

# Kids can't float: epidemiology of paediatric drowning and near-drowning in Singapore

Tyebally A, Ang S Y

## ABSTRACT

**Introduction:** The aim of this research was to study the epidemiology of paediatric near-drowning and drowning victims in Singapore so as to determine the risk factors that will guide drowning prevention strategies.

**Methods:** A total of 38 children aged 0–16 years, who were managed in the Emergency Departments of the Singapore Health Services network or the Department of Forensic Medicine, Health Sciences Authority, for drowning and near-drowning between February 2002 and January 2004, were surveyed as part of the Childhood Injury Surveillance Project. Data on demographics, the location of injury, environmental factors and injury particulars was collected by means of questionnaire forms, review of the in-patient records and the coroner's reports.

**Results:** A total of 38 drowning or near-drowning cases in Singapore were reported during the study period, with nine deaths. The median age of the victims was 6.3 years. 52.6 percent of the incidents occurred in swimming pools. 60 percent of the swimming pools had a lifeguard on duty, and all the deaths that occurred in swimming pools were in those without a lifeguard. In 39.5 percent of the cases, no safety features were present at the site of the incident. Most of the deaths by drowning occurred in the sea (55.5 percent).

**Conclusion:** Deaths by drowning are preventable, and appropriate environmental redesign, legislation and public education are necessary to reduce the rate of paediatric drowning. The important factors that are lacking include the absence of pool fencing and lifeguards at swimming pools and recreational beaches.

**Keywords:** epidemiology, paediatric drowning,

prevention, risk factors, water safety

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## INTRODUCTION

Drowning is an injury that can affect all age groups at all geographical locations. World Health Organization (WHO) statistics reveal that 388,000 deaths by drowning were reported around the world in 2004, and almost half of the victims were under the age of 20 years.<sup>(1)</sup> In Singapore, death by drowning is the second commonest cause of death due to unintentional injury in children after road traffic injuries.<sup>(2)</sup> However, death is just the tip of the iceberg. For every drowning death, there are many more children treated for non-fatal injuries, often with profound and disabling consequences that impose a great burden on their families, and this is aggravated by the high costs of healthcare.<sup>(1)</sup> As these injuries occur disproportionately among children, they have a significant impact on the years of potential life loss (YPLL).<sup>(3)</sup>

With increasing emphasis being placed on leisure and lifestyle, children are becoming more exposed to swimming pools and other recreational bodies of water. The trend toward condominium living and private home pools also means that children have closer and sometimes unsupervised access to swimming pools. It is thus important to study the local paediatric drowning and near-drowning epidemiology in order to guide the implementation of prevention strategies.

## METHODS

All children who attended the Emergency Departments in the Singapore Health Services network or the Department of Forensic Medicine, Health Sciences Authority, for near-drowning and drowning between February 2002 and January 2004, were surveyed as part of the Childhood Injury Surveillance Project. Cases of death by unintentional drowning that were brought directly to the mortuary were also included.

The following data was collected by means of questionnaire forms, review of the in-patient records and the coroner's reports: (1) demographics, including

Department of  
Emergency Medicine,  
KK Women's and  
Children's Hospital,  
100 Bukit Timah Road,  
Singapore 229899

Tyebally A, MBBS,  
MRCPCH, MMed  
Associate Consultant

Ang SY, MBBS, MRCP  
Senior Consultant

**Correspondence to:**  
Dr Arif Tyebally  
Tel: (65) 6394 1171  
Fax: (65) 6394 1163  
Email: arif.tyebally  
@kkh.com.sg

**Table I. Characteristics of children involved in drowning and near-drowning.**

Characteristic	No. (%)	
	Drowning and near-drowning (n= 38)	Drowning deaths (n = 9)
Age (yr)		
< 1	0	0
1–2	7 (18.4)	0
3–4	8 (21.1)	3 (33.3)
5–6	8 (21.1)	2 (22.2)
7–8	5 (13.2)	0
9–10	6 (15.8)	3 (33.3)
11–12	2 (5.3)	0
≥ 13	2 (5.3)	1 (11.1)
Gender		
Male	22 (57.9)	7 (77.8)
Female	16 (42.1)	2 (22.2)
Race		
Chinese	26 (68.4)	6 (66.7)
Malay	9 (23.7)	2 (22.2)
Indian	2 (5.3)	1 (11.1)
Others	1 (2.6)	0

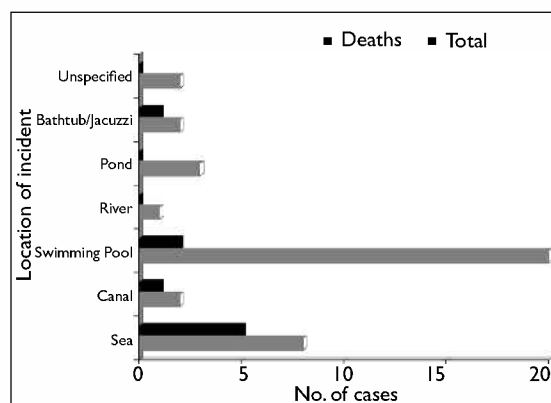
age, gender and race; (2) detailed circumstances of the injuries: the data sets in this category were coded using the WHO/Centers for Disease Control and Prevention (CDC) recommended International Classification of External Causes of Injuries Codes (ICECI); and (3) environmental factors, including the presence of fencing, lifeguards, flotation devices and life vests.

## RESULTS

A total of 38 children presented at our hospital during the study period with drowning or near-drowning, and nine deaths were reported. The median age of the children was 6.3 years, with a male predominance observed in the deaths (Table I).

Out of the 38 incidents, 20 occurred in swimming pools. Of these, 55% (n = 11) occurred in private home and condominium swimming pools. Incidents that occurred in the sea were the next commonest (Fig. 1). This predominance of swimming pool and seaside incidents was reported in all age groups (Fig. 2). In addition, bathtubs, jacuzzis and ponds posed a risk to toddlers and pre-schoolers (Fig. 2). Mortality in sea-related incidents was observed to be higher compared to that in pool-related incidents (Fig. 1).

Most incidents occurred between 1400 and 1900 hours, and on weekends (Table II). The caregivers at the time of the incidents were most frequently the parents (Table III). However, only 23.6% of the incidents were witnessed by the caregivers. In 47.4% of the cases, there were absolutely no safety features at the location of the incident, such as lifeguards, flotation devices,



**Fig. 1** Bar chart shows the cases of drowning and near-drowning based on the location.

life jackets, fencing, a swimming instructor or warning signboards. The two deaths in a swimming pool occurred in the absence of a lifeguard. At the swimming pool, a lifeguard was present in 60% of the cases (n = 12). All the children who had a near-drowning incident at a pool with a lifeguard present survived. Of the five children who drowned in the sea, two drowned despite the presence of a lifeguard (Table IV).

## DISCUSSION

There is a need for a multifaceted approach to drowning prevention that is age appropriate. The majority of drowning and near-drowning incidents occur among toddlers and children of school-going age. The swimming pool is the area that poses the highest risk to all age groups. For younger children aged four and below, ponds, buckets, bathtubs and jacuzzis pose an added danger. Children younger than the age of four tend to fall into swimming pools or other open bodies of water while unsupervised, whereas older children are more likely to drown while swimming.<sup>(4)</sup> Public education must focus on home and pool safety. Pails and buckets in the home should never be left filled with water when not in use, and ponds in the home should be inaccessible to small children. Drowning prevention should also focus on advocacy for safety considerations in the designs of private swimming pools. With the increasing trend toward condominium living and private pools, young children may fall into an unrecognised death trap right at the doorsteps of their homes.

Demographically, males were found to be at a higher risk of drowning, and the racial group with the highest risk of drowning or near-drowning incidents was the Malays. The predominance of males is consistent with the results of other studies, possibly due to the fact that males exhibit more risk-taking behaviour.<sup>(5)</sup> Additional research is required to understand the factors that

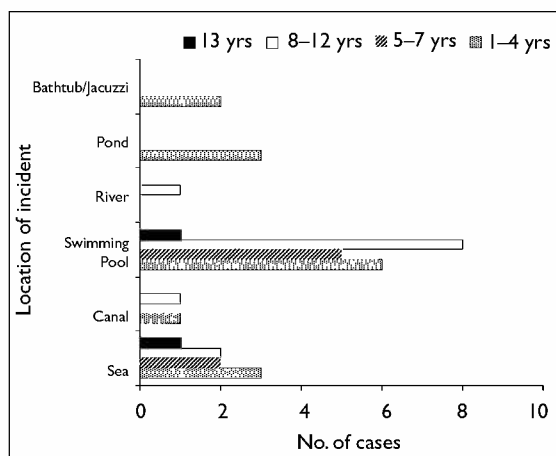


Fig. 2 Bar chart shows the location of drowning and near-drowning cases based on age.

contribute to disparities in the risk of drowning among the different ethnic groups in Singapore.

A disturbing fact is that many drowning and near-drowning incidents occur despite the child being placed under the supervision of an adult. Other publications on drowning have reported a strong association between the lack of close supervision and drowning.<sup>(6)</sup> We thus cannot overemphasise the importance of constant supervision by a caregiver. Lack of supervision is the main reason behind most drowning incidents. Only nine (23.6%) adults witnessed the drowning or near-drowning incidents despite being present. For infants and toddlers in the bath, the presence of an older sibling does not guarantee safety, and an adult must always be present.<sup>(7)</sup> Interestingly, grandparents do not feature in the data, although we did specifically look out for this. Grandparents could be the safest caregivers since they have more time and are less likely to be distracted while supervising their grandchildren.

From our data, it is observed that drowning is most likely to occur on weekends and between 1400 and 1900 hours, so caregivers must be extra vigilant at these times. The reason for these being the “at-risk” times is likely due to the fact that it reflects exposure time to swimming activities. Adult caregivers may also be distracted by other activities such as cooking and household chores.<sup>(8)</sup>

Another concern is that almost half of the time when the drowning incidents occurred, there were absolutely no safety features present at the location of the incident. Lifeguards and swimming instructors were the only safety features at swimming pools. At the seaside, there were additional safety features such as warning boards and a flotation device. At both locations, there was a total absence of life jackets and fencing. Installation of

Table II. Time and day of drowning and near-drowning.

Time (hr); day	No. (%)	
	Drowning and near-drowning (n = 38)	Drowning deaths (n = 9)
<b>Time</b>		
0901-1000	1 (2.6)	0 (0)
1001-1100	0 (0)	0 (0)
1101-1200	1 (2.6)	0 (0)
1201-1300	2 (5.3)	0 (0)
1301-1400	5 (13.2)	2 (22.2)
1401-1500	4 (10.5)	0 (0)
1501-1600	4 (10.5)	2 (22.2)
1601-1700	3 (7.9)	0 (0)
1701-1800	8 (21.1)	3 (33.3)
1801-1900	6 (15.8)	2 (22.2)
1901-2000	1 (2.6)	0 (0)
2001-2100	1 (2.6)	0 (0)
Missing data	2	0
<b>Day</b>		
Monday	5 (13.2)	2 (22.2)
Tuesday	3 (7.9)	1 (11.1)
Wednesday	5 (13.2)	0 (0)
Thursday	3 (7.9)	1 (11.1)
Friday	3 (7.9)	0 (0)
Saturday	11 (28.9)	1 (11.1)
Sunday	7 (18.4)	4 (44.4)
Missing data	1	0

a four-sided fencing around pools and self-closing gates that lead to pools has proven to be effective in reducing pool submersion injuries among young children by more than 50%.<sup>(9,10)</sup> A study by Thompson et al showed that the odds ratio for near-drowning or drowning in a fenced versus an unfenced pool is 0.27.<sup>(11)</sup> Pool alarms and rigid pool covers may provide additional protection, but cannot replace four-sided fencing as they are not likely to be used appropriately and consistently.<sup>(12)</sup> At the seaside, swimming areas should be clearly demarcated with safety features such as buoys and markers. Other safety devices and features that must be present in order to reduce the incidence of drowning include ring buoys, poles and prominent signs.<sup>(13,14)</sup>

The presence of a lifeguard appeared to influence the chances of survival in swimming pool incidents and to a lesser extent, in incidents occurring in the sea (Table IV). While our figures were not statistically significant because the numbers were small, further research should be conducted in this area. The presence of lifeguards should be a precondition before swimming is allowed during designated times in public and condominium swimming pools and at designated swimming areas at the seaside. It may be difficult for lifeguards to look out for drowning victims at the beach as the area available for swimming is too large for them to cover. We thus advocate that popular local beaches have designated

**Table III. Supervision during the incident.**

Caregiver	No. (%)	
	Drowning and near-drowning (n = 38)	Drowning deaths (n = 9)
Mother	17 (44.7)	6 (66.7)
Father	4 (10.5)	0
Mother and Father	1 (2.6)	0
Aunt/Uncle	4 (10.5)	0
Grandparent	0	0
Unsupervised child	5 (13.2)	2 (22.2)
Domestic helper	2 (5.2)	0
Others	4 (10.5)	1 (11.1)
Unspecified	1 (2.6)	0

swimming areas that are manned by lifeguards, and that parents should encourage their children to swim only in these designated areas. Several other studies have shown that near-drowning victims are more likely to have a favourable outcome if lifeguards are present.<sup>(15-17)</sup>

Another concern is the way in which private swimming pools are designed and where they are located. Aesthetic features such as waterfalls, landscaping, irregularly shaped pools and convoluted fun-slides may pose additional dangers when compared to the usual rectangular Olympic-sized public swimming pools, in terms of reduced visibility of the child and hence a reduced level of supervision. Private pools should also not be built close to recreational areas that may be used by children, such as playgrounds, as this increases the risk of unsupervised access to swimming pools and hence the risk of unintentional drowning.

In summary, drowning prevention must be made a priority and we should focus on the “Es” of prevention:<sup>(18)</sup>

- 1) Education: Public education should emphasise constant caregiver supervision when children are near water and the importance of keeping pots and buckets empty after use.
- 2) Engineering: Homes should not be designed with indoor ponds that give children access to bodies of water. All private pools should have four-sided fencing with self-latching gates. Landscape architects who design condominium pools should take water safety into consideration instead of focusing solely on the aesthetic and geomancy aspects. Redesigning for safety considerations is urgently required in private pools.
- 3) Enforcement: There should be legislation to establish basic safety requirements for swimming activities in swimming pools and at the beach. This relates especially to the presence of lifeguards and pool fencing.

**Table IV. Drowning in relation to the presence of a lifeguard.**

Presence of a lifeguard	Drowning and near-drowning (n = 28)	Drowning deaths (n = 7)
Lifeguard present		
Swimming pool	12	0
Sea	2	2
Lifeguard absent		
Swimming pool	8	2
Sea	6	3

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## REFERENCES

1. WHO World Report On Child Injury Prevention. 2008; 59-77. Available at: [whqlibdoc.who.int/publications/2008/9789241563574\\_eng.pdf](http://whqlibdoc.who.int/publications/2008/9789241563574_eng.pdf). Accessed June 2, 2009.
2. Immigration and Checkpoint Authority of Singapore. Report on registration of births and deaths. 2004.
3. National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System [database]. Available at: [www.cdc.gov/Ncipc/wisqars/](http://www.cdc.gov/Ncipc/wisqars/). Accessed June 2, 2009.
4. Quan L, Cummings P. Characteristics of drowning by different age groups. *Inj Prev* 2003; 9:163-8.
5. Cass DT, Ross FI, Lam LT. Childhood drowning in New South Wales 1990-1995: a population-based study. *Med J Aust* 1996; 165:610-2.
6. 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; 83:1035-40.
7. Staines C, Ozanne-Smith J, Davidson G. Child and early adolescent drowning deaths in developing communities: Victoria, a case study. Melbourne, Monash University Accident Research Centre, 2008. Available at: [www.monash.edu.au/muarc/reports/Other/drowning.pdf](http://www.monash.edu.au/muarc/reports/Other/drowning.pdf). Accessed June 2, 2009.
8. Stevenson MR, Rimajova M, Edgecombe D, Vickery K. Childhood drowning: barriers surrounding private swimming pools. *Pediatrics* 2003; 111:E115-9.
9. Pitt WR, Balanda KP. Childhood drowning and near-drowning in Brisbane: the contribution of domestic pools. *Med J Aust* 1991; 154:661-5.
10. Orłowski JP. It's time for pediatricians to 'rally round the pool fence'. *Paediatrics* 1989; 83:1065-6.

11. Thompson DC, Rivara FP. Pool fencing for preventing drowning in children. *Cochrane Database Syst Rev* 2000; CD001047.
12. Whitfield T. An evaluation of swimming pool alarms. Washington DC: Consumer Product Safety Commission 2000. Available at: [www.epsc.gov/library/alarm.pdf](http://www.epsc.gov/library/alarm.pdf). Accessed June 2, 2009.
13. Tan RM. The epidemiology and prevention of drowning in Singapore. *Singapore Med J* 2004; 45:324-9.
14. Keshlear B. Drowning prevention: an Army Corps of Engineers perspective. In: Fletemeyer JR, Freas SM, eds. *Drowning: New Perspectives on Intervention and Prevention*. Boca Raton: CRC Press, 1999; 165-75.
15. Langley J. Review of literature on available strategies for drowning prevention. In: Joost JLM Bierens, ed. *Handbook on Drowning: Prevention, Rescue, Treatment*. Berlin: Springer, 2005.
16. Manolios N, Mackie I. Drowning and near-drowning on Australian beaches patrolled by life-savers: a 10-year study, 1973-1983. *Med J Aust* 1988; 148:165-71.
17. Fenner PJ, Harrison SL, Williamson JA, Williamson BD. Success of surf lifesaving resuscitations in Queensland, 1973-1992. *Med J Aust* 1995; 163:580-3.
18. Mace SE, Gerardi MJ, Dietrich AM, et al. Injury prevention and control in children. *Ann Emerg Med* 2001; 38:405-14.

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