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RESEARCH

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## Injuries in Public Swimming Pools in Victoria: A Pilot Study

**Bernadette L. Matthews, Alistair Thom, and Richard C. Franklin**

Swimming is an integral part of the Australian lifestyle. Studies have examined drowning fatalities in public and residential swimming pools and the potential factors involved, but there is little evidence detailing the extent of injuries that occur in public pools. This article describes the types of injuries that occur at public pools, the locations in pools where injuries occur, the type of medical treatment required, and the rate of injury. Incident reports were collected from 18 public pools across metropolitan and regional Victoria, Australia. Over 6 months, 1,715 injuries were recorded, representing an injury rate of 142.2 per 100,000 pool visits. The highest proportion of injuries occurred in children age 5–14 years, accounting for 50% of all injuries. The injuries were typically minor cuts, bruises, and grazes. Individuals were usually involved in water recreation or swimming lessons when the injury occurred. The study demonstrated that the role of the lifeguard is much more than that of providing supervision and performing rescues.

**Keywords:** injury, lifeguarding, aquatic risk management, commercial aquatic facility

Swimming is an integral part of the Australian lifestyle, attracting 1.6 million adult participants in 2002, the third highest participation rate of physical activities in adults. It also has the highest participation rate in children age 5–11 years (Australian Bureau of Statistics, 2003). Studies have examined drowning fatalities in public and residential swimming pools and the potential factors involved (Brenner, 2003; Bugeja, 2004a, 2004b; IWSPSP, 1988; Pearn & Nixon, 1997; Present, 1987; Stevenson, 2003; SWSAHS, 2000). There have been few studies, however, that have detailed the extent of all injuries that occur in commercial aquatic facilities (public pools; The Royal Life Saving Society Australia, 2004; Victorian Aquatic Industry Council, 2003). To help ensure an enjoyable and safe visit to public pools, information about injury events is required. This information can then be used to help reduce the likelihood of injury occurring by improving standards at public pools.

In Australia the guidelines for safe pool operation provide a set of standards developed by and for industry to help improve safety at public pools (The Royal Life Saving Society Australia, 2005). The guidelines provide best-practice infor-

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mation on areas such as general operations, technical operations, facility design, first aid, supervision, and program delivery. As part of the continual review of the guidelines there is a need to ensure that they are based on the latest and highest quality evidence available to ensure best practice. Evidence from this study will be used to examine the role of lifeguards, their duties necessary for preventing injury, and information about hazardous areas in facilities, as well as providing further directions for research. The aim of this pilot study was to describe the injuries that occur in a sample of public pools in Victoria.

## Method

A convenience sample of 22 public pools in Victoria was selected for the pilot study to represent a cross-section of public pools in Victoria. Of these, 18 participated, providing their major- and minor-emergency incident-report forms and estimated visits for the period of July 1 to December 31, 2004, or for seasonal pools for the time they were open during that period. Of the four facilities that did not participate three gave initial verbal acceptance but failed to provide their forms, and the fourth was unable to locate records for the time period specified. This sample represents 5% of all public pools in Victoria (336; Source: Victorian Aquatic Industry Council database, October 2005). Table 1 lists the features of the various facilities included in the study.

The representation of public pools was based on the following criteria: metropolitan, regional, year-round, and seasonal operation. Metropolitan locations included major cities; all other locations were classified as regional (Australian Bureau of Statistics, 2001). Seasonal pools are open for a limited period across the spring, summer, and autumn months. Of the metropolitan pools selected ( $n = 12$ ), nine were year-round. The regional pools ( $n = 6$ ) included three year-round public pools. Of the four public pools that did not participate two were metropolitan, year-round; one was metropolitan, seasonal; and the other was regional, seasonal.

The variables examined from the report forms included age; gender; incident location; type, site, and mechanism of resultant injury; and treatment provided. The nature of injury sustained, body region injured, and the way the injury was sustained, or mechanism of injury, were classified using the National Data Standards for Injury Surveillance Version 2.1 (Australian Institute of Health and Welfare, 1998). The type of treatment provided was classified using the Australian sports-injury data dictionary (Australian Sports Injury Data Working Party, 1997). The location in the pool area where the incident occurred and the activity before injury were determined from the categories recorded on most forms. Only information pertaining to the aquatic area of facilities (e.g., the pool, walkways around the pool or pool concourse, and change rooms connected to the pool area) was included in the analysis. Major- and minor-incident report forms were used to collect incident information. A minor emergency is defined as a non-life-threatening first-aid situation, and a major emergency is defined as life threatening (The Royal Life Saving Society Australia, 2001).

Data were analyzed with SPSS version 14. Descriptive statistics were used to profile persons injured (when data were available). For comparison of proportions, chi-square analysis was used. A rate of injury per 100,000 aquatic visits was

**Table 1** Number, Percentage, and Rate of Injuries in Public Swimming Pools in Victoria (N = 18)

	Number of Injuries		% of injuries	Visits	Rate of injury (per 100,000 visits)	95% confidence interval	Number of pools in facility
	Metropolitan	Regional					
Seasonal <sup>a</sup>							
Facility A	9		0.5	38,267	23.5	8.2, 38.9	2
Facility B	2		0.1	6,919	28.9	-3.4, 61.2	3
Facility C		1	0.1	1,965	50.9	-48.9, 150.6	2
Facility D		2	0.1	2,137	93.6	-11.1, 198.2	2
Facility E	33		1.9	9,880	334.0	220.1, 448.0	3
Facility F		3	0.2	571	525.4	-69.1, 1119.9	2
Total seasonal	44	6	2.9	59,739	83.7	60.5, 106.9	2 <sup>b</sup>
Year-round							
Facility G	32		1.9	174,584	18.3	12.0, 24.7	5
Facility H	53		3.1	120,000	44.2	32.3, 56.1	5
Facility I		27	1.6	54,513	49.5	30.8, 68.2	3
Facility J	42		2.4	59,195	71.0	49.5, 92.4	3
Facility K	69		4.0	95,383	72.3	55.3, 89.4	5
Facility L		44	2.6	56,854	77.4	54.5, 100.3	3
Facility M	50		2.9	39,923	125.2	90.5, 160.0	3
Facility N	76		4.4	60,000	126.7	98.2, 155.1	1
Facility O	175		10.2	123,193	142.1	121.0, 163.1	8
Facility P		136	7.9	49,829	272.9	129.2, 416.7	5
Facility Q	577		33.6	207,429	278.2	255.5, 300.9	5
Facility R	384		22.4	105,272	364.8	328.3, 401.2	6
Total year-round	1,458	207	97.1	1,146,175	145.3	138.3, 152.2	4 <sup>b</sup>
<b>Total</b>	<b>1,502</b>	<b>213</b>	<b>100</b>	<b>1,205,914</b>	<b>142.2</b>	<b>135.5, 148.9</b>	

<sup>a</sup>Data for 3 months only (October 1 to December 31, 2004). <sup>b</sup>Average.

determined by dividing the number of injuries by the number of aquatic visits. Data were collected, managed, and stored in accordance with the Information Privacy Principles of the Privacy Act, 1988. Ethics approval was obtained from The Royal Life Saving Society Australia Ethics Committee (Reference no. RLS03R01).

At the request of some councils, incident data from their facilities were de-identified, removing each individual's name, date of birth, and address, before being submitted. This resulted in missing age and gender data for some public pools.

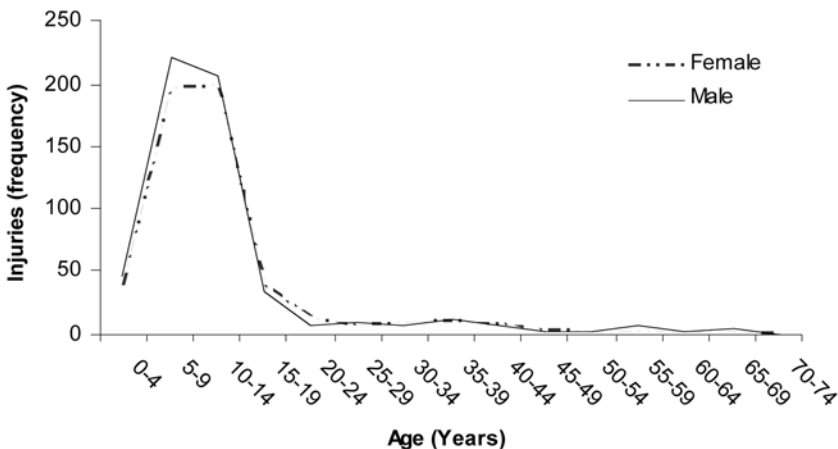
## Results

During the period the study covered, 1,715 injuries were recorded. This represents an injury rate of 142.2 per 100,000 pool visits. The rate of injury per pool visitation was similar between the metropolitan facilities (144.4) and rural or regional facilities in Victoria (128.4). Facilities operating year-round had a significantly greater injury rate than seasonal facilities (145.3 vs. 83.7, respectively;  $p < .05$ ; Table 1).

Of cases in which gender was known (70%), 51% of those injured were male. The highest proportion of injuries occurred to children age 5–14 years (50%), followed by toddlers age 0–4 years (5%) and adolescents age 15–19 years (4%; Figure 1).

The most common time of day that injuries occurred was in the afternoon between 1 and 3 p.m. (23%). There was no difference in the frequency of cases that occurred on weekend days and weekdays. Incidents were spread evenly across all days of the week (13–17%).

People were more likely to suffer an injury in an extremity, particularly the foot (29%), face (23%), or hand (10%). The severity of injuries was generally low, typically minor cuts (45%), bruises (12%), and grazes (10%). Cuts to the foot (23%) were the most common single injury. At the time the incident occurred individuals



**Figure 1** — Age and gender distribution of injuries in public swimming pools in Victoria ( $N = 18$ ).

were involved in general water recreation (45%), that is, playing in or around the pool, or were participating in swimming lessons (26%). Typical mechanisms of injury were cutting, tearing, or abrasion (50%); collisions (17%); and falls (11%). The locations in the facility where incidents occurred were the indoor pool (49%), learners' pool (13%), and concourse (12%), followed by the wave pool (7%), water slide (4%), toddlers' pool (3%), and change rooms (3%).

The most common first-aid treatment was wound management (45%), that is, cleaning and dressing the wound, for cuts and grazes, followed by ICE (ice, compression, and elevation; 25%; Table 2). Of the 149 cases for which treatment time was noted (this only occurred at one facility), the median treatment time was 10 min (range: 5–110 min). After initial treatment no referral for further medical attention was required in most cases (59%).

The types of action taken by lifeguards as a result of a person being injured included reporting the incident to the manager on duty (36%), providing patron education (8%) aimed at preventing recurrence of similar injuries, and no action (6%). Many facilities do not report on the action taken as a result of injury, so in 50% of cases any further action taken was unknown.

## Discussion

This study provides an indication of the injuries that typically occur in public pools in Victoria. The overall injury rate for this study was 142.2 per 100,000 pool visits. This rate is similar to that found in a previous study in Victoria (120 incidents per 100,000 visits) but greater than those reported elsewhere (The Royal Life Saving Society Australia, 2004; Victorian Aquatic Industry Council, 2003). Comparisons with other studies are difficult because collection dates, collection frequency, pool

**Table 2 First-Aid Treatment After Injury**

Treatment	Frequency	%
Wound management	768	44.8
Ice, compression, and elevation	434	25.3
Combined treatment (e.g., ice, compression, and elevation and wound management)	245	14.3
None given, referred elsewhere	68	4.0
Clean	50	2.9
Rescue	34	2.0
Rest, ice, compression, elevation, and referral	24	1.4
Rest	31	1.8
Oxygen	26	1.5
Medication	10	0.6
Other	16	0.9
Unknown	9	0.5
<b>Total</b>	<b>1,715</b>	<b>100.0</b>

types, and facility definition differed. For example, a Western Australian study reported an average of only 34 incidents per 100,000 patrons (The Royal Life Saving Society Australia, 2004), but the types of incidents and facilities included were not fully defined.

There was no significant difference in the rate of injury between metropolitan and regional pools in the current study, but year-round pools had a significantly greater injury rate than seasonal facilities. This might be because of the collection period, staffing ratios, training, number of pools, number of hazards, time of year, or seasonal conditions. Control of these factors is required in future research.

Males are typically overrepresented in injury statistics and have a four times greater risk of drowning than females (Life Saving Victoria, 2006). In the current study, however, there was no gender difference. This might be because of higher swimming participation rates in females in Victoria (Standing Committee on Recreation and Sport, 2005; Victorian Aquatic Industry Council, 2003). There is little information, however, on participation by location (beach, public pool, home pool, etc.), age, and gender to estimate the risk.

Differences between age groups in the number of people injured might also reflect participation rates. Swimming has the highest participation rate of any organized sport for children 5–11 years old in Victoria (Australian Bureau of Statistics, 2003), and in this study the 5- to 14-year age group had the highest number of injuries. The greater number of injuries in this age group might also be a result of typical behavior patterns of this group. This needs to be explored further in subsequent research.

Injuries that occurred during supervised swimming lessons (26%), although predominantly minor, are concerning. This should be one of the most controlled environments in a public pool. These injuries might be a result of having groups of children within a confined space. It is also possible that some of the injuries reported by teachers in lessons go unreported in the recreational setting. Further studies are required to determine the reasons for such figures and possible preventive strategies.

Although almost half the injuries occurred in indoor pools, in many instances information was insufficient to determine the specific part of the pool involved (e.g., tile or steps). Modification to incident-report forms could prove useful in directing pool maintenance to prevent further injury.

Most incidents to which the lifeguards attended were minor first-aid treatments. This emphasizes the importance of ensuring that lifeguards are up to date with their first-aid qualifications and receive continual updates to ensure that they are able to manage the types of injuries they are likely to see on a regular basis. Furthermore, the amount of time spent by lifeguards on treatment (e.g., median treatment time of 10 min over 149 incidents) affects the determination of how many lifeguards to have on duty. The amount of time spent on incidents needs to be taken into account because of the potential for lifeguards to be drawn away from or distracted from other responsibilities such as continuing to maintain vigilance over swimming areas.

The strength of this study is that it is the first to provide detailed information about injuries and other incidents. Limitations to the study included missing or unreported data, inconsistent report-form categories (nonstandardized incident-report forms are currently used across the industry), missing age and gender data

for four facilities (as a result of staff misunderstanding of deidentification process), lack of detailed exposure data (e.g., pool visits by age, gender, and duration), and the limited data-collection period. It is unclear whether there was any effect from the use of a convenience sample. In the future a random sample of pools would be more valuable. The small number of cases might limit the wider application of this information.

Implications from this study include that public pools are reasonably safe places to visit and undertake aquatic activities, and lifeguards need to be up to date in their first-aid training and management. Further work in public pool safety is required to understand injury resulting from children's play at public pools, the effectiveness of injury-prevention measures in public pools, and the types of surfaces used in public pools to prevent slips, trips, and falls, along with exposure information by age, gender, and duration of visit.

In conclusion, this study showed that the typical injuries that occur in public swimming pools are of a minor nature, often involving children 5–14 years old, during recreational activities or swimming lessons. Larger long-term studies are required and should include standardized data collection, pool usage, and exposure patterns. This study has demonstrated that the role of the lifeguard is much more than providing supervision and performing rescues.

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