: 1988–2000.

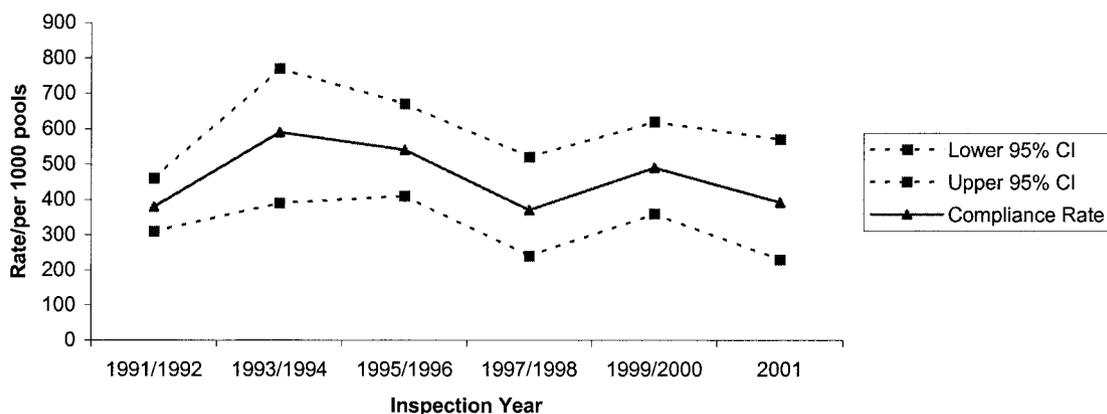


Fig 3. Compliance rates for swimming pool barriers at first inspection between 1991 and 2001

During the 12-year observational period (1988–2000), 50 children younger than 5 years drowned in private swimming pools in Western Australia. There is no distinct trend in the incidence of drowning in private swimming pools during this period. Despite the increase in the incidence of drowning in 1999, the overall incidence of 4.4 per 100 000 children per year in private swimming pools reflects that reported in other states and countries that also have legislation relating to barriers that surround private swimming pools.<sup>5,18,19</sup>

Almost two thirds of the swimming pools in which children drowned had only 3-sided fencing. The majority of these drownings could have been prevented by a change in legislation from 3-sided to 4-sided fencing or at least by uniform legislation requiring a secured access from the residence with 3-sided fencing as unintended access to the pool was a contributing factor in 86% of drownings. The findings from this study are similar to that reported by Pearn and Nixon<sup>20</sup> in which they found that 63% of drowning cases were attributable to absent or inadequate fencing.

This study also estimated that there is almost a 2-fold increased risk (approximately 78% increased risk) of a child's drowning in a swimming pool with 3-sided versus 4-sided fencing. The elevated risk associated with drowning in swimming pools with 3-sided versus 4-sided fencing concurs with previous research.<sup>21</sup> However, it is not sufficient to advocate for 4-sided fencing alone; in 15 drowning events, 4-sided fencing surrounding private pools failed to prevent unintended access because the pool gates were propped open or had insufficient self-closing/latching pool gate mechanism. It is important, therefore, that regular extensive public education on the risks of toddler drowning and the need for 4-sided fencing with self-closing gates (that are not propped open) is undertaken.

Because inadequate pool fencing was a contributing factor in almost half of the drowning events, it was pertinent that this study focus on the inspection process for swimming pool fencing. A unique aspect of this study was the ability to determine the compliance of swimming pools at first and subsequent inspection by the shire or city council. The results from the study highlight that compliance to the leg-

islation after inspection is excellent. Although only 45% of swimming pools were compliant with the legislation at first inspection, most property owners achieve compliance after the inspection. For example, in the short term, compliance changes dramatically after an inspection, achieving up to 80% compliance within a 4-week period, and in the long term, the compliance changed from 45% at first inspection to 71% at the third inspection (during an 8-year period).

Swimming pool inspections have been mandatory since 1992, and although the inspections have been highly successful in achieving swimming pool compliance, the compliance of swimming pools when first inspected is still only adequate. Compliance rates were highest (590 per 1000 swimming pools) in the period after the introduction of the legislation in 1992. However, the rate declined in the succeeding years and seems relatively stable at 400 per 1000 swimming pools.

One should be cautious when interpreting the compliance rates, however, as the rates are based on small numbers and the estimates are likely to vary considerably. Furthermore, although the estimates are based on a random sample of swimming pools provided by the shire or city councils, they do not represent population estimates for the state of Western Australia.

So what can be done to improve the compliance of barriers surrounding swimming pools? The majority of Councils undertake swimming pool inspections on a 4-yearly cycle and tend to adopt an inspection process that is continuous throughout the year. However, the continuous inspection process throughout the year may not be efficient. Because the incidence of drowning is exposure dependent and peaks in December through March (approximately 60% of drownings occur during this period), it is likely that the inspection process would be more effective if initiated during these months. This finding is particularly important when considered in relation to the compliance rates observed in the study. A second change to the inspection process, namely, biennial inspections, is also likely to result in a greater prevalence of compliance to the legislation.

Until now, no research has been undertaken in Western Australia to examine explicitly childhood

drowning and the legislation relating to the inspection of barriers around private swimming pools. The findings from this research indicate that with a change in legislation (to a minimum of uniform legislation requiring secured access from the residence, with 3-sided fencing for established swimming pools and 4-sided fencing for new pools), enhanced management of inspections, and public education, it is likely that the incidence of childhood drowning in private swimming pools in Western Australia could be reduced in the coming years. After the results of this research, the state government introduced new legislation (March 2002) that requires that all new private swimming pools have 4-sided fencing. This means that the fence must isolate the pool from the residence and restrict access from outside the property.

#### ACKNOWLEDGMENTS

This research was supported by the Department of Health of Western Australia and the Department of Local Government and Regional Development.

We thank the Local Government Councils and the Royal Life Saving Society of Australia (Western Australia Branch) for support.

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