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*Cochrane Database of Systematic Reviews* 1998, Issue 1. Art. No.: CD001047.  
DOI: [10.1002/14651858.CD001047](https://doi.org/10.1002/14651858.CD001047).

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## TABLE OF CONTENTS

HEADER .....	1
ABSTRACT .....	1
PLAIN LANGUAGE SUMMARY .....	2
BACKGROUND .....	3
OBJECTIVES .....	3
METHODS .....	3
RESULTS .....	4
DISCUSSION .....	5
AUTHORS' CONCLUSIONS .....	6
ACKNOWLEDGEMENTS .....	6
REFERENCES .....	7
CHARACTERISTICS OF STUDIES .....	8
DATA AND ANALYSES .....	10
Analysis 1.1. Comparison 1 Fencing versus no fencing - all pool types, Outcome 1 Drowning and near-drowning. ....	10
Analysis 2.1. Comparison 2 Fencing versus no fencing - in-ground pools, Outcome 1 Drowning and near-drowning. ....	11
Analysis 3.1. Comparison 3 Fencing versus no fencing - above ground pools, Outcome 1 Drowning and near-drowning. ....	11
Analysis 4.1. Comparison 4 Isolation versus perimeter fencing, Outcome 1 Drowning. ....	11
Analysis 5.1. Comparison 5 Fencing versus no fencing - all pool types, Outcome 1 Drowning. ....	12
APPENDICES .....	12
FEEDBACK .....	13
WHAT'S NEW .....	13
HISTORY .....	13
CONTRIBUTIONS OF AUTHORS .....	14
DECLARATIONS OF INTEREST .....	14
SOURCES OF SUPPORT .....	14
INDEX TERMS .....	14

[Intervention Review]

# Pool fencing for preventing drowning of children

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**Editorial group:** Cochrane Injuries Group.

**Publication status and date:** Stable (no update expected for reasons given in 'What's new'), published in Issue 9, 2010.

**Citation:** Thompson DC, Rivara F. Pool fencing for preventing drowning of children. *Cochrane Database of Systematic Reviews* 1998, Issue 1. Art. No.: CD001047. DOI: [10.1002/14651858.CD001047](https://doi.org/10.1002/14651858.CD001047).

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## ABSTRACT

### Background

In most industrialized countries, drowning ranks second or third behind motor vehicles and fires as a cause of unintentional injury deaths to children under the age of 15. Death rates from drowning are highest in children less than five years old. Pool fencing is a passive environmental intervention designed to reduce unintended access to swimming pools and thus prevent drowning in the preschool age group. Because of the magnitude of the problem and the potential effectiveness of fencing, we decided to evaluate the effect of pool fencing as a drowning prevention strategy for young children.

### Objectives

To determine if pool fencing prevents drowning in children (under 14 years of age).

### Search methods

We searched the Cochrane Injuries Group's Specialised Register, CENTRAL, MEDLINE, EMBASE, National Research Register, Zetoc and other specialist databases. We searched reference lists of relevant articles and contacted relevant organisations and experts. The searches were last updated in October 2006.

### Selection criteria

In order to be selected, a study had to be designed to evaluate pool fencing in a defined population and provide relevant and interpretable data that objectively measured the risk of drowning or near-drowning or provided rates of these outcomes in fenced and unfenced pools.

### Data collection and analysis

Data were extracted by two authors using a standard abstract form. Odds ratios (OR) with 95% confidence intervals (CI), and incidence rates, were calculated for drowning and near-drowning.

### Main results

Three case-control studies met the selection criteria. The results of these studies indicate that pool fencing significantly reduces the risk of drowning. The OR for the risk of drowning or near drowning in a fenced pool compared to an unfenced pool is 0.27 (95% CI 0.16 to 0.47). Isolation fencing (enclosing pool only) is superior to perimeter fencing (enclosing property and pool); the OR for the risk of drowning in a pool with isolation fencing compared to a pool with three-sided fencing is 0.17 (95% CI 0.07 to 0.44).

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**Authors' conclusions**

Pool fences should have a dynamic and secure gate and should isolate the pool from the house (that is, four-sided fencing). Legislation should require isolation fencing with secure, self-latching gates for all pools, public, semi-public and private. Legislation should require fencing of both newly constructed and existing pools and include enforcement provisions, in order to be effective.

**PLAIN LANGUAGE SUMMARY****Fencing which completely encloses all sides of a swimming pool and isolates it from the home is effective in preventing drowning of young children**

In most industrialized countries, drowning is one of the top killers of children, especially young children. Medical care offers little to help drowning victims, and thus survival must rely on prevention of the drowning. The review found no trials of pool fencing. However evidence from other studies found that pool fencing that adequately prevents children reaching the pool unsupervised can prevent about three-quarters of all child drownings in pools. Fencing which completely encircles the pool and isolates it from the house is much more effective than methods where children can still gain access to the pool through the house.

## BACKGROUND

In most industrialized countries, drowning ranks second or third, behind motor vehicles and fires, as a cause of unintentional injury deaths to children under the age of 15. Death rates from drowning are highest in children less than five years old. Among children, the most important risk factors for drowning are age and, to some degree, location. For infants, bathtub drowning poses the greatest hazard. Once children attain mobility as toddlers (ages one to four years), swimming pools pose the greatest risk of immersion injury. Rates vary by area and are higher in locations where the weather is hot and exposure to swimming pools is the greatest. For example, the rate for children aged four years and under in the US is 3.9 per 100,000 but 9.4 per 100,000 in Arizona ([US Mortality Data](#)). The preschool drowning rate in Australia is 8.2 per 100,000 and varies from 4.69 in the Australian Capital Territory (Canberra) to 15.7 per 100,000 in Queensland ([Pearn 1979](#)).

It has been estimated that for each childhood drowning fatality, about four children are hospitalized ([Wintemute 1990a](#)) and 14 are seen in the emergency department and released ([Spyker 1985](#)). [Geddis 1984](#) estimated that there were 10 "near misses", that is children sustaining immersion who were rapidly rescued, for each child seen in the emergency department. However, among those sustaining immersion and losing consciousness, the mortality rate is as high as 50%. The outcome for most children with immersion is determined by their status on arrival to the emergency department; medical and intensive care unit (ICU) care once admitted appear to have relatively little impact on outcome.

Pool fencing is a passive environmental intervention, designed to reduce unintended access to swimming pools and thus prevent drowning in the preschool age group.

Over the last decade many communities, particularly in Australia, have passed laws requiring the fencing of private and public pools. In fact, much of the evidence that pool fencing reduces the risk of drowning among children comes from studies examining before-and-after rates of drowning for fenced and unfenced pools. Even after some of the pioneering studies had been done, the favorable attitude toward pool fencing did not necessarily translate into actual changes in pool fencing ([Choo 1995](#); [Fergusson 1983](#); [Nixon 1986](#); [Wintemute 1990b](#)).

More recently, studies have examined whether the *type* of fence surrounding a pool makes a difference. Comparison studies of perimeter fencing (property barrier) versus isolation fencing (around immediate pool area) show isolation fencing to be much more effective in reducing the risk of drowning ([Wintemute 1990a](#)). Adding to this finding are studies examining children's ability to climb certain types of fence ([Nixon 1979](#); [Rabinovich 1994](#)). In particular, chain-link fences, while allowing visibility of the pool area, are the most easily scaled by children as young as two years old. Ornamental iron bar fences were advocated as a better barrier, with reduced 'climb ability' while retaining the visibility factor. Fence height makes little difference if the child is able to climb; one study showed the median time for four year olds to climb a five foot fence was 17 seconds ([Nixon 1979](#)). For a fence that is not scaleable, the most important element of fencing is a secure, self-closing gate. Taking these and other finding into account, the US Consumer Product Safety Commission has compiled a list of minimum recommendations ([US CPSC 1991](#)) for residential pool fencing. Recent legislation passed in Seattle, Washington, USA

requires a fence height of at least five feet (1.5m), and an inter-bar spacing to be no more than four inches (10cm) ([Quan 1990](#)).

Because of the magnitude of the problem and the potential effectiveness of fencing we decided to evaluate the effect of pool fencing as a drowning prevention strategy for young children.

## OBJECTIVES

The specific aims were:

- comparison of drowning and near-drowning rates for fenced and unfenced pools;
- comparison of drowning rates for specific fencing types (isolation versus perimeter);
- calculation of attributable risk percent (AR%) to quantify the reduction in drowning attributed to pool fencing.

## METHODS

### Criteria for considering studies for this review

#### Types of studies

Studies eligible for review were controlled studies that evaluate the effectiveness of pool fencing using some type of comparison group, and provide relevant and interpretable data that objectively measure the risk of drowning or near drowning. The comparison could be to another group, whether it be part of a randomized controlled trial (RCT), a non-randomized controlled trial, a case-control study, a cohort study or an ecological study. Ecological studies either involve comparison across communities (ecological group study), or over time within a community as in a time series study or a before-after study (ecological time study). An ecological mixed study examines within-group changes and between-group changes. For example, such a study might compare drowning rates before and after passage of fencing legislation in State A, and also compare these data to mortality in State B, which has no such law during the entire period being examined.

#### Types of participants

Children 14 years of age or younger who are exposed to swimming pools.

#### Types of interventions

Fencing location terms used in this review were; perimeter (three-sided) and isolation (four-sided) pool fencing.

In order to standardize fencing location terminology in Australia, the following terms have been proposed by Barker and colleagues ([Barker 2003](#)):

*Perimeter fencing* - the boundary of the house allotment has a fence restricting access to the property by a toddler but there is no restriction of physical access for toddlers from the house to the pool;

*House containment* - the only fence restricting access to the pool is perimeter fencing but all doors and windows in the house restrict access to the pool by a toddler;

*Three-sided fencing* - a fence and building wall restricts access to the pool by a toddler but there is restricted access via a house-door from the house to the pool;

*Four-sided fencing* - a fence or building wall restricts access to the pool by a toddler and there is no direct door access from the house to the pool but may include a window;

*Isolation fencing* - as for four-sided fencing except all ancillary structures (not related to the function of the swimming pool) excluded from the pool area and a maximum distance between the pool fence and the edge of the pool is prescribed.

### Types of outcome measures

- drowning (submersion with fatal outcome)
- near-drowning (non-fatal submersion resulting in treatment in a hospital or emergency department)

### Search methods for identification of studies

#### Electronic searches

We searched the following electronic databases;

- Cochrane Injuries Group's specialised register
- CENTRAL
- MEDLINE
- EMBASE
- ERIC
- NTIS
- Sport
- BIOS
- PsycLIT
- CINAHL
- DIALOG
- Dissertation Abstracts

We searched these using drowning or near-drowning as subject headings and adding interventions identified in the research question as keywords, adapted as appropriate to the specifications of each database.

The searches were last updated in October 2006. For this update we searched Cochrane Injuries Group's specialised register, CENTRAL, MEDLINE, PubMed, EMBASE, Indian Medlars, National Research Register, Zetoc and the Internet. The search strategies used for this update are presented in [Appendix 1](#).

#### Searching other resources

We contacted organizations, agencies, and researchers knowledgeable in drowning prevention including colleagues from the International Society for Child & Adolescent Injury Prevention, World Injury Network, CDC-funded Injury Control & Research Centers, US Consumer Products Safety Commission, US National Spa & Pool Institute and US National Safety Council. We also searched reference lists of previous reviews and relevant articles and handsearched abstracts of the Third International Injury Conference, Melbourne Australia.

#### Data collection and analysis

We independently screened the results of the searches. We then obtained the full text of the potentially relevant studies. In order to be included in this review, we required studies to have complete outcome/case ascertainment, accurate exposure measurement, appropriate selection of a comparison/control

group and elimination or control of factors such as selection bias, observation bias, and confounding. For a cohort study, ascertainment of exposure and outcome had to be the same for all members of the cohort. Case-control studies were required to have equal ascertainment of the exposure for case and control groups. Additionally, controls had to have been selected from the same population from which the cases were derived. Methodologically acceptable ecological studies were required to include ascertainment of exposure, outcome, and measurement of potential confounders be the same for all members of the population. Studies that did not meet this methodological criteria were excluded from the review.

## RESULTS

### Description of studies

Three eligible studies were identified, all of which were case-control studies.

#### [Pitt 1991](#)

##### *Study design*

Case-control study, population based.

##### *Intervention*

Fencing around domestic pools.

##### *Population*

All children under 14 years of age who were treated for an immersion injury at Mater Children's Hospital in South Brisbane, Australia from 1984 to 1989 were potential cases (n = 139). Death certificate records and autopsy files of the Institute of Forensic Pathology were reviewed to identify children who died at the scene. The population based control group was identified by a random sample telephone survey to identify households with swimming pools. Both case and control groups were interviewed in person to determine pool fencing characteristics.

##### *Outcomes*

Risk of drowning and near-drowning in fenced compared to unfenced pools.

#### [Intergov. WA 1988](#)

##### *Study design*

Case-control study, population based.

##### *Intervention*

Pool fencing, comparing isolation (four-sided) and perimeter (three-sided) fencing.

##### *Population*

Cases were preschool children aged four years and under who drowned in fenced private swimming pools in the metropolitan area of Perth, Australia, between 1975 and February 1988. The comparison (control) group were fenced pools in households with children in the same age group. Controls were identified by a household survey in 1988.

##### *Outcome*

Estimated incidence rates for drowning for specific fencing types and attributable risk percent (AR%) for pool fencing.

#### [Fergusson 1984](#)

##### *Study design*

Case-control study

##### *Intervention*

Pool fencing versus no fencing. Type of fencing and type of gate not specified.

##### *Population*

Cases were 60 pool drownings between 1973 and 1981 where the fencing status was known. The proportion of fenced pools in the Christchurch, New Zealand area was obtained from two surveys conducted by the Christchurch Child Development Study in 1980 and 1982.

#### Outcome

The risk of drowning in unfenced pools and the attributable risk percent (AR%) for pool fencing.

Further details of the studies are presented in the characteristics of included studies table.

### Risk of bias in included studies

Major problems, encountered in all three of the studies, revolve around the selection of appropriate control/comparison groups, and measuring the exposure to pools of children in various age groups.

The Western Australia study ([Intergov. WA 1988](#)) obtained data for the control/comparison group from a survey conducted in 1988, the end of the data collection period for the cases; it is not known whether the distribution of the two fencing types (perimeter and isolation) for pools in households with young children changed over the 13 year period.

[Pitt 1991](#) did not specify whether the identified control households contained children, nor did he document their ages.

[Fergusson 1984](#) did not provide the age group distribution of the drowning cases or the control group. The control group for this study was appropriately obtained from a survey that identified the distribution of fenced and unfenced pools in the community; however, the proportion of children exposed to unfenced pools is unknown.

[Pitt 1991](#) did limit his case group to children with unintended access to pools; however, there was not similar exposure information for the control group.

One case-control study ([Present 1987](#)), was excluded on methodological grounds - see Table of excluded studies.

None of the studies adjusted for the possible confounding influence of parental and child behavior. It is possible that parents who are more safety conscious would fence their pools and supervise their children more carefully.

### Effects of interventions

The three case-control studies seem to indicate that pool fencing can reduce the risk of drowning.

[Fergusson 1984](#) compared the risk of drowning in a fenced pool with the risk in an unfenced pool; odds ratio (OR) was 0.29 (95% CI 0.16 to 0.55).

[Intergov. WA 1988](#) compared isolation (enclosed pool on four sides) with perimeter fencing (three-sided fencing). The results indicate that isolation fencing is superior to perimeter fencing, OR for the risk of drowning was 0.17 (95% CI 0.07 to 0.44).

[Pitt 1991](#) compared the risk of drowning and near-drowning in a fenced pool with the risk in an unfenced pool; OR was 0.27 (95% CI 0.15 to 0.47). For in-ground pools, the OR for the risk of drowning

and near-drowning in a fenced pool was 0.24 (95% CI 0.13 to 0.48). For above ground pools, the OR for the risk of drowning and near-drowning in a fenced pool was 0.23 (95% CI 0.06 to 0.92).

### DISCUSSION

Case-control studies are well suited to evaluate pool fencing as an intervention to prevent pool drowning in children. Drowning is a rare outcome which makes cohort or interrupted times series designs difficult. The only randomized controlled trial (RCT) design which is feasible would be an RCT evaluating isolation versus perimeter fencing; however, this would be logistically difficult to carry out.

Measuring exposure is difficult and requires collecting information on the number of pools in the population and the age distribution of the population exposed to pools. [Pearn 1979](#) has proposed an objective method called the Swimming Pool Drowning Index (SPDI), to evaluate the effect of fencing legislation changes and educational initiatives. This formula adjusts for population distribution and home pool installation changes over time. The SPDI is calculated as follows: (No. of pool fatalities/No. of children at risk) x (No. of private pools/No. of private dwellings) ([Intergov. WA 1988](#)). Due to the small number of drownings in a given year, the index is more stable if calculated over a multi-year period of time; cases should be grouped in five year segments to obtain stable rates for comparison. More complete data collection systems are needed to calculate a reliable SPDI. Since drownings are an infrequent occurrence the addition of near-drowning cases would make evaluation of interventions easier. However, in most areas reporting of near-drownings is incomplete. The direction of this ascertainment bias would depend on the distribution of the unreported near drowning cases between fenced and unfenced pools.

Two recent studies evaluating pool fencing ordinances in Los Angeles County and Queensland, Australia indicate that the mere passage of legislation is not sufficient to reduce drowning. In Los Angeles, 81% of all child drownings occurred in pools that were regulated by pool fencing ordinances; odds ratio = 1.27 (95% CI 0.72 to 2.25) comparing presence of fencing ordinance to absence of fencing ordinance. However, the local ordinances did not require four-sided fencing. Additionally, there was inadequate enforcement of the ordinance and poor maintenance of pool barriers ([Morganstern 2000](#)). In Queensland, deaths decreased from 12 per year (1982 to 1991) to two per year (1992 to 1994) but increased to 11 per year three years later (1995 to 1997). Eighty-seven percent (33/38) of pools where children drowned did not comply with fencing legislation ([Pitt 1998](#)). Opponents of pool fencing legislation argue that parents or caregivers should increase pool safety by increased vigilance and control when children are present. A small study from Queensland provides evidence that caregiver factors may be inadequate to prevent toddler drownings ([Fisher 1997](#)).

The recommendations of three studies evaluating fencing legislation in Western Australia ([Stevenson 2003](#)), New South Wales ([van Weerdenburg 2006](#)), and Queensland ([QUISU 2006](#)) include improving pool fencing legislation, requiring inspection and efficient enforcement protocols to increase compliance with legislation. Emphasis is placed on adequate four-sided fencing, secure gates, and public education.

## AUTHORS' CONCLUSIONS

### Implications for practice

Isolation fencing with dynamic self-latching gates is an effective environmental intervention that reduces unintended access to pools and reduces the risk of drowning for preschool children. Legislation accompanied by educational campaigns should be implemented for all public, semi-private and private swimming pools. Legislation should require fencing of both newly constructed and existing pools and include enforcement provisions, in order to be effective.

### Implications for research

Additional case-control studies are needed to provide a more precise estimate of the protective effect of fencing. The study design should use pools as the unit of analysis. Pools in which a young child drowns would be considered cases and other pools where no drowning occurred would be considered controls. Information would be collected on exposure to pools for children of various ages

in the case and control groups. This would allow for controlling for the degree to which each pool is exposed to a young child in the home on the owner's property.

Studies examining fencing enforcement might allude to better fencing legislation. Specifically, a study comparing types of fencing legislation and their policies (fines, periodic inspections etc) would be important in determining the most effective and practical means of enforcement for a given community. Updating and maintenance of existing databases of drownings, near-drownings, number of private and public pools, fencing types, and regulations is the most important element in ascertaining the effectiveness of, not only fencing type, but also any other intervention.

## ACKNOWLEDGEMENTS

Matthew Patterson, MPH.  
Ann Zavitkosky, MS.  
Chris Beahler, MLS.  
Linda Quan, MD.



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#### Pitt 1991 {published data only}

Pitt WR, Balanda KP. Childhood drowning and near-drowning in Brisbane: the contribution of domestic pools. *Medical Journal of Australia* 1991;**154**(10):661-5. [MEDLINE: 1991238602]

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#### Milliner 1980 {published data only}

Milliner N, Pearn J, Guard R. Will fenced pools save lives? A 10-year study from Mulgrave Shire, Queensland. *Medical Journal of Australia* 1980;**2**(9):510-1.

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Present P. Child drowning study: a report on the epidemiology of drownings in residential pools to children under age five. US Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis 1987.

#### Stevenson 2003 {published data only}

Stevenson MR, Rimajova M, Edgecome D, Vickery K. Childhood drowning: Barriers surrounding private swimming pools. *Pediatrics* 2003;**111**:115-9.

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Queensland Injury Surveillance Unit. Children, pools and drowning statistics. [www.poolfencing.qld.gov.au](http://www.poolfencing.qld.gov.au).

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Spyker DA. Submersion injury: epidemiology, prevention and management. *Pediatric Clinics of North America* 1985;**32**:113-25.

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**US Mortality Data**

National Center for Health Statistics (NCHS), see CDC\_WONDERAc3.

**van Weerdenburg 2006**

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**Wintemute 1990a**

Wintemute GJ. Childhood drowning and near-drowning in the United States. *American Journal of Disease in Childhood* 1990;**144**(6):663-9.

**Wintemute 1990b**

Wintemute GJ, Wright MA. Swimming pool owners' opinions of strategies for prevention of drowning. *Pediatrics* 1990;**85**(1):63-9.

**CHARACTERISTICS OF STUDIES**
**Characteristics of included studies** [ordered by study ID]

**Fergusson 1984**

Methods	Case control study using probabilities from previous studies.
Participants	Sixty pool drownings for which pool fencing type was known.
Interventions	Fencing was not specifically defined as three or four sides; type of gate not specified.
Outcomes	Risk of drowning in fenced and unfenced pool and attributable risk percent calculated using Bayes Theorem.
Notes	Quality of previous studies used to obtain estimates of pool fencing is unknown. Small numbers thus unstable risk estimates.

**Intergov. WA 1988**

Methods	Case-control study, population based. Children aged 0-4 years in Metropolitan Perth, Australia, 1975 to 1988.
Participants	Cases: Children under five years who drowned in fenced pools in metropolitan Perth, Australia 1975 to 1988. Controls: Children in the same age group as cases who lived in households with fenced pools. Identified by 1988 community survey.
Interventions	Perimeter fencing (3-sided) versus isolation fencing (4-sided).
Outcomes	Estimated incidence rates for drowning for specific fencing types; AR%.
Notes	Good ascertainment of drownings. Recommended use of SPDI to adjust for population distribution and home pool installation changes (i.e., exposure to pools) over time. Include near drownings if complete case ascertainment is possible

**Pitt 1991**

Methods	Case-control design, population based. Analyses restricted to immersions with unintentional access to pool.
Participants	All children 0-13 years old with immersion injury in Brisbane (n = 139) from 1984 to 1989. Cases: Children with immersion injury resulting from unintentional access to domestic pools. Controls: random sample of households with pools.
Interventions	Pool fencing stratified by type (isolation, three-sided, none) because all children gaining unintentional access to pool from three-sided fencing did so through the house door, both no fencing and three-sided fencing comprise the unfenced category).
Outcomes	Risk of drowning or near drowning in fenced pools compared to unfenced pools.
Notes	Contains data for three pool types; in ground, above ground and spas. Eighty-three percent of all immersions occurred in children less than three years of age.

**Characteristics of excluded studies [ordered by study ID]**

Study	Reason for exclusion
<a href="#">Blum 2000</a>	Case series study of coroner reported drowning deaths of children aged four years and younger in Victoria, Australia. Thirty of 33 children (91%) drowned in unfenced (>50%) or poorly fenced pools. Excluded because comparison group (controls) not used.
<a href="#">Milliner 1980</a>	Ecological study comparing drowning and near drowning rates in Mulgrave Shire which had pool fencing legislation and Cairns Shire which had no fencing legislation. Age specific drowning rate calculated for ages 14 years and under. Near drownings included rivers. Excluded because exposure information not available; that is, no information on exposure to pools for children in the same age group as the cases.
<a href="#">Morganstern 2000</a>	Retrospective cohort study design with nested case-control study. Study did adjust for exposure but was unable to verify presence or type of fencing installed or measure the level of ordinance enforcement. Excluded because study designed to evaluate effect of pool fencing ordinance and not pool fencing per se.
<a href="#">Nixon 1986</a>	Interrupted time series design comparing drowning and near-drowning rates before and after fencing legislation. Excluded due to lack of exposure information. There were no adjustment made for age, population distribution or number of pools over the time period evaluated (1967 to 1981).
<a href="#">Pearn 1979</a>	Ecological study comparing drowning fatality rate between Honolulu, Hawaii, USA which had regulations requiring pool fencing and Brisbane, Australia which had no regulation. The study did not control for exposure; that is, the number of swimming pools in each city.
<a href="#">Pitt 1998</a>	Interrupted time series design comparing drowning rates for one to four year old children before and after fencing legislation in Queensland, Australia. Eighty-seven percent of pools where drowning occurred did not comply with fencing legislation. Rates not adjusted for exposure (increase in number of pools). Excluded because aim of study was to evaluate effectiveness of legislation.
<a href="#">Present 1987</a>	Case-control study conducted in eight counties in three states (south Florida, Arizona, and California) in the US. Intervention was isolation fencing versus three-sided fencing compared to no fencing. Controls were self-selected and not drawn from the same population as the cases. Additionally, case ascertainment was incomplete.
<a href="#">Stevenson 2003</a>	Time series study designed to investigate causes of drowning and evaluate pool fencing legislation in Western Australia during 12 year observation period, 1988 to 2000. Children (under five years

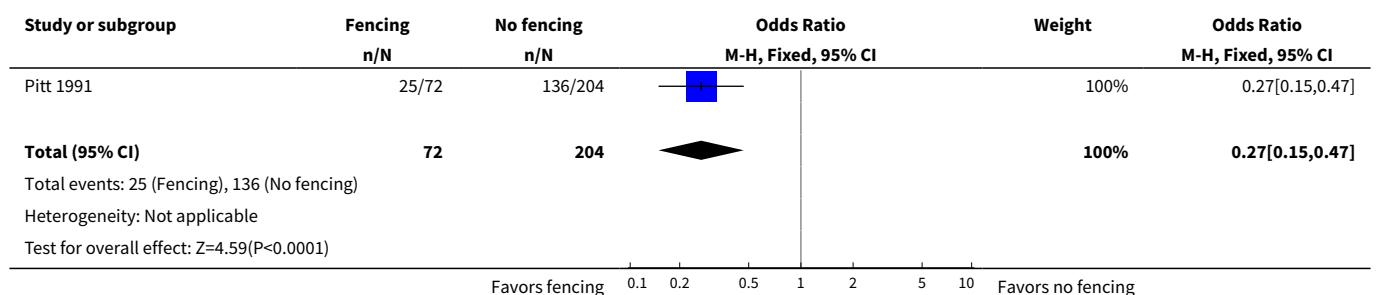
Study	Reason for exclusion
	of age) who lived in or visited households with three-sided fencing were almost twice as likely to drown compared with children exposed to four-sided fencing around swimming pools. IRR = 1.78; 95% CI 1.40 to 1.79. Seventy percent (35 of 50) cases occurred in pools with three-sided fencing. All the deaths occurring in pools with four-sided fencing were attributed to gate failure. Complete exposure information. Study excluded because IRR calculated for 1999 data. No numerator data provided and it was not clear which denominator was used, the average 12 year population of children under five or the population for 1999.

## DATA AND ANALYSES

### Comparison 1. Fencing versus no fencing - all pool types

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Drowning and near-drowning	1	276	Odds Ratio (M-H, Fixed, 95% CI)	0.27 [0.15, 0.47]

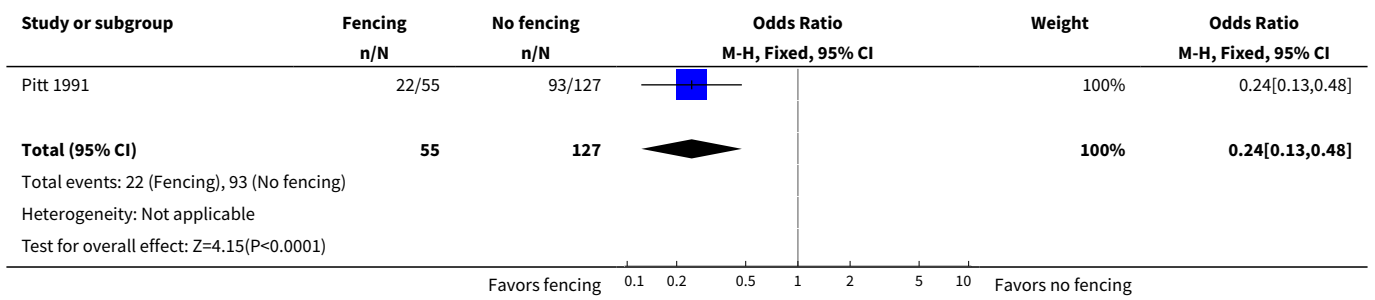
#### Analysis 1.1. Comparison 1 Fencing versus no fencing - all pool types, Outcome 1 Drowning and near-drowning.



### Comparison 2. Fencing versus no fencing - in-ground pools

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Drowning and near-drowning	1	182	Odds Ratio (M-H, Fixed, 95% CI)	0.24 [0.13, 0.48]

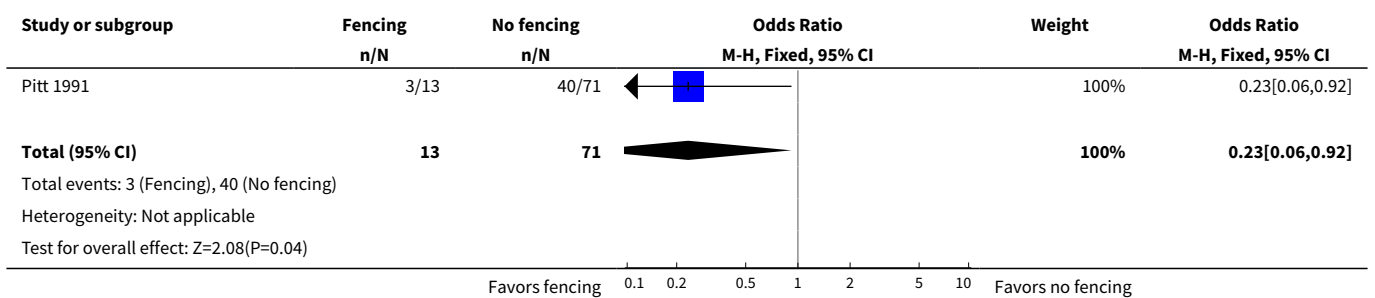
**Analysis 2.1. Comparison 2 Fencing versus no fencing - in-ground pools, Outcome 1 Drowning and near-drowning.**



**Comparison 3. Fencing versus no fencing - above ground pools**

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Drowning and near-drowning	1	84	Odds Ratio (M-H, Fixed, 95% CI)	0.23 [0.06, 0.92]

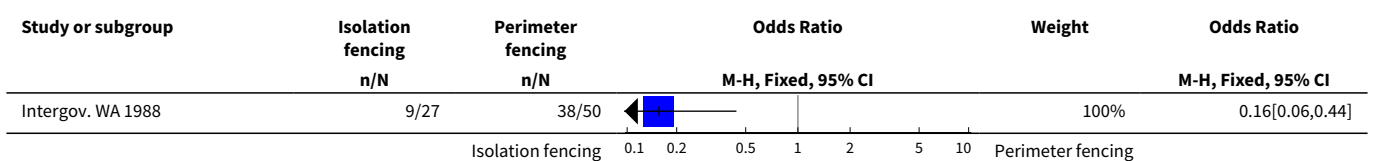
**Analysis 3.1. Comparison 3 Fencing versus no fencing - above ground pools, Outcome 1 Drowning and near-drowning.**

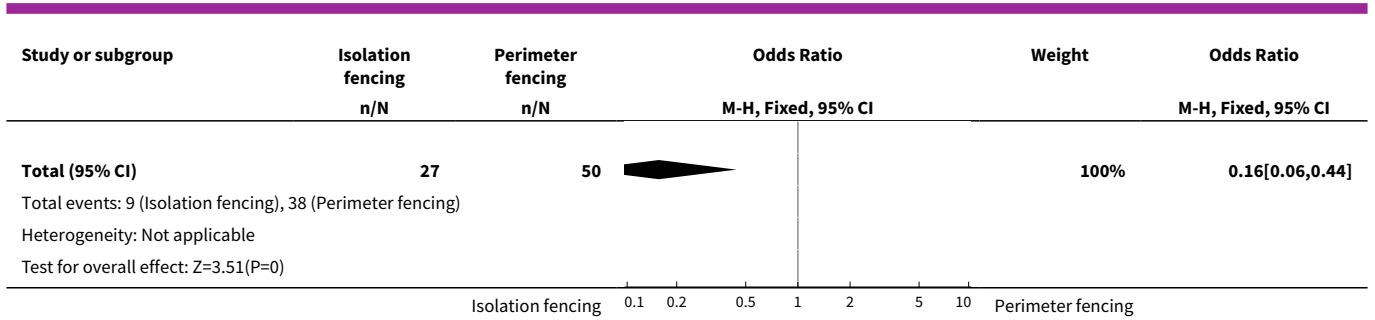


**Comparison 4. Isolation versus perimeter fencing**

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Drowning	1	77	Odds Ratio (M-H, Fixed, 95% CI)	0.16 [0.06, 0.44]

**Analysis 4.1. Comparison 4 Isolation versus perimeter fencing, Outcome 1 Drowning.**

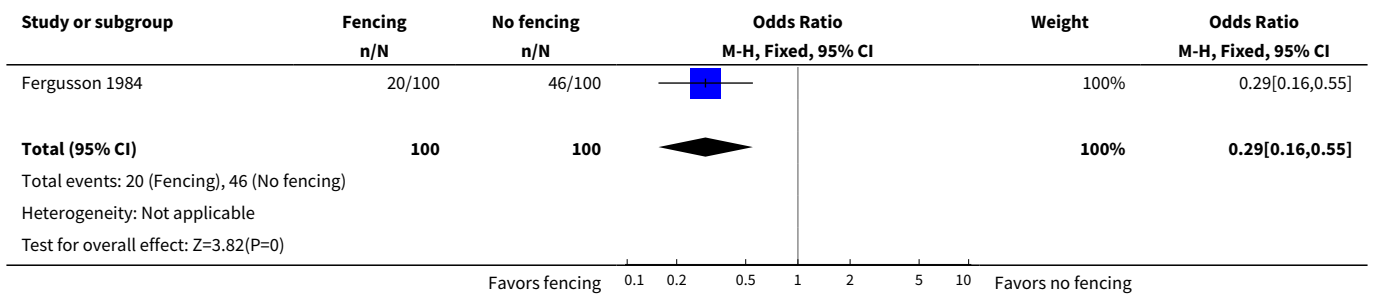




**Comparison 5. Fencing versus no fencing - all pool types**

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Drowning	1	200	Odds Ratio (M-H, Fixed, 95% CI)	0.29 [0.16, 0.55]

**Analysis 5.1. Comparison 5 Fencing versus no fencing - all pool types, Outcome 1 Drowning.**



**APPENDICES**

**Appendix 1. Search strategy**

**MEDLINE 1966-2006/10**

- 1.explode "Drowning-" / pc
- 2.drown\$.ti,ab.
- 3.1 or 2
- 4.(fencing or fence\$ or unfence\$ or barrier\$) adj3 (pool\$ or swim\$).ti,ab.
- 5.3 and 4
- 6.2005\$.em. or 2006\$.em.
- 7.5 and 6

**EMBASE 1983-2006/10**

- 1.explode "Drowning-" / pc
- 2.explode "Near drowning" / pc
- 3.drown\$.ti,ab.
- 4.1 or 2 or 3
- 5.(fencing or fence\$ or unfence\$ or barrier\$) adj3 (pool\$ or swim\$).ti,ab.
- 6.3 and 4
- 7.2005\$.em. or 2006\$.em.

**Pool fencing for preventing drowning of children (Review)**

8.5 and 6

**CENTRAL** 2006 issue 3

1.MeSH descriptor Drowning explode all trees with qualifier: PC

2.(drown\*):ti or (drown\*):ab

3.(1 OR 2)

4.(fencing or fence\* or unfence\* or barrier\*) and (pool\* or swim\*):ti or (fencing or fence\* or unfence\* or barrier\*) and (pool\* or swim\*):ab

5.(3 AND 4)

6.5 limited to 2005-06

**PUBMED** (strategy based on MEDLINE above; searched 12-10-06; no results)

**Indian Medlars** (strategy based on MEDLINE above; searched 12-10-06; no results)

**National Research Register**; strategy (strategy based on Central above; 2006 issue 3: no results)

**Zetoc** (strategy based on MEDLINE above; searched 12-10-06; no results)

## FEEDBACK

### Relevance of the review to developing countries

#### Summary

Potential relevance of this review to developing countries.

I wonder if the authors have considered the relevance of protecting exposed water to safety in developing countries. Myaux et al. in Bull WHO 1997; 75:533-539 examine the effect of flood control embankment of total mortality in children 1-5 years. This included direct protection (death rates from accidental drowning) and indirect (death rates from infectious diseases).

I certify that I have no affiliations with or involvement in any organisation or entity with a direct financial interest in the subject matter of my criticisms

#### Reply

A new review is currently underway, entitled 'Interventions for the prevention of drowning', which will include studies of measures to physically separate people from water and engineering modifications to aid exit from areas of water. The citation mentioned has been forwarded to the Reviewer who is preparing this review.

#### Contributors

Paul Garner

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## WHAT'S NEW

Date	Event	Description
29 April 2010	Review declared as stable	The review is no longer being updated. The authors' opinion is that future research will focus mainly on the effectiveness of pool fencing legislation.

## HISTORY

Protocol first published: Issue 1, 1998

Review first published: Issue 1, 1998

Date	Event	Description
30 June 2008	Amended	Converted to new review format.
16 November 2006	New search has been performed	November 2006

Date	Event	Description
		<p>An updated search for new trials was carried out in October 2006. No new trials for inclusion were identified.</p> <p>One study (Stevenson 2003) was added to the list of excluded studies.</p> <p>Three studies which evaluated fencing legislation have been added to the discussion section.</p>

## CONTRIBUTIONS OF AUTHORS

DCT reviewed the protocol, performed searches, reviewed titles and abstracts, reviewed manuscripts of potential trials, extracted data, performed the analyses, wrote drafts of the review.

FPR designed the protocol, reviewed titles and abstracts, reviewed manuscripts of potential trials, edited drafts of the review and provided statistical advice.

## DECLARATIONS OF INTEREST

None known.

## SOURCES OF SUPPORT

### Internal sources

- Harborview Injury Prevention & Research Center, University of Washington, USA.

### External sources

- Centers for Disease Control, USA.

## INDEX TERMS

### Medical Subject Headings (MeSH)

\*Accident Prevention; \*Swimming Pools; Drowning [\*prevention & control]; Swimming

### MeSH check words

Child, Preschool; Humans