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DROWNING RATES DUE TO FALLS IN SWIMMING POOLS IN BRAZIL BETWEEN THE LAST 25 YEARS

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Abstract: **Introduction**: Drowning is the process of respiratory failure due to submersion/immersion in liquids, being responsible for generating a victim every 94 minutes in Brazil. Still, it is the second leading cause of accidents in young children in the country. Objective: To describe the epidemiological profile of hospitalizations due to drowning by falling into a swimming pool in Brazil between 1998 and 2022, understanding the main affected public, as well as the measures implemented to combat this situation. **Methodology**: This is a descriptive observational study, whose data were collected by the DataSUS platform. The collection started from the Hospital Information System (SIH), through hospital morbidity data by place of hospitalization between January 1998 and December 2022 through the category of disease: drowning and submersion resulting from falling into a swimming pool CID 10- W68. **Results and discussion**: Drowning on beaches, pools, rivers and dams are the cause of an average of 5,700 deaths per year in Brazil. Children and young men are the main victims. The most affected age group is between 1 and 4 years old and the main reason associated with drowning is the lack of attention from parents. Children with epilepsy and developmental disorders are risk factors for drowning. This way, protective measures are the best way to combat. **Conclusion**: Despite being something easily preventable, drowning, especially in children, is still common in Brazilian daily life. Thus, prevention measures for both children and adults and awareness programs must be used in order to reduce their mortality in the country.

INTRODUCTION

Prior to 2002, public health surveillance, research and policy on drowning were hampered by a lack of clear terminology. After several revisions, debates and discussions,

the World Health Organization (WHO) published the following definition: "Drowning is the process of respiratory failure due to submersion/immersion in liquids".[1] Some terms such as wet and dry or passive and active drowning must no longer be used because they are confusing and make it difficult to properly categorize and manage, and may lead to incorrect measurements during the support call. Utstein's approach simplified the classification of drowning outcomes into just three domains: death, morbidity, and no morbidity.[2]

Nearly 4,000 drowning deaths occur annually in the United States, representing the most common cause of injury-related deaths in children ages one to four years old.[3] Drowning ranges from a small entry of fluid into the airway with subsequent patency, to the prolonged presence of fluid in the lungs leading to lung dysfunction, hypoxia, cardiac and neurological abnormalities, and even death.[1]

Initially, the fluid enters the oropharynx and is eliminated if possible. At this first moment, the individual can still consciously retain his breath. However, the internal impulse to inhale becomes insurmountable, causing fluid to enter the airways, stimulating coughing or laryngospasm. If the drowning process continues, events such as electrolyte disturbance, alveolar dysfunction and hypoxia tend to occur. These can trigger further deterioration with acute lung edema, decreased lung compliance and bronchospasm.[4,5]

Cardiac deterioration develops after seconds to minutes of hypoxia, typically progressing from tachycardia to bradycardia, pulseless electrical activity, and asystole. [5-7] Sinus tachycardia, sinus bradycardia, and atrial fibrillation are the most common arrhythmias seen in this setting. Metabolic and respiratory acidosis is often seen initially in patients with non-fatal drowning. Submersion for six minutes or more is associated with a significantly worse prognosis. When considering victims of drowning in open water with good results (i.e., they did not die or have severe neurological sequelae), 88% were submerged for less than six minutes against 7.4% of victims with six to 10 minutes of submersion. [8]

Drowning patterns vary by age, gender, cultural background and geographic location.[9] The babies are more likely to drown in bathtubs, while young children are more likely to overbalance and fall into containers of liquids.[10,11] Children under the age of four are more likely to drown in a swimming pool, while adults are more likely to drown in a natural body of water. [12] A systematic review found that drowning is the most common cause of death in recreational water activities in people aged 15 years and older; 30% to 70% of fatal drowning victims had alcohol in their bloodstream. [13] Even small amounts of alcohol increase the risk of drowning, and this risk increases with the amount of alcohol consumed. [9,13-15]

Submersion in cold water was previously thought to be neuroprotective due to decreasing the metabolic demands of hypothermia and the diving reflex. Case reports have described young victims with prolonged submersion in very cold water who survived neurologically intact. [16,17] However, it has been determined that the water temperature has no correlation with the overall result.[8] Furthermore, contrary to popular belief, aspirating fresh versus salt water makes no difference in the degree of lung damage, unless the liquid contains particulate contaminants such as mud, sewage and bacteria, which can significantly increase the risk of infection. (bacterial and fungal in nature).[18]

The WHO global report on drowning states that the highest rates of drowning deaths occur among children aged 1 to 4 years, followed by

children aged 5 to 9 years. In fact, in countries like Australia, drowning is the leading cause of death from unintentional injury in children aged 1-3 years, and in the US, drowning is responsible for more deaths among children aged 1-4 years than any other other cause (other than birth). Additionally, drowning is the third leading cause of death worldwide for people ages 5 to 14. In the Western Pacific region, children ages 5 to 14 die more often from drowning than from any other cause.[19]

In Brazil, unfortunately, the situation is not very different. Every ninety-four minutes, a Brazilian drowns. Drowning represents the second cause of death from accidents among children and adolescents up to 14 years of age in the country. Research has shown that more than half of drowning deaths among children aged 0 to 4 years occurred in swimming pools. There are risks involved, whether it's a portable, inflatable, permanent in-ground or residential pool.[20] Approximately 5,800 people are treated in US emergency departments each year for submersion or drowning injuries, with half of these patients requiring hospitalization.12,21,22 Permanent neurologic sequelae, such as a persistent vegetative state or spastic tetraplegia, occur in 5% to 10% of childhood drowning cases. [23]

Thus, the objective of this work is to describe the epidemiological profile of hospitalizations due to drowning by falling into a swimming pool in Brazil between 1998 and 2022, understanding the main affected public, as well as measures implemented to combat this situation.

METHODOLOGY

This is a quantitative descriptive ecological observational study, whose objective is to understand the epidemiological distribution of hospitalization due to drowning and submersion resulting from a fall into a CID 10 - W68 pool. Data were collected by the DataSUS platform, through information obtained by the Notifiable Diseases Information System (SINAN). The collection started from the Hospital Information System (SIH), through hospital morbidity data by place of hospitalization between January 1998 and December 2022.

The study population is composed of patients who were admitted to any hospital in the Brazilian territory of both sexes and of all age groups. The indicators used were: sex, age, color/race, deaths and mortality rates. The study was carried out in line with the principles of Resolution 466/2012 of the National Health Council of Brazil.

RESULTS AND DISCUSSION

Drowning happens quickly and silently and its signs often go unnoticed. Attention to airway, breathing, and compressions (ABC) in that order (as compared to compressions, airway, and breathing [CAB] in modern advanced cardiac life support guidelines) is critical because any cardiac arrhythmias are almost exclusively secondary to hypoxia.[24] A patient who is not breathing or has a Glasgow Coma Scale score of less than 8 must be intubated and given ventilatory support.[25] Conscious drowning victims with rales in some or all lung fields require supplemental oxygen and evaluation in the emergency department. [7,25] Vomiting occurs in 30% to 85% of drowning victims due to ingestion of large amounts of water and positive pressure ventilation during resuscitation. [26,27] Aspiration of gastric contents portends worse lung injury.

In Brazil, according to the Mortality Information System – SIM, between 1996 and 2020, 165,184 people died of drowning, of which 999 were due to falling into swimming pools.[28] The most affected age group in this group was children between 1 and 4 years old (34.8%), which is in line with the WHO

global drowning report.[19] Small children can drown silently in just 25 seconds, even in the shallow end or in a kiddie pool.[29] For all of these reasons, it's important for parents and caregivers to actively supervise their children near water, even if lifeguards are present.

The report "Preventing Drowning: An Implementation Guide" identifies absence or inadequate supervision as the major risk factors for children drowning.[30]

Another report by the Royal Life Saving Society Australia found a relationship between distracted parents in 77.8% of cases of drowning in children aged 5 to 9 years in public and commercial swimming pools between 2005 and 2015.[31] In cases of unsupervised drowning, the child's parent or caregiver was absent or physically close to the child but distracted (talking to another adult or caring for another child in their care). Furthermore, the German Lifeguard Association reported that more than 300 people died in Germany in 2018 and linked the growing number of children drowning due to their parents' obsession with mobile phones.[32] In addition, the Australian report reported that, between 2002 and 2017, 447 children under the age of four drowned, with about 5% being a direct result of poor supervision due to the use of electronic devices such as smartphones, tablets and laptops.[33]

In Brazil, between 1998 and 2022, 727 people were hospitalized for drowning Table 1.0. The most critical years were 2012, 2016, 2021 and 2022. These were the only years, among the 25 analyzed, in which more than 40 hospitalizations occurred throughout the year. The most affected regions were, respectively: Southeast, Northeast, Midwest, South and North. Only the Southeast, the most developed economic region in the country, accounted for more than 55.7% of cases. Still, the mortality rate in the Southeast was 8.40%, while the national rate was 6.88%.

Whether or not socioeconomic status is a risk factor for drowning in children remains controversial. Some evidence suggests that children from wealthy families and those living in cities with high pool-to-population ratios are at particular risk.[34,35] However, other previous studies report that children from low-income families are 4.1 times more likely to die from a drowning incident, which could be associated with low paternal income and low maternal education due to decreased awareness of issues of drowning. water safety and higher rates of childhood drowning.[36,37]

Several reports also suggest that children of younger mothers (under 25) are less likely to drown than children of mothers over 30. Older mothers are more likely to have multiple children and conflicting demands, which can compromise their ability to actively supervise.[38,39]

In this period of 25 years, of the 727 hospitalizations in the country, 34.4% of the cases were children between 1 and 4 years old **Table 2.0**. At this age, they become more mobile and are inherently curious.[40] They also demonstrate limited awareness of potential dangers and have little or no ability to care for themselves.[41,42] Physiological features that increase your risk include a higher center of gravity, weak musculature, and underdeveloped balance and coordination systems.[43]

Age and gender have been extensively examined in relation to the risk of childhood drowning. In this studied period, 69.6% of all hospitalizations were male, which has been attributed to the exploratory characteristics of the male gender **Table 3.0**.[41] In the first half of 2022, according to the Brazilian Society of Water Rescue (Sobrasa), in the range between 15 and 21 years old, the number of deaths is 17 times higher than that of women.[44]

Temporal factors are also associated with drowning. Almost 42% of drowning accidents

Region	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
TOTAL	14	23	21	20	24	28	11	12	18	26	39	14	28	31	46	40	39	25	48	26	32	34	37	46	45	727
North	-	4	1	5	-	3	-	-	-	-	3	-	2	2	5	4	6	3	8	4	3	3	4	1	2	63
Northeast	3	5	6	-	5	5	1	2	4	3	4	2	5	3	1	7	2	5	2	1	2	3	4	12	15	102
Southeast	7	12	13	11	14	14	8	10	12	18	16	8	17	21	30	19	23	8	29	13	18	23	20	21	20	405
South	4	1	1	1	2	4	1	-	2	2	4	3	3	2	2	2	3	2	3	4	5	1	3	4	6	65
Midwest	-	1	-	3	3	2	1	-	-	3	12	1	1	3	8	8	5	7	6	4	4	4	6	8	2	92

Table 1.0 Number of patients hospitalized due to drowning by falling into a swimming pool reported by region between 1998 and 2022.

Source: Ministry of Health - SUS Hospital Information System (SIH/SUS). 2023.

Region	Minor 1 year	1 to 4 years	5 to 9 years	10 to 14 years	15-19 years	20 to 29 years	30 to 39 years	40 to 49 years	50 to 59 years	60 to 69 years	70 to 79 years	80 years and over	Total
TOTAL	17	250	77	48	39	88	73	55	38	21	9	12	727
North	1	10	9	8	4	10	7	9	2	1	2	-	63
Northeast	0	16	9	12	14	14	15	7	5	5	1	4	102
Southeast	7	153	42	23	18	52	33	29	26	11	5	6	405
South	2	23	5	3	2	5	11	5	4	3	1	1	65
Midwest	7	48	12	2	1	7	7	5	1	1	0	1	92

Table 2.0 Distribution by age group of the hospitalized population due to drowning due to a fall in the pool reported by region between 1998 and 2022.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS). 2023.

Region / gender	Masculine	Feminine	Total
TOTAL	506	221	727
North	45	18	63
Northeast	78	24	102
Southeast	285	120	405
South	47	18	65
Midwest	51	41	92

Table 3.0 Distribution by sex of the population hospitalized for drowning due to a fall in the swimming pool reported by region between 1998 and 2022.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS). 2023

occurred in the hottest months (December to March), corresponding to summer in the country, periods in which there is greater involvement in water activities.

Certain health conditions are strongly linked to the risk of drowning. Increased exertion during water activity can cause arrhythmias and loss of consciousness in children with cardiac disorders. Reports also suggest that drowning is the most common cause of injury-related mortality in people with epilepsy. Seizures often involve loss of consciousness and muscle control, and children may disappear underwater quickly and silently during the tonic phase of a seizure. Developmental disorders have also been reported associated with drowning in children. This is likely a result of cognitive and communication deficits and increased seizure activity in this population.

Thus, prevention is the best control measure for these drownings. Drowning is rarely caused by a single factor; therefore, prevention strategies must not be adopted in isolation. Prevention methods address the aforementioned epidemiological concerns and can be divided into physical, behavioral, medical, and community/government areas of interest. The institution of educational programs, swimming lessons and water safety, as well as fencing non-climbable pools, especially for children from two to four years of age, are actions that reduce these hospitalization and mortality rates.

The height and design of the fence remains a challenge, particularly to define what is the effective height to prevent children from climbing into the pool area, as well as ensuring that the fence is not climbable. The first works by Nixon et al. (1979) found that a 1.4 m fence can be climbed by 0% of three-year-olds, a 1.2 m fence by 18%, and a 90 cm fence by 55%. With that, it was instituted that fences over 1.2 m, without transverse scalable stakes and taking care not to leave close to objects such as pitchers that could be used to overcome the fence, are effective in preventing these falls.45 Another important The measure implemented was the recognition of the lifeguard profession and, despite being a state and municipal determination, there is a recommendation for the presence of at least two of these professionals for every 300m² of water surface during hours of use of public and collective swimming pools, understood as those used in clubs, condominiums, schools, associations, hotels and public and private parks. Ultimately, with proper supervision, swimming instruction, and public education measures, an estimated 85% of drownings are preventable.[46]

CONCLUSION

Drowning on beaches, pools, rivers and dams are the cause of 5,700 deaths per year in Brazil. Children and young men are the main victims. The most affected age group is between 1 and 4 years old and the main reason associated with drowning is the lack of attention from parents. Children with epilepsy and developmental disorders are risk factors for drowning. This way, protective measures are the best form of combat.

CONFLICT OF INTERESTS

There is not any.

FINANCING

The own researchers

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