

# Childhood near-drowning — a 12-year retrospective review

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## Summary

The epidemiological findings in 107 patients admitted to Red Cross War Memorial Children's Hospital, Cape Town, between 1976 and 1987 with a diagnosis of near-drowning are reported. Of these patients, 77% were less than 5 years of age (ratio of boys to girls 2,1:1) and 46% of accidents occurred in swimming pools, 18% in buckets and only 9% in the sea. The high percentage of bucket near-drownings is unique in published medical reports; this appears prevalent in socially disadvantaged communities. Seventy-six per cent of the children were normal on discharge from hospital, 12% died and 6% had neurological damage. In 6% the final outcome was not known. These results are in keeping with other hospital-based studies. Preventive strategies are discussed and the need for further research highlighted.

*S Afr Med J* 1990; 78: 418-421.

It is now well accepted that injury and death from submersion are potentially preventable. After road accidents drowning is the second most common cause of traumatic death in South African children aged under 15 years, and accounts for 19% of these deaths — an average of 546 childhood deaths annually.<sup>1</sup> Near-drowning can have serious long-term sequelae such as permanent anoxic brain damage, often necessitating prolonged hospitalisation,<sup>2</sup> with high financial costs and serious emotional trauma.

To plan preventive strategies data on the local situation are required, since this may differ significantly from other coun-

tries. This study was designed to review the experience of a major hospital in a city with a high incidence of childhood drowning.<sup>3</sup> We aimed to shed some light on the South African situation and to highlight aspects that require further research. This paper covers the epidemiological aspects.

## Subjects and methods

All 107 children (aged 0 - 14 years) admitted to Red Cross War Memorial Children's Hospital from January 1976 to December 1987 with a diagnosis of near-drowning were included. Although Red Cross Hospital is the main paediatric referral hospital in the western Cape region, it is not the only hospital in the Cape to admit children after near-drowning accidents.

**Near-drowning** was defined as an immersion incident with survival and admission to hospital. Patients in whom no discernible heartbeat was detected at any stage after rescue were not included. This definition does include 13 children who died in hospital as a direct consequence of cerebral anoxia or respiratory complications.

**Neurological damage** was defined as a documented neurological abnormality present on discharge from hospital but not present before the immersion incident.

A **fully conscious child** was one who was alert and responding appropriately. All other children were regarded as having a decreased level of consciousness.

**Population group:** whites and blacks were classified as in the population register. 'Coloureds' included children of Asian descent.

The records of all patients were reviewed by two of the authors (S. M. K. and F. O. N.) and data concerning age, sex, population group, pre-hospital history, clinical course and outcome were entered on a standard form. Because the study was retrospective, the pre-hospital history was often poorly recorded. Small numbers and incomplete data made multivariate analysis inappropriate and confounding or interaction of variables could therefore not be assessed. In addition they vitiated comparison by site except in the larger groups, namely

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bucket and swimming pool submersions. Several factors previously documented to affect outcome<sup>4</sup> were analysed. Student's *t*-test or Fisher's exact test was used to test for significance at the 95% level. The odds ratio and 95% confidence limits were calculated where appropriate. Missing data were assigned to one or other possible outcome groups and the test for significance repeated three times to account for the effect of misclassification. Only those variables not influenced by missing data are reported.

**Results**

During the 12-year period reviewed, 107 patients were admitted to Red Cross Hospital with a diagnosis of near-drowning. Seven patient records could not be traced and for these patients only age, population group, sex and admission date were known. Sixty per cent of patients were admitted to an intensive care ward and 40% to a general ward. The mean age was 3,46 years, ranging from 0,4 to 13,8 years. The age distribution is shown in Fig. 1; 76,6% of the children were aged under 5 years.

The ratio of boys to girls was 2,1 : 1. Forty-seven (43,9%) of the patients were white, 41 (38,3%) were coloured and 19

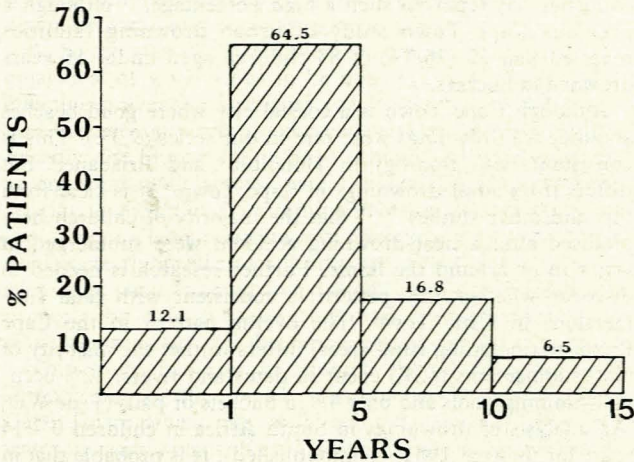


Fig. 1. Age distribution of 107 victims of near-drowning seen at the Red Cross Hospital, 1976 - 1987.

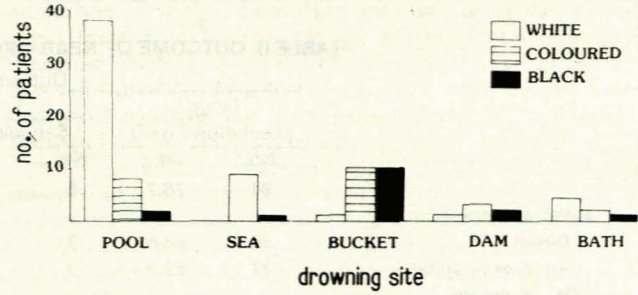


Fig. 2. Population group distribution of victims of near-drowning, 1976 - 1987, according to submersion site.

(17,8%) were black. The population group and age distribution varied dramatically according to drowning site (Fig. 2 and Table I).

Forty patients (37,4%) were referred from other hospitals and 36 (33,6%) came directly from the drowning site; 16 (15,0%) were referred by a general practitioner and 5 (4,7%) came by ambulance. Referral source was not known for 10 patients (9,4%).

The site of submersion is shown in Fig. 3. Six pools were public swimming pools and 43 were privately owned. Two submersions, grouped with dams, occurred in lagoons. One near-drowning took place in a spa bath, and sea submersions included 3 accidents in tidal pools. Eighty-three near-drownings (77,6%) occurred in fresh water and 13 (12,1%) in seawater. One child fell into a bucket of paraffin and 1 into a bucket containing sodium hypochlorite solution. In 9 cases (8,4%) the type of fluid was unknown. The time of submersion was unknown or unrecorded in the majority of patients (72%) and water temperature was unrecorded in all cases.

Although near-drowning accidents occurred throughout the year, the majority (71%) were in the summer months (October - March); 60,7% occurred on weekdays and 39,3% during the weekend. More accidents occurred on Sundays than on any other day of the week.

Near-drownings occurred throughout the greater Cape Town area, but 6 occurred outside greater Cape Town.

Overall, 81 patients were discharged well, 13 (12,1%) died and 6 (5,6%) had neurological damage. The final outcome for 7 patients (6,5%) was not known.

TABLE I. COMPARISON OF BUCKET AND POOL DROWNINGS

	Bucket	Pool	Test	Significance
Age (yrs) (mean ± SD)	1,07 ± 0,33	3,24 ± 2,34	Student's <i>t</i> -test <i>t</i> = 6,3339	<i>P</i> < 0,001
Sex				
Males	8	34	Fisher's exact test	NS
Females	11	15		
Population group				
White	1	39	Fisher's exact test*	<i>P</i> < 0,001
Coloured	9	8		
Black	9	2		
LOC at hospital				
Alert	6	25	Fisher's exact test	NS
Decreased	13	24		
Outcome				
Normal	15	40	Fisher's exact test	NS
Died or sequelae	4	9		

\*For statistical purposes, coloureds were grouped together with blacks. NS = Not significant; LOC = level of consciousness.

TABLE II. OUTCOME OF NEAR-DROWNING AT RED CROSS HOSPITAL

	Outcome						Significance	Odds ratio* (95% confidence limits in in brackets)
	Good (discharged well)		Sequelae		Poor Died			
	No.	%	No.	%	No.	%		
<b>Referral source</b>	<b>81</b>	<b>75,7</b>	<b>6</b>	<b>5,6</b>	<b>13</b>	<b>12,1</b>		
<b>Direct</b>	54	88,5	3	4,9	4	6,6	<i>P</i> = 0,02	3,42 (1,09 - 11,05)
<b>Another hospital</b>	27	69,2	3	7,7	9	23,1		
<b>LOC on arrival</b>								
<b>Fully conscious</b>	43	100	0	0	0	0	<i>P</i> < 0,001	Not calculable
<b>Decreased LOC</b>	38	66,7	6	10,5	13	22,8		

\*For statistical analysis patients with a 'good' outcome were compared with those with a 'poor' outcome (death or sequelae). All tests performed were Fisher's exact tests.  
LOC = level of consciousness.

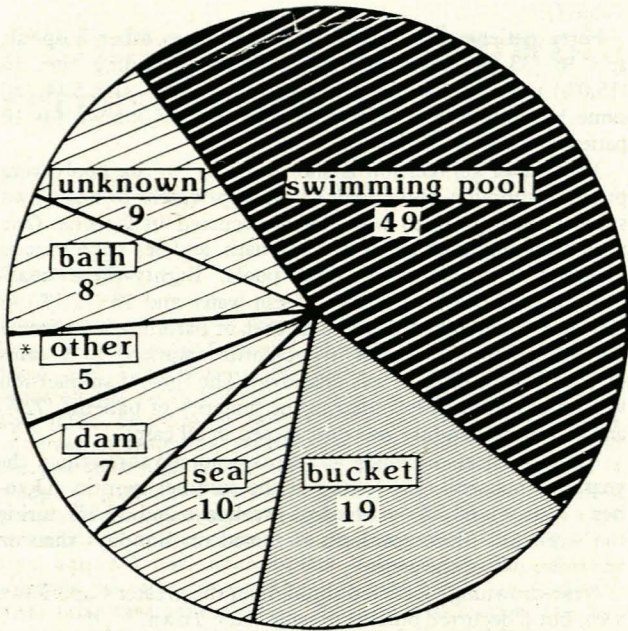


Fig. 3. Sites of 107 near-drownings, 1976 - 1987.

The referral source and level of consciousness on arrival at Red Cross Hospital were shown to have a significant effect on outcome (Table II). Although the level of consciousness and the respiratory effort on extraction from water were not recorded accurately in all cases, 20 patients who were either fully conscious or breathing normally on extraction from water recovered completely. There was no significant difference in outcome between bucket and swimming pool submersions (Table I). Other factors affecting outcome are discussed in a separate article.<sup>5</sup>

**Discussion**

This was a hospital-based retrospective study and therefore had certain limitations. Firstly, not all data were completely recorded. This principally affected data surrounding the drowning itself, e.g. supervision, submersion time and water temperature, and the prehospital clinical history. In addition, 7 patient records could not be traced and for these children only age, sex and population group were known. Red Cross Hospital is a referral unit and a certain amount of selection bias cannot be avoided. A larger percentage of patients referred

to such a hospital than of patients brought to a peripheral hospital would be expected to have a reduced level of consciousness on admission and a poorer outcome.

The majority of near-drowning accidents (45,8%) occurred in swimming pools, but it is most significant that 17,8% occurred in buckets. No other published series from other countries has reported such a high percentage,<sup>6-9</sup> although a previous Cape Town study of urban drowning fatalities revealed that 22 (26,5%) of 83 children aged under 15 years drowned in buckets.<sup>3</sup>

Although Cape Town is a coastal city where good beaches abound, sea drownings were rare in our series (9,3%). This is consistent with findings in Honolulu<sup>6</sup> and Brisbane,<sup>7</sup> but differs from adult drownings in Cape Town.<sup>3</sup> It is clear from this and other studies<sup>2,6,7,10</sup> that the majority of children hospitalised after a near-drowning accident were submerged in water in or around the home. Further research is needed to discover whether this pattern is consistent with fatal submersions in Cape Town. The overall pattern in the Cape Province (including rural areas) differs in that the majority of fatal submersions (62%) occur in dams and rivers; 12% occur in swimming pools and only 4% in buckets or pails (J. de Wet, 'An analysis of drownings in South Africa in children 0 - 14 years for the year 1985' — unpublished). It is probable that in the home the child is likely to be found sooner and to receive help quicker, resulting in better survival than for the child submerged in a dam or river.

The results also show a clear difference in the population group distribution for different drowning sites. The majority of bucket near-drownings affected coloured and black children, whereas most of the children who fell into swimming pools were white — this reflects access to pools, which is a socio-economic phenomenon. In Australia children from both very rich and poor families are at greatest risk of drowning. Almost all bathtub drownings occur in poorer families, whereas most children who drown in swimming pools are from richer families.<sup>2,7</sup>

Children under 5 years are at a highest risk of a near-drowning accident. This is consistent with other studies,<sup>6</sup> although the age pattern varies according to site.<sup>6</sup> On average children who fall into buckets are younger than those who fall into pools. The predominance of boys is consistent with injury patterns throughout childhood, although under 5 years of age the difference between the sexes is not great. This is reflected in our findings that boys and girls have an equal chance of drowning in pools and buckets (Table I). The population group distribution in this study is very different from that for the Red Cross Hospital patient population as a whole, where 8,1% of patients are white, 65,5% coloured and 26,4% black (1976 - 1987). This may in part be due to a higher incidence of

drownings in private swimming pools, but may also be due to differences in access to health care between population groups.

Overall, 75,7% of the patients recovered well and 17,7% had a poor outcome (death or sequelae), which is in keeping with other hospital-based studies.<sup>9,11</sup> Total population studies from Hawaii<sup>12</sup> and Brisbane<sup>13</sup> show a morbidity and mortality rate of under 5%. Although not recorded sufficiently accurately for statistical analysis, the level of consciousness on extraction from the water appears to affect outcome.<sup>12</sup> Table II shows clearly that both referral source and level of consciousness on arrival at hospital influence outcome. A child referred from another hospital to Red Cross Hospital has a 3,4 times greater chance (odds ratio = 3,42) of a poor outcome than one who is brought directly to Red Cross, indicating that more severe cases are referred from other hospitals.

As the outcome for buckets and pools did not differ (Table I), it appears that site does not influence outcome. However, total population studies that include fatalities have shown that streams and rivers are associated with a poorer outcome.<sup>6,14</sup>

Six of the survivors (6,8%) had documented neurological damage when discharged from hospital, as opposed to other studies, which report a range from 0% to 31%.<sup>15</sup> While patients in this study were not subjected to a full neuropsychological assessment on discharge, other authors have found that children who do not have gross neurological disturbance appear to recover completely, although subtle visual-motor<sup>13</sup> or co-ordination deficits<sup>11</sup> may become apparent later.

Although this study has shed some light on the subject, a great deal of work needs to be done in South Africa before effective preventive strategies can be planned. Until such a time we can only rely on the experience of other countries. Broadly, the causes of childhood submersions can be grouped as environmental factors, parent-related factors and factors relating to the child.<sup>10</sup> Swimming pool fencing and safety nets can prevent a large percentage of drownings provided they are used correctly at all times.<sup>16</sup> In Cape Town the law requires swimming pools to be separated from the road or a neighbour's property by a fence. However, most municipalities do not make it compulsory that this fence encloses the pool completely.

This study has also highlighted the problem of bucket submersions in the socially disadvantaged communities of Cape Town, which may well reflect the absence of running water in many homes. Keeping buckets out of reach of young children and encouraging the use of buckets with secure lids are two simple measures that might prevent these unnecessary deaths. However, overcrowding, lack of playing space and inadequate supervision are likely to be aggravating factors that should be considered when planning educational programmes.

The importance of active supervision of children near water cannot be overstated. Parents and teachers need to be made aware of the dangers, and ideally all parents should be able to

administer first aid. Immediate effective resuscitation and rapid transfer to hospital are the mainstay of treatment.<sup>17</sup> Teaching children to swim and older children to administer first aid<sup>18</sup> may also help to prevent these tragic events, while additional measures are lifesavers at all beaches and public pools and the use of buoyancy aids.

Public awareness campaigns aimed at specific high-risk groups and appropriate safety legislation can prevent injuries. Before this can come about, total population studies that consider fatalities as well as survivors are needed to determine the true incidence and effects of serious near-drowning accidents. This study has also highlighted the importance of addressing the socio-economic and cultural factors associated with these tragedies. Only in this way can effective preventive strategies be planned.

We thank the South African Medical Research Council for funding, Miss P. Ball for typing and Ms J. Altschuler for the artwork.

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