

Effect of submersion injury on water safety practice after the event in children, Saudi Arabia

Omar M. Hijazi, MBBS, Amr A. Shabin, MBBS, Nasser A. Haidar, MBBS, Muna F. Sarwi, BSC, Eman S. Musawa, MBBS.

ABSTRACT

Objective: To bring to light issues surrounding water safety practices and the impact of such incidents on these practices in our community.

Methods: We conducted a prospective observational study at King Abdul-Aziz Medical City, Riyadh, Kingdom of Saudi Arabia of all children <12 years of age presenting with submersion injury in the period between January 1999 through December 2004 noting the demographics and the pattern of water safety practices prior to and after event.

Results: A total of 29 patients were included. The majority of incidents took place in swimming pools. Water safety practices were lacking in most cases as evidenced by the fact that 87% of the victims were not properly supervised at the time of the event. None of swimming pools met the required safety regulations. Cardiopulmonary resuscitation knowledge was virtually nonexistent. The event did not have a positive impact on the water safety practices of the affected families.

Conclusions: Submersion injury is also prevalent in land locked areas. Water safety practices are deficient in our community. Submersion injury was not enough to have a consistent positive impact on water safety practices of the affected families. Much can be carried out to improve water safety and save lives.

Saudi Med J 2007; Vol. 28 (1): 100-104

From the Department of Pediatrics (Hijazi, Shabin, Sarwi, Musawa), King Fahad National Guard Hospital, and the Department of Pediatrics (Haidar), King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia.

Received 13th May 2006. Accepted 13th September 2006.

Address correspondence and reprint request to: Dr. Omar M. Hijazi, Department of Pediatrics, King Fahad National Guard Hospital, PO Box 22490, Riyadh 11426, Kingdom of Saudi Arabia. Fax: +966 (1) 2520088 Ext. 11641. E-mail: omanhijazi@yahoo.com

Drowning is a serious international and regional problem. The King Abul-Aziz Medical City, experience in treating drowning victims suggests that this problem is more widespread in the Kingdom than previously thought.

The World Health Organization (WHO) defines drowning as “the process of experiencing respiratory impairment from submersion/immersion in liquid.” The WHO classifies drowning outcomes as death, morbidity and no morbidity”. The previous definition of drowning, used for epidemiological reporting was death within the first 24 hours from submersion. The old definition of drowning resulted in underreporting of this serious problem.¹

In 2000, drowning accounted for 9% of total global mortality (409,272 deaths) making it the second leading cause of unintentional injury death globally after road traffic injuries. This total includes only “accidental drowning and submersion”. The problem is even greater. These Global Burden of Disease figures are an underestimate of all drowning deaths, since they exclude drowning due to cataclysms (floods), water and other transport accidents, assaults and suicide.¹ Ninety-seven percent of unintentional drowning deaths occur in low- and middle-income countries.² Prevention efforts should be focused on these countries.

The Center for Disease Control in Atlanta report on submersion accidents found that for each drowning victim there are 3 serious near drowning that required emergency treatment.³ The location at which the drowning took place varied with age, a fact that helps in planning preventive measures. Of infant drowning, 78% were in bathtubs and 20% in pools. In the 1-4 year age group 56% of drowning occurred in bodies of fresh water. Most pool drowning occurred at home swimming pools.^{4,5}

Prevention is the best approach for this serious injury. Many measures have been suggested to help decrease the risk of submersion injuries. Fencing is the most effective and the one that was studied the most.⁶⁻⁹ Continuous close observation by an adult who knows how to swim and to do cardiopulmonary resuscitation (CPR) is essential to decrease the risk or improve the outcome of submersion injuries.¹⁰

In this paper, we study the risk factors associated with submersion injuries admitted to our center. We also measured

the impact of the injury on the implementation of water safety measures by the affected families.

Methods. This prospective observational study was conducted at King Fahad National Guard Hospital, King Abdul-Aziz Medical City, Riyadh, Kingdom of Saudi Arabia. All pediatric patients <12 years of age who presented with submersion injury to our emergency room (ER) from January 1999 through December 2004 were included. Children ≥12 years or with old submersion injury were excluded.

The initial data were collected from the patients' charts and family interview. Collected data included patients' demographics (age, gender and weight), and submersion circumstances (location of submersion and safety related issues). To study the impact of submersion injury on the affected families' awareness and implementation of water safety, a prospective questionnaire focusing on water safety practices before and after the event was carried out. Consent from the patient's guardian was obtained in all cases. The questionnaire was completed during interview with the families of the victims. The interview took place 1-12 months after the event. Patient families were given informal instructions regarding water safety. No formal session on water safety or CPR was given to the affected families.

Results. In the study period, a total of 29 submersion injury cases presented to our ER. Of our subjects, 66% were male. Of the victims' families, 83% (24/29) could be reached to answer the questionnaire. None of the 29 patients knew how to swim. All of the victims fell in the water by accident. None of them were bathing or having water recreational activity before the submersion (Table 1).

Seventy-two percent (21/29) of submersion injuries took place in a swimming pool (Table 1). The swimming pools were public in 81% (17/21), and private in 19% of cases (4/21). Eighty percent of our study subjects ≤2 years of age drowned outside home. Fifty percent (7/14) of subjects >2 years drowned outside home (6 at public swimming pools, 1 in sewage water) and 50% at home (3 at private swimming pools, 2 in washing machine and 2 in water buckets). A family member discovered the incident in 96% and performed 89% of the resuscitation attempts. When first discovered, 89% of the patients were not responsive and 79% were not breathing, immediate attempts at some form of resuscitation were initiated in only 55% of the cases. In only one case, the rescuer had prior formal CPR training. Before being discovered, 60% of the cases were submerged for a period estimated to be ≤10 minutes and 40% for >10 minutes.

Table 1 - Subjects demographics, submersion location and observation status at the time of submersion.

<i>Weight and age characteristics of the submerged cases:</i>		
Weight		13.1 ± 5.0 kg
Age	(mean)	30.6 ± 18.8 months
	(range)	12-96 months
	≤12 months	7% of the total
	13-24 months	45% of the total
	25-36 months	31% of the total
	>36 months	17% of the total
<i>Location of submersion injury:</i>		
Swimming pool		(21/29)
Home in water buckets		(3/29)
Home in washing machine		(3/29)
Sewage water		(1/29)
Rain water pond		(1/29)
<i>At the time of injury the child was observed by:</i>		
Adult family member		(17/24) 71%
Other child		(4/24) 17%
No body		(3/24) 12%

Table 2 - Results of the safety related questions to the patients' families with submersion injury at King Abdul-Aziz Medical Center.

Questions	Yes (%)	No (%)
Were you given safety instruction when you visited swimming pool areas?	(5)	(95)
Were you/your relative asked to apply water safety when you established the pool at your/your relative home?	(9)	(91)
Was there a fence around the pool?	(41)	(59)
Did the fence have a self-latching door?	(33)	(67)
Was the fence ≥4 feet in height?	(100)	(0)
Were the gaps in the fence ≤4 inches?	(67)	(33)
Was the fence surrounding the pool from 4 areas?	(89)	(11)
Was the fence ≥50 cm from the pool edge?	(78)	(22)
Does the fence door have an alarm?	(11)	(89)
Does the fence door open to outside the pool?	(44)	(56)
Was there a telephone around the pool?	(41)	(59)
Was there a rope around the pool?	(14)	(86)
Were there life jackets around the pool?	(32)	(68)
Was the child having life jacket on at the incident time?	(9)	(91)
Was there lifeguard around the pool?	(5)	(95)
Did the child have disease before the incident?	(21)	(79)

While around the water bodies, children were not well observed (Table 1). In only 13%(3/24) of the incidents was the child in close contact (namely, within the hand reach). Furthermore, 75% of the observers were observing ≥ 3 children at the same time. Seventy five percent of observers did not know how to swim and only one knew how to do proper CPR.

Table 2 shows the results of the questionnaire in relation to the water safety when visiting swimming pools. Only 41% of the swimming pools at which the drowning took place had fences in place. Other measures as power safety cover, shepherd's hook and telephone by the pool all adding to water safety, were available in less than 50% of the pools at which submersion injuries took place (Table 2).

Table 3 shows the results of the questionnaire in relation to the impact of the incident of the affected family behavior towards water safety. The submersion injury tragedy did not lead to a consistent positive change in the affected families behavior and commitment towards children safety around water bodies.

Discussion. Our center is located in a dry area in the desert far away from natural water bodies. However, no area or family is immune from submersion injury. One does not have to have a swimming pool at home to think about or implement water safety. In our study, 20% of our subjects drowned in common household items; 10% in washing machine and 10% in water buckets. These are, to most of us, unusual objects for submersion accidents.

It has been suggested that more than 80% of all drowning accidents are preventable and that prevention

is the key management intervention.^{1,11} Submersion injury prevention involves environmental and behavioral measures. Of the environmental measures, fencing is the most effective and the one that was studied the most. Isolation fencing is superior to fencing that allows access to the pool.^{3,6} However, in our study only 41% of the swimming pools at which the drowning took place had a fence (Table 2).

For a pool fence to be effective, it has to surround the pool, be at least 4 feet in height with openings less than 4 inches with a functional self-latching door, with latches that are higher than a child's reach, with no protrusions or cavities that may enable the child to climb over and to be placed no fewer than 20 inches from the pool edge.⁶⁻⁹ None of the fences that were available in our study met all the safety standards (Table 2). Other measures as power safety cover, shepherd's hook and telephone by the pool were available in less than 50% of the pools at which incidents took place in our study. Site-specific submersion potential is important in planning the preventive measures.^{4,5,12} Ross et al¹² reported that the majority (82%) of near drowning occurred in the child's house. However, in our study with 93% of our subjects ≤ 4 years of age, only 34% (10/29) of the submersion injuries took place at the home. The majority of our submersion injuries (59%) took place outside home at public swimming pool.

As reported in other studies, children move fast. In our study, a short lapse of (9.6 ± 4 minutes) in observation resulted in submersion injury. Inadequate supervision was a major safety issue observed in previous studies and in our study.^{13,14} Of our submersion victims, 87% were not properly supervised. The observer was a child in 17% of cases. In 12% of cases no one was observing the children. In 2 previous studies, absent or no supervision at all at the time of submersion was reported in 89% and 83% of cases.^{13,14} Quan and Cummings⁵ reported that 28% in age group 0-4 years and 76% in age group 15-19 years were not supervised at time of submersion. Pre-submersion activities also vary with age. Quan and Cummings⁵ reported that most (76%) of victims 0-4 years drowned while bathing or after falling in the water. Among those 15-19 years, most occurred while swimming (34%) or boating (31%). In our area most families do not fill the bathtub before bathing. This might have contributed to the fact that none of our subjects 0-4 years of age had the submersion injury while bathing. Actually, all of our cases had the submersion injury after falling in water bodies and none of them was bathing, swimming or boating before the incident.

Continuous observation by an adult who knows how to swim and how to perform CPR is essential to decrease the risk or improve the outcome of submersion injuries.¹⁰ In our study, in only one case the rescuer

Table 3 - The impact of the tragedy on the behavior of the affected families towards water safety.

Questions	Answer			
	Yes	(%)	No	(%)
Did you learn a bout water safety before the incident?	7	(29)	17	(71)
Did you learn about water safety after the incident?	11	(46)	13	(54)
Did you learn CPR after the accident?	4	(17)	20	(83)
Did you enforce water safety precautions round the pool after the incident?	2	(8)	22	(92)
Did you buy life jackets after the incident?	4	(17)	20	(83)
Did you close the pool and/or avoid going to areas with swimming pool after the incident?	6	(25)	18	(75)
Did you read about drowning?	5	(21)	19	(79)

knew how to perform proper CPR. Furthermore, CPR was not even tried at the scene in 9 patients that were not breathing. Our data are showing persistence in significant deficits in water safety compared to data of a previous local study on water safety, which reported that proper water safety measures were applied in only 5% (1/21) of the private swimming pools.¹⁵ Ninety-three percent of our subjects were ≤ 4 years of age group. Not surprisingly, none of them knew how to swim. However, whether that had any impact on risk of submersion is not clear.¹⁶ Swimming lessons are not recommended as drowning prevention measure. The American Academy of Pediatrics states, "children are generally not developmentally ready for swimming lessons until after their fourth birthday."¹⁷ Immediate resuscitation at the scene, however, was associated with better neurological outcome in children with submersion injury.¹⁸ Failure to provide immediate resuscitation is associated with poor outcome.¹⁹⁻²¹ Certain medical illnesses as seizure disorders can increase the risk of drowning and near drowning.²²⁻²⁴ However, none of our subjects had seizure disorder and only one subject had mild neurodevelopmental delay.

Posner²⁵ reported that comprehensive home safety education and free safety device programs were effective in improving home safety practices of caregivers of young children. In our study, safety instructions were given to less than 10% of those visiting a public swimming pool or when establishing a private swimming pool (Table 2). Furthermore, O'Flaberty and Pirie²⁶ reported that most pediatricians do not routinely provide information to their patients or their families on submersion injuries prevention.

Unfortunately, yet understandably, in regards to the impact of the tragedy on family attitudes towards safety, it was apparent from our questionnaire that it had little impact. Despite having been subjected to this sad and serious event, the families did not have any consistent or major improvement in the knowledge or approach to water safety practices (Table 3). A community-wide approach is potentially far more effective. A continuous and goal directed media coverage strategy of the topic is essential. More importantly, an intensive advocacy campaign by the Saudi Pediatric Association and other Pediatric Organizations to disseminate the concepts and practices of water safety and bring forward the importance of this matter to the minds of the public is paramount. This applies to many other areas of injury prevention, which requires a dual approach of legislation and implementation thereof, and raising awareness and public education.

In conclusion, the degree of knowledge and implementation of water safety measures in our community are far below what is expected. Exposure to submersion tragedy was not enough to impose a

consistent positive change towards water safety practices. Community and municipal approaches are a must. We recommend that the government form a task force of experts to create and implement kingdom wide water safety guidelines. Water safety is the responsibility of all the parties involved including families, owners of public pools, and above all the municipalities.

References

1. World Congress on Drowning. Amsterdam. 26-28 June 2002. Available from: http://www.who.int/violence_injury_prevention/publications/other_injury/en/drowning_factsheet.pdf
2. Peden MM, McGee K. The Epidemiology of drowning worldwide-INJ Control Saf Promot. *J Food Med* 2003; 10: 195-199.
3. Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. (2003) National Center for Disease Control and Prevention (producer) [cited 2003 Dec 31]. Available from URL: www.cdc.gov/ncipc/wisqars.
4. Brenner RA, Trumble AC, Smith GS, Kessler EP, Overpeck MD Where children drown, United States, 1995. *Pediatrics* 2001; 108: 85-89.
5. Quan L, Cummings P. Characteristics of drowning in different age groups. *Inj Prev* 2003; 9: 163-168.
6. Thompson DC, Rivara FP. Pool fencing for preventing drowning in children. *Cochrane Database Syst Rev* 2000; 2: CD001047.
7. US Consumer Product Safety Commission. Children and pools: a safety checklist. Washington, DC: US Consumer Product Safety Commission, 1993; publication no.357.
8. American academy of Pediatrics. TIPP: Pool Safety for Children. The Injury Prevention Program. Available from: <http://www.aap.org/family/tippool.htm> on 1/14/2004.
9. American Academy of Pediatrics. Policy. Residential Swimming Pool Safety Act. Available from: <http://www.aap.org/policy/m940.html> on 12 of Jan, 2004
10. American Academy of Pediatrics. Policy Statement, Prevention of Drowning in Infants, Children, and Adolescents. *Pediatrics* 2003; 112: 437-439.
11. Mackie I. Availability and quality of data to assess the global burden of drowning In: Bierens J, editor. Handbook on drowning. Prevention, rescue and treatment. Netherlands: Springer; 2003.
12. Ross FI. Children under 5 years presenting to pediatricians with near-drowning. *J Paediatr Child Health* 2003; 39: 46-50.
13. Quan L, Gore EJ, Wentz K, Allen J, Novack AH. Ten-year study of pediatric drowning and near-drowning in King County, Washington: lessons in injury prevention. *Pediatrics* 1989; 83: 1035-1040.
14. Kemp A, Sibert JR. Drowning and near drowning in children in the United Kingdom: lessons for prevention. *BMJ* 1992; 304: 1143-1146.
15. Al-Mofadda SM, Nassar A, Al-Turki A, Al-Salloum A. Pediatric near drowning: the experience of King Khalid University Hospital. *Ann Saudi Med* 2001; 21: 5-6.
16. Rodgers GB. Factors contributing to child drownings and near-drownings in residential swimming pools. *Hum Factors* 1989; 31: 123-132
17. American Academy of Pediatrics, Committee on Sports Medicine and Fitness and Committee on Injury and Poison Prevention. Swimming programs for infants and toddlers. *Pediatrics* 2000; 105: 868-870 .

18. Kyriacou DN, Arcinue EL, Peek C, Kraus JF. Effect of immediate resuscitation on children with submersion injury. *Pediatrics* 1994; 94: 137-142.
19. Wintemute GJ, Kraus JF, Teret SP, Wright M. Drowning in childhood and adolescence: a population-based study. *Am J Public Health* 1987; 77: 830-832.
20. Present P. Child drowning study: A report on the epidemiology of drowning in residential pools to children under the age five. Washington, DC: Directorate for Epidemiology, US Consumer Product Safety Commission; 1987.
21. Wintemute GJ. Childhood drowning and near-drowning in the United States. *AJDC* 1990; 144: 663-669.
22. Pearn J, Bart R, Yamaoka R. Drowning risks to epileptic children: A study from Hawaii. *BMJ* 1978; 2: 1284-1285.
23. Orłowski JP, Rothner AD, Lueders H: Submersion accidents in children with epilepsy. *Am J Dis Child* 1982; 136: 777-780.
24. Diekema D, Quan L, Holt V. Epilepsy as a risk factor submersion injury in children. *Pediatrics* 1993; 91: 612-616.
25. Posner JC. A randomized, clinical trial of a home safety intervention based in an emergency department setting. *Pediatrics* 2004; 113: 1603-1608.
26. O'Flaberty JE, Pirie PC. Prevention of pediatric drowning and near drowning: a survey of members of the American Academy of Pediatrics. *Pediatrics* 1997; 99: 169-174.



Excerpts from the Uniform Requirements for Manuscripts Submitted to Biomedical Journals updated November 2003. Available from www.icmje.org

The international Committee of Medical Journal Editors has recommended the following criteria for authorship; these criteria are still appropriate for those journals that distinguish authors from other contributors.

Authorship credit should be based on 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) intellectual content; and 3) final approval of the version to be published. Authors should meet conditions 1, 2, and 3.

Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

Author should be prepared to explain the order in which authors are listed.