

The epidemiology and prevention of drowning in Singapore

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ABSTRACT

Introduction: The aim of this study was to derive a profile of drowning victims in Singapore in the 10-year period 1992-2001 and determine if there are any patterns, trends or factors which may affect the risk profile of victims. Another objective was to recommend measures for reducing deaths from drowning through a review of some of the current literature and studies on drowning prevention.

Methods: Data for epidemiological analysis were studied and analysed. Data was primarily obtained from the annual drowning statistics reported in the annual reports of the Singapore Life Saving Society, which were in turn obtained from the Registry of Births and Deaths, and the Coroner's Court. The review of current literature and studies on drowning was concentrated on the publications of leading drowning experts and agencies and on the papers presented at two important international conferences, the International Drowning Symposium in May 1996 and the first World Congress on Drowning in June 2002. The review was done with a view to identify successful drowning prevention measures that may be adopted or enhanced in Singapore.

Results: The study revealed a few important findings. Firstly, Singapore had a drowning rate per 100,000 population that varied from a low of 0.88 in one year to a high of 1.72 in another in the period 1992-2001. Secondly, the male drowning mortality rate in Singapore was much higher than the female drowning mortality rate. Thirdly, persons in the age group of 20-29 years were at the highest risk. Fourthly, the sea, rivers and swimming pools were the locations with the highest number of drowning victims. The study also showed that the main measures of drowning prevention may be broadly divided into supervision, environmental design changes, legislation, swimming lessons and aquatic safety education.

Conclusion: The situation in Singapore is generally comparable to that in high income or developed countries although there are some differences. Further studies and research need to be done to provide a better understanding of the epidemiology and prevention of drowning in Singapore. In the meantime, the main measures of drowning prevention should, as far as possible, be followed or enhanced.

Keywords: drowning, epidemiology, risk profile, water safety

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INTRODUCTION

Drowning is not a leading cause of death in Singapore and is not highlighted by the health authorities as a major area of concern. Consequently, there has also not been much research or interest in this area. However, the reality is that each death by drowning is still one death too many. This is especially when hindsight often shows that many deaths from drowning are preventable. More data and knowledge about drowning can only help in a better understanding of drowning and should in turn lead to more effective measures to tackle the problem.

The present study was embarked with the aim of contributing to the better understanding of drowning and deriving a profile of drowning victims in Singapore. The study focused on finding out if there are any patterns, trends or factors which may help in determining the risk profile of drowning victims and in recommending measures for reducing the number of deaths from drowning in Singapore. It also aims to describe the incidence of drowning in Singapore in the 10-year period 1992-2001. In addition, a review of current literature and studies on drowning was made to identify successful drowning prevention measures that may be followed or enhanced in Singapore.

METHODS

The data for epidemiological analysis were primarily obtained from the annual drowning statistics reported

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Table I. Singapore drowning statistics 1992-2001¹.

Year	Total population ('000) ²	Total drowning	Rate per 100,000
1992	3,232.1	50	1.55
1993	3,315.4	46	1.39
1994	3,421.1	45	1.32
1995	3,526.6	31	0.88
1996	3,670.4	63	1.72
1997	3,793.7	58	1.53
1998	3,922.0	52	1.33
1999	3,950.9	43	1.09
2000	4,017.7	60	1.49
2001	4,131.2	41	0.99

¹ Source: Singapore Life Saving Society Annual Reports 1992- 2002 which are derived from figures from the Registry of Births and Deaths. Numbers exclude drowning from suicide.

² Source: Population (Mid-Year Estimates) from the Department of Statistics, Singapore (<http://www.singstat.gov.sg/keystats/hist/population.html>) (Accessed 4 March 2003) where the total population is stated to comprise all citizens and permanent residents with local residence and foreigners staying in Singapore for one year or more.

Table II. Gender of drowning victims 1992-2001

Year	Total	Male	Female	Male to female ratio
1992	54	41	13	3.2 : 1
1993	91	72	19	3.8 : 1
1994	36	30	6	5 : 1
1995	37	34	3	11.3 : 1
1996	83	75	8	9.4 : 1
1997	61	54	7	7.7 : 1
1998	71	61	10	6.1 : 1
1999	56	41	15	2.7 : 1
2000	63	46	17	2.7 : 1
2001	38	30	8	3.8 : 1

Source: Singapore Life Saving Society Annual Reports 1992- 2002 which are derived from information of drowning cases heard in the coroner's court.

Table III. Age groups of drowning victims 1992-1996.

Age (in years)	1992	1993	1994	1995	1996
0-9	2	6	2	2	3
10-19	8	7	5	6	9
20-29	10	13	8	5	15
30-39	9	15	7	10	17
40-49	7	18	4	3	11
50-59	3	6	4	4	4
60-69	1	3	2	2	2
70 and above	4	4	3	2	5
Unknown	10	19	1	3	17

Source: Singapore Life Saving Society Annual Reports 1992- 2002 which are derived from information of drowning cases heard in the coroner's court.

in the annual reports of the Singapore Life Saving Society, the only national life saving and aquatic safety organisation in Singapore. The drowning statistics in those reports were in turn obtained from the Registry of Births and Deaths, and the Coroner's Court. For the purpose of this study, the drowning data were arranged in 10-year tables for ease of comparison and analysed for any patterns, trends or factors which may help in determining the risk profile of victims and in recommending measures for controlling drowning in Singapore.

The review of current literature and studies on drowning was concentrated on the publications of leading drowning experts and agencies and the papers presented at two important international drowning conferences. They were the International Drowning Symposium⁽¹⁾ organised by the International Swimming Hall of Fame in May 1996, and the first World Congress on Drowning⁽²⁾ held in Amsterdam in June 2002 and organised through an initiative of the Maatschappij tot Redding van Drenkelingen (Dutch Society for the Rescue of Drowning Victims).

RESULTS

The results of the epidemiological study are presented in Tables I to VI. Table I sets out the total population, total number of deaths from drowning, and the drowning rate per 100,000 population in the period under study. Table II sets out the gender of the drowning victims, and the male to female ratio. Tables III and IV set out the age groups of the drowning victims, and Tables V and VI set out the location of the drowning cases in Singapore. The review of current literature and studies on drowning showed that the main measures of drowning prevention may be broadly divided into five categories, namely: supervision, environmental design changes, legislation, swimming lessons and aquatic safety education.

DISCUSSION

The data study revealed several interesting facts about the drowning situation in Singapore. Singapore has a drowning rate per 100,000 population that varied from a low of 0.88 in one year to a high of 1.72 in another, in the period 1992-2001, as shown in Table I. This is comparable to the drowning-related mortality rate per 100,000 population of 1 to 1.3 in the high-income or developed countries of Europe and America in 2000⁽³⁾. This is also better than the average global drowning mortality rate of 7.4 per 100,000 population derived from a study of data from the 2000 Global Burden of Disease study, probably the most comprehensive source of global data on drowning⁽³⁾. The 2000 Global Burden of

Disease study was a joint effort of the World Health Organisation, the World Bank and Harvard University.

The study data also shows that in all the years under consideration, the male drowning mortality rate in Singapore was much higher than the female drowning mortality rate. In fact, the male to female ratio ranged from a low of 2.7 to one in the lowest year to a high of 11.3 to one in the highest year as shown in Table II. The lowest year situation is also comparable to the global position in 2000 where overall, male drowning-related mortality rates were almost twice as high as female drowning-related mortality rates⁽³⁾. However, the causes of the much higher rates in Singapore in the other years warrant further investigation.

According to Tables III and IV, in five out of the 10 years under study, the age group of 20-29 years had the largest number of drowning victims and persons in that group were therefore at the highest risk as compared to the other age groups. This is unlike the global situation where children under the age of 15 years were generally at the highest risk⁽³⁾. A possible explanation in Singapore's case could be that parents here are more careful about their younger children. Another possibility could be the prevalence of maids looking after children in many local households. Further research in this area may lead to a better understanding of the situation.

In all 10 years of the study, the sea was the location with the highest number of drowning victims, as shown in Tables V and VI. This was followed by rivers and swimming pools as the next two locations with the highest number of drowning victims. Unfortunately, very few countries report to the World Health Organisation according to the International Classification of Disease, with the inclusion of the place of the injury or related risk factors such as alcohol consumption⁽³⁾. Therefore, a comparison with the global position of this factor could not be made. The literature review showed that there are many methods of preventing drowning that have been adopted around the world. The main measures may be broadly divided into: supervision, environmental design changes, legislation, swimming lessons and aquatic safety education.

Supervision by lifeguards is a positive factor in the reduction of drowning or near-drowning incidents. United States Lifeguards Association (USLA) data during the period of 1988-1997 indicate that more than three-quarters of deaths by drowning at USLA sites occurred at times when beaches were unguarded, and that the chances of drowning at a beach protected by lifeguards trained under USLA standards is less

Table IV. Age groups of drowning victims 1997-2001.

Age (in years)	1997	1998	1999	2000	2001
0-9 years	3	4	3	12	3
10-19	6	2	7	3	–
20-29	13	17	9	14	11
30-39	12	9	6	12	6
40-49	12	7	8	16	3
50-59	3	9	3	1	1
60-69	–	8	3	1	2
70 and above	3	5	7	4	6
Unknown	9	10	10	–	6

Source: Singapore Life Saving Society Annual Reports 1992- 2002 which are derived from information of drowning cases heard in the coroner's court.

Table V. Location of drowning cases 1992-1996.

	1992	1993	1994	1995	1996
Sea	27	57	20	20	52
River	8	12	3	6	8
Canal	1	3	2	1	4
Drain	–	2	1	1	–
Swimming pool	2	7	3	1	10
Reservoir	2	1	2	1	5
Lake	2	1	1	2	2
Beach	–	–	–	1	–
Others	12	8	4	4	2

Source: Singapore Life Saving Society Annual Reports 1992- 2002 which are derived from information of drowning cases heard in the coroner's court.

Table VI. Location of drowning cases 1997-2001.

	1997	1998	1999	2000	2001
Sea	34	36	22	26	17
River	5	8	12	8	4
Canal	4	3	3	1	3
Drain	–	2	1	2	–
Swimming pool	11	3	2	5	8
Reservoir	1	2	3	3	3
Lake	4	1	2	–	–
Beach	–	3	–	4	2
Others	2	13	11	14	1

Source: Singapore Life Saving Society Annual Reports 1992- 2002 which are derived from information of drowning cases heard in the coroner's court.

than one in 18 million⁽⁴⁾. In another study of data from the 1995 annual report of Jeff Ellis & Associates, a leading American lifeguard training agency, it was revealed that there were no deaths by drowning despite 60 million participants at their clients' aquatic facilities⁽⁵⁾. In Brazil, the presence of the lifeguard

has been said to be a fundamental factor in the prevention of drowning⁽⁶⁾. It is also interesting to note that a recent Singapore study on childhood injuries seen in at the National University Hospital's emergency department revealed that the one pool drowning and most near-drownings occurred in private pools where lifeguards are unlikely to be available⁽⁷⁾. All these point towards the conclusion that the presence of lifeguards does reduce the incidence of drowning incidents. In addition to being available if a rescue or resuscitation is necessary, the presence of lifeguards may also discourage behaviour like horseplay that may put swimmers at risk of drowning. Another type of supervision, supervision that is exercised by parents and other minders, is also likely to reduce the incidence of drowning although no studies appear to have been done in this area.

The making of environmental design changes can also reduce the incidence of drowning. The United States Army Corps of Engineers found that environmental design changes at aquatic facilities (at inland lakes, in their case) play a role in reducing recreation-related drowning by 73% between 1981 and 1995, even though visitation at the public facilities managed by them increased by 66%. The changes include having buoys and markers to delimit swimming areas and lifesaving devices consisting of life jugs, ring buoys and lines, poles and prominent signs⁽⁸⁾. In an interesting study from Bangladesh, environmental design changes through flood control embankments with irrigation and drainage components for the purposes of increasing agricultural yield had the unintended consequence of reducing accidental deaths by drowning in the zero to four years age group⁽⁹⁾. In fact, one of the recommendations of the World Congress on Drowning was that environmental design and equipment design should be included as a first route, together with a few others, to take for drowning prevention⁽¹⁰⁾.

Legislation, or pool-fencing legislation to be more specific, has been shown to reduce the risk or incidence of drowning, especially in young children. It was noted that much of the evidence that pool fencing reduces the risk of drowning among children comes from early studies examining the before and after rates of drowning for fenced and unfenced pools, although some recent studies suggest that the mere passage of legislation may not be sufficient⁽¹¹⁾. In Australia, a study on pool fencing in Queensland after pool fencing legislation was passed in 1992 showed that deaths by pool drowning decreased from 15 in 1988 to one in 1993⁽¹²⁾. For the same reason, there are also swimming pool fencing laws

in New Zealand and the United States⁽¹¹⁾. There have been some comparative studies of perimeter fencing (around the pool and property) and isolation fencing (around immediate pool only), and they suggest that isolation fencing is much more effective in reducing the risk of drowning⁽¹¹⁾.

An American study concluded that while the acquisition of swimming skills among young children improved their ability to swim and recover safely from a simulated episode of falling into a swimming pool, the correlation with the ability to survive in the water is still unproven since ethical reasons precluded the duplication of realistic drowning scenarios⁽¹³⁾. However, evidence from Australia suggests that swimming lessons for children have some correlation to their drowning rates. In the Australian state of Victoria, reduction in drowning rates of more than 50% were observed in association with the introduction of widespread and well-documented school-based swimming and water safety training for children aged five to 14 years from the 1950s⁽¹⁴⁾. The World Congress on Drowning also acknowledged the importance of learning to swim by recommending that all individuals should learn to swim because it is a major skill to prevent drowning by individuals at risk⁽¹⁵⁾.

Interestingly, while it is commonly assumed that a general aquatic safety education would help prevent the incidence of drowning, there appears to be no published studies which investigate the effect of such general education programmes on drowning prevention⁽¹¹⁾. Indirectly though, environmental design changes often include aquatic safety education notices, and swimming lessons often include water safety lessons, and these probably go some way towards drowning prevention. In any case, one of the recommendations of the World Congress on Drowning recognised the importance of aquatic safety education by calling for such education, together with a few other measures, to be included as a first route to take for drowning prevention⁽¹⁰⁾.

It should be pointed out that this study has certain limitations. Statistics on drowning are dependent on how drowning is defined. In fact, the definition of drowning has changed over the years and differs in different jurisdictions. For example, it has been pointed out that in some jurisdictions, if someone dies more than 24 hours after being immersed in water even though it may be due to delayed physiological complications, that is considered a resuscitative death, not a drowning⁽¹⁾. However, many in the aquatic safety community would probably consider such a situation a case of a secondary drowning, one of the four generally-accepted types

of drowning together with wet drowning, dry drowning and the sudden drowning syndrome⁽¹⁶⁾.

The annual reports of the Singapore Life Saving Society are not primary sources of data, and they have been derived from information obtained from the Registry of Births and Deaths, and the Coroner's Court over the years. The data may not have been subject to a consistent definition and method of classification of death by drowning. In fact, the first time a worldwide consensus was reached on the definition of drowning was at the first World Congress on Drowning in 2002. It defined drowning as "the process of experiencing respiratory impairment from submersion/immersion in liquid"⁽¹⁵⁾. It is also understood that the data from the Coroner's Court were previously consolidated by the Singapore Life Saving Society each year, based on cases where drowning is mentioned or suspected for both coroner's inquiries which had verdicts pending and those which had verdicts pronounced. Hence, the figures are not consistently based on verdicts of coroner's inquiries, although steps are currently being taken to change the way they are consolidated in the future.

Furthermore, the age groups of a fairly significant number of drowning victims were also not known and therefore, the age-related conclusions in this study may differ from the actual situation. In addition, the literature review was limited to English language publications and involved mostly European, Australian and American writers. Very little was written from an Asian or Singapore perspective and consequently the conclusions drawn have to be considered in that light. Notwithstanding these limitations, it is submitted that the study has produced some important findings and helps to raise the awareness in this area.

CONCLUSION

The present study shows that while Singapore's drowning rates are generally comparable to those of high income or developed countries worldwide, males in Singapore are far more at risk of death by drowning than females. It further shows that the age group of 20-29 years is most at risk of death by drowning and that the most likely locations for drowning incidents in Singapore are the sea, the rivers and the swimming pools. The study also shows that the main measures of drowning prevention may be broadly divided into supervision, environmental design changes, legislation, swimming lessons and aquatic safety education. While there may be a lack of conclusive supporting evidence for some of these measures, there is enough justification for the measures to be followed or enhanced as far as possible. The fact remains that more can be done for drowning

prevention in Singapore. Supervision by lifeguards and other persons should be encouraged in all aquatic facilities in Singapore and every architect, developer and operator of an aquatic facility should consider environmental design changes to improve the safety of their facility. Furthermore, swimming skills and water-safety should be widely taught in the schools and other institutions (with special emphasis in males) and pool fencing legislation ought to be seriously considered by the government. Finally, more studies and research also needs to be done to provide a better understanding of the epidemiology of drowning in Singapore and how deaths by drowning may be further reduced. In the meantime, it is hoped that the present study has contributed in some way towards a better understanding of the problem.

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