



Deaths in Open Water Swimming Races in Brazil from 2009 to 2019

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ABSTRACT

International Journal of Exercise Science 15(6): 1295-1305, 2022. Since the inclusion in the Olympic Games (2008), open swimming races have attracted greater media attention and, therefore, have a greater number of practitioners, especially in Brazil, an extremely favorable country for this sport. However, increasing reports of fatal incidents in open water races brought the medical and scientific community to attention. The aim of this study was to review the characteristics of deaths in open waters events in Brazil from 2009 to 2019. The survey was divided into 3 steps: 1) contacting sports-related federations and companies, including swimming and triathlon federations, master associations and event organizing companies; 2) internet search; and 3) personal communication with athletes, coaches, organizers, and health personnel. A total of 12 deaths were observed in open water swimming races, including triathlon swimming segment races in Brazil from 2009 to 2019. The average was 1.1 deaths per year, whereas in the last 3 years (2017-2019) the average was 3 deaths per year. The male participants accounted for 11 deaths (91.7%), the average age was 47 years old, experienced athletes were more affected (80%), and incidents occurred mainly in ocean waters (75%). The increase of deaths in the last 3 years draws attention, and the best way to reduce the deaths by drowning in open waters in Brazil, is to understand the profile and causes, to propose solutions.

KEY WORDS: Drowning, water sports, athletic performance, accident prevention

INTRODUCTION

Since the inclusion of the open water marathon race in the Beijing Olympic Games in 2008, the sport has won greater media attention and, therefore, a greater number of practitioners. In 2010, the fatal drowning of swimmer Francis Crippen during the FINA Open Water World

Championship (24) shed light on the problem of deaths in open water and swimming triathlon events.

Researchers have reviewed the data on deaths in open water swimming competitions, and the results are alarming. Harris et al. (11) examined participant deaths from USA Triathlon (USAT) records, national records of sudden deaths in athletes in the USA and other sources to determine incidence and prevalence of deaths for triathlon races from 1985 to 2016. The resulting data revealed 122 deaths in triathlon races, of which 85 (70%) occurred in the swimming segment. Cardiovascular problems were considered as the primary cause of these fatal events Windsor et al. (30) in a recent survey in the UK, reported five deaths in triathlon races from 2009 to 2015, three of them were during the swimming segment.

The deaths of athletes in open water races and the predominance of the number of cases in the triathlon swimming segment led the scientific community to try to understand this phenomenon, raise awareness and try to reduce these deaths (25). Being in the water already represents a risk, the inability to keep the airways out of the water in cases of a total or partial reduction of aquatic competence due to some trauma or sudden illness and/or unconsciousness increases the possibility of drowning (23, 25).

The causes of the higher rate of deaths in open water swimming races when compared to other sports is worrying researchers that have been trying to understand it (11, 13, 30). Open water swimming has peculiarities that may offer some insights. Eichner, Dressendorfer and Tipton (9, 10, 27) hypothesize that anxiety/panic crisis, swimming-induced pulmonary edema (IPE), autonomic conflict and the Long QT Syndrome (LQTS) are some explanations of the greater number of swimming incidents compared to other sports such as running and cycling.

Brazil is an extremely favorable country for swimming in open water due to its geographical characteristics (8), with an extensive coastline and large hydrographic basins which increases the risk of death due to exposure to the water environment. Even though official statistics have extensive data about drowning in Brazil, there are no accurate data about deaths in open water swimming events, including triathlon (swimming segment), pointing a gap in the literature.

Over the years, there has been an increase in Brazilian open water races and, consequently, a possible increase in number of deaths by drowning. Attempting to understand the burden, its profile, and causes, and propose solutions to reduce this, the aim of this study was to review the characteristics of deaths, in open waters races, in Brazil from 2009 to 2019.

METHODS

Design and sample

A retrospective survey of the number of deaths in open water events in Brazil from 2009 to 2019 were done, including the triathlon swimming segment and deaths during the whole swimming route (from the start area until the first minutes after arrival on land). Deaths during training or

in swimming pools were excluded. The 11-year period (2009 to 2019) was selected, due to the growth in the number of races after the inclusion of the water marathon race in the Beijing Olympics (2008). The limitation up to 2019 was due to the reduction in the number of open water races due to the pandemic of COVID-19.

The study does not use methodological procedures that involve the use of data captured with participants or identifiable information or that may entail greater risks than those in everyday life, according to Brazilian Health Council Resolution nº 510/2016. The present study was carried out according to the Declaration of Helsinki (31). We also follow the ethical standards of the International Journal of Exercise Science (16).

Protocol

For stratification purposes, the cases were separated between experienced and non-experienced swimmers according to the data obtained through media reports and personal reports. Considering that in Brazil there is no official record of deaths in open water swimming races, the survey was divided into 3 research areas (Sports Cia., Internet search and Personal communication).

The first area was by contacting sports-related federations and companies, including swimming and triathlon federations (by e-mail and institutional phone), swimming master associations, and event organizing companies. Individuals at these institutions were asked if there were any reports of deaths during open water swimming events from 2009 to 2019.

The second area was the analysis of internet search. The platforms Google, Yahoo and DuckDuckGo were used. Social networks as Facebook, Twitter, YouTube channels and Instagram were also searched. The search occurred from June to September 2020, using keywords in Portuguese as descriptors for *Descritores en Ciencias de la Salud (DeCS)* or words in the text: "death", "drowning", "accident", "swimmer", "athlete", "competitor", "open water swimming", "swimming", "triathlon", "marathon swim" and "crossings".

The third area used personal communication by social apps, contact through social networks and application groups with people interested in the topic (practitioners, coaches, and enthusiasts) to survey athletes, coaches, organizers, health personnel by personal recall reports. The results were all compared and duplicated cases were excluded after extracting quality data if needed.

The investigated data were age, sex, level of experience, race distance, location, swimming route moment, type of race and cause of death. Participants were classified as experienced when linked to federations and with previous experience in several competitions with similar characteristics.

The moments of the races where the fatal incidents occurred were divided into: Start (pre-start in the water or out), opening (1/3 of the race), middle (2/3 of the race), final (3/3 of the race) and arrival (when the arrival was on land).

Statistical Analysis

The statistical procedures consisted of descriptive analysis using measures of central tendency (mean) and dispersion (standard deviation), and absolute and relative values.

RESULTS

10 results of deaths were found using the internet search, and 2 more cases of death were identified by personal communication. Of the nineteen sports federations, associations, and event organizers contacted, only eight returned with information, but with no reports of death.

A total of 12 deaths in open water events were identified in Brazil from 2009 to 2019, distributed as: eight (8) in the Southeast region, two (2) in the Northeast region, one (1) in the South region and one (1) in the North region. Male participants were accounted for 11 deaths (91.7%). The only death reported of a woman was in an accident caused by a boat crash. The average age of the incidents was 46.6 years old.

Of the collected data (10 reports), 8 were considered experienced swimmers and only 2 were non-experienced. The most critical points of the races were the opening (23%) and the final (33.3%), whereas the races between 1 km and 5 km represented the largest number of deaths (45.4%). Incidents were mostly recorded in oceanic waters (75%).

Table 1 presented the epidemiological findings and Table 2 presented a detailed information about the place, race, and cause of athletes' death in each open water race in Brazil from 2009 to 2019.

Table 1. Summary of deaths and complementary data in open water events in Brazil from 2009 to 2019.

Variables	N (%)
<i>Total of deaths</i>	12 (100%)
Men	11(91.7%)
Women	1(8.3%)
<i>Age (years old)</i>	46.6 ± 8.6
<i>Type of Race</i>	
Open Water	10 (83.3%)
Triathlon (swimming)	2 (16.7%)
<i>Race moment</i>	
Start	1 (8.3%)
Opening	3 (25%)
Middle	2 (16.7%)
Final	4(33.3%)
Arrival	2 (16.7%)
<i>Event distance</i>	
< 1 km	2 (18.2%)

< 3 km	5 (45.4%)
< 5km	3 (27.3%)
Above 5km	1 (9.1%)
Level*	
Experienced	8 (80%)
Not experienced	2 (20%)
Local	
Ocean	9 (75%)
Lake/Lagoon/Dam/River	3 (25%)
Cases per year	1.1

*Percentual by available data; ‡ Standard Deviation

Table 2. Reports of Brazilian drowning deaths in open water race from 2009 to 2019.

<i>Year</i>	<i>Place</i>	<i>Athlete information</i>	<i>Race Information</i>	<i>Cause of Death</i>	<i>Report and additional information</i>
2019	Salvador, BA.	Male, 51 yrs. Athlete (Experience in long distances)	1 st Stage of the Bahian Championship of Water Marathons - Museum of Modern Art Beach (Distance: 3km).	Sudden illness during the race at the end of the first lap (there were 3 laps of 1km).	ND.
2019	Ilha Bela, SP.	Male, 34 yrs. Athlete (Amateur)	Crossing and Water Marathon of Fuga das Ilhas - Barra do Sahy Beach (Distance: 2km).	He felt sick at the start, vomiting convulsion. He went into the water to warm up and asked for help. The victim passed out, vomited, and suffered convulsions while still on the rescue boat.	According to athletes' reports, it was a race with a very large number of participants and limited support boats.
2019	Florianópolis, SC.	Male, 57 yrs. Recreational swimmer and surfer	Campeche Island Crossing (Distance: 1.5 km).	Drowning caused by cardiorespiratory arrest.	ND.

2018	Palmas, TO.	Female, 40yrs. Athlete (Federated athlete with 2 years of experience)	6 th Stage of the Tocantis Aquatic Maraton Circuit – Graciosa Beach (Distance: 2.5km).	The athlete was hit by the firefighter’s speedboat. The incident occurred after halfway. The race started with good weather conditions and turned abruptly (heavy rain and wind). The athlete lost a lot of blood due to the leg amputation.	Possible security failure. Climatic condition with a lot of rain / low visibility associated with unprotected speedboat propeller. Firefighter's speedboat was out of the circuit.
2018	Caraguatatuba, SP.	Male, 61yrs. No information available	Mares Circuit – Cocanha Beach (Distances between 500m and 5 km).	The athlete died after the race. Cardiac arrest possibly associated with the use of energy drinks.	The Organization did not require a medical certificate
2018	Ubatuba, SP.	Male, 30 yrs. Rookie in the race	21K Beach Challenge - Crossing between Cais Hill and Tenório Beach (Distance: 21km).	Cardiorespiratory arrest in the final stretch of the race.	Very sunny with high temperatures.
2017	Fortaleza, CE	Male, 48 yrs. Athlete (Experienced)	Ironman 70.3 (Triathlon) – Formosa Beach (1.9 km of Swimming).	Drowning with Hypothesis ischemia and cardiac arrest. The third of the race that death occurred is uncertain	The sea was difficult, and 25 athletes were removed from the water.
2017	Rio de Janeiro, RJ.	Male, 39 yrs. No swimming experience	Fluminense Federal University Triathlon Circuit – Recreio Beach (Distance: 750m of swimming).	After the start (his foul was given after 30 minutes of testing), an undisclosed cause. The athlete did not get to take the bicycle. However, don’t know exactly which third of the race occurred.	ND.
2017	Uberlândia, MG.	Male, 48 yrs. Athlete (Experienced)	Milk Trail – Capim Branco Dam (Distance: 4km).	The athlete felt sick in the final kilometer of the race. The suspected cause would be a massive heart attack.	ND.

2016	Arraial do Cabo, RJ.	Male, 50 yrs. Athlete (Experienced athlete and surfer)	Arraial Swim Race – Farol Beach (Distance: 3.5 km).	The athlete felt sick at the final third of the race.	ND.
2010	Rio de Janeiro, RJ.	Male, 48 yrs. Athlete (Experienced)	Fort Crossing – Copacabana Beach (Distance: 4 km).	Suddenly ill in the final third. After 45 minutes of attempted resuscitation, the athlete suffered cardiorespiratory arrest.	ND.
2009	Belo Horizonte, MG.	Male, 33 yrs. Athlete (Federated)	Triathlon Minas Meeting Movement, Alpha Vile Lagoon of Ingleses (Distance: 1.5 km).	Death occurred in the first third of the race. The cause is apparently undetermined	ND.

Legend: yrs.: years-old, ND: nothing declared.

DISCUSSION

The average of 1.1 deaths per year found per se can be considered an important data, but what stands out is an increase in the average mortality rate (3 per year) in the last 3 years analyzed (2017, 2018 and 2019), associated to a possible underreporting due to lack of official data. Part of the explanation may be associated with the success of the activity and the increase in the number of participants. At the Rio Olympics (2016), Poliana Okimoto won the first Brazilian medal in the history of aquatic marathon. It seems that this feat increased the search for open water swimming competitions among enthusiasts, especially from 2017 onwards.

The study showed race distances between 1 km and 3 km had the highest number of deaths. It is important to emphasize that short races are more frequent, which can cause a bias. However, adverse events in the water do not seem to be directly related to the distance of the race, but to the fact that swimmers with less experience may choose short events as more appropriate to them (11). Corroborating the incidence of death with Harris et. al. (11) data during the races was not directly related to the duration of the competition, with the majority of fatalities paradoxically occurring during shorter runs.

During these 11 years surveyed, 9 deaths (75%) occurred in competitions at the ocean. According to *Swim Channel* magazine, only 15% of 171 amateur open water events scheduled for 2020 in Brazil would take place (although never occurred because of COVID-19 pandemic) in fresh water (dams, lakes, rivers), this helps explain the predominance of adverse events in the ocean in Brazil. Although most of the events occur in the final part of the races (33%), where theoretically the fatigue and the increase in the pace due to a dispute for position causes cardiac overload, apparently it is no different from other moments in the race.

Due to the lack of official records, it was not possible to determine the total number of participants involved in all open water races in Brazil, to report the proportion of deaths per

100.000 participants. Harris et al. (11) showed an incidence in Triathlon of 1.17 deaths per 100.000 participants in swimming, higher than cycling (0.27) and 0.19 in the running segment. Dayer & Green (7) reported the value of 0.67 deaths for every 100.000 participants in street marathon events. In our study it was only possible to find the average number of deaths per year, which was 1.1 deaths/year from 2009 to 2019. When analyzing only the last 3 years (2017 to 2019), the rate is practically triple (3 per year).

In general, authors (11, 30) report that deaths in competition, are mainly caused by cardiovascular disease but there are no precisely determined causes of death, as there is no follow-up by specific agencies and media. Harris et.al. (13) drowning study identified the cause of death along the triathlon swimming segment in 9 cases, where seven athletes' autopsies presented cardiovascular abnormalities or diagnostic pre-conditions such as left ventricular hypertrophy, Wolff-Parkinson-White Syndrome, or congenital coronary artery anomaly. Swimming can trigger arrhythmias in competitors (especially in cold water) and be the primary cause of what becomes or appears to be a primary drowning (low water competence against the environment risk), explaining the higher number of deaths in relation to other out-of-water sports (20). A large number of those deaths could be considered to have a secondary cause, since once a person is in the water, the inability to remain with their airways out of the water due to sudden illness, fatigue, unconsciousness, or injury can lead to drowning, playing an important role (25).

The Long QT syndrome (LQTS), a disease characterized by the widening of the space between depolarization (Q wave) and ventricular repolarization (T wave), can cause severe arrhythmias with sudden death (29). The LQTS could manifest in episodes of ventricular arrhythmias during exercise, especially during swimming (17). Episodes of LQTS are more common in swimming since the simultaneous facial immersion with physical effort can promote premature ventricular contractions (4). The "Autonomic conflict" that develops by concomitant activation of sympathetic and parasympathetic tone can cause cardiac arrhythmias, which can be fatal, mainly in athletes with pre-existing conditions. In an open water race several factors can trigger this co-activation: cold water, stress, apnea, swallowing water and diving reflex (5, 20, 27). Some common drugs can also cause a prolongation of the QT interval, and may thereby promote autonomic conflict (20). There are also others factors like panic/anxiety crisis, especially at the swimming segment of races, at the start and turning buoys where agglomerations cause great confusion promoting distress, swallowing and/or water aspiration (9).

Swimming-induced pulmonary edema (SIPE) is another possible cause for an adverse event, where hydrostatic pressure, cold vasoconstriction and/or pronated swimming position combine to the increase of blood volume in the central region of the body, overload the pulmonary vascular system, especially in cold water, increasing the pulmonary artery pressure and promoting an acute pulmonary edema (9, 14). However, Spencer et al. (21), in a systematic review of the topic, did not find conclusive evidence for the risk of developing SIPE in open water swimmers.

In recent years, swimming in cold water without a wetsuit is growing in popularity (6). Despite the fact that cold water-induced skin cooling is linked to a series of important cardiac changes (28), local muscle cooling and general hypothermia, this may also affect open water swimmers, especially long distances (3), eliciting the need to closely monitor athletes regarding water temperature. The body heat exchange (loss or gain) is faster in water than air and the heat exchange for swimmers is predominantly determined by water temperature, personal heat capacity and thermal conductivity and convective of heat loss (19). Mild hypothermia or hyperthermia produces symptoms, especially in acclimated athletes. Moderate to severe problems usually occur in high-performance athletes due to their determination to finish the race. Altered deep body temperature may cause disorientation and lack of capacity to adequately judge limits and their water competences, exposing the athlete to a greater risk. If this is not recognized and interrupted by the coach or the paramedical/rescue team, it may lead to drowning and death (10, 15).

During Francis Crippen's death, described previously, water above 30°C may have been the primary trigger. The championship rules also may have had a negative impact as the athletes needed to complete the race to be qualified. After this incident, FINA provided an important change to the rules.

In this review, it was observed that males were primarily affected and the cardiovascular problems were reported to be among the most common in the context of the cause of swimming race deaths (11, 13, 30). In general, in sports, men have a higher incidence of sudden cardiac death than women and suffer more fatal events (91.7%) (1). Harris et al. (13) point a ratio of 2.40 deaths for men versus 0.74 for women for every 100.000 triathlon participants. Some factors may play a role in this sex ratio difference: the reduced number of women in races; the women understand and respect their water competence limits, which may be influenced by the levels of testosterone (2); and women are less affected by heart disease, influenced by the estrogen hormonal levels (18).

The southeast region was the top ranking of drowning deaths (66.7%), but this region hosts the majority of the events (64%) according to the amateur open water competition calendar scheduled for 2020 (22).

Dressendorfer (9) stated that most deaths during triathlon swimming occurred near the start area, even with calm waters. The present study identifies the most critical part of the race as the start (including preparation and initial stretch) and the final point (including the arrival or transition), suggesting that these points should be given special supervision. Leaving and arriving on the sand are common in amateur races and represent extra physical and psychological stress for the athlete. Furthermore, there is a cardiovascular strain, which occurs due to the change from the immersed horizontal position to an upright posture in air, with the consequent loss of the hydrostatic pressure support to the circulation (sometimes compounded by removing tight fitting rubber race suits), that needs to be considered (26).

With the increased number of deaths in recent years, extra care is recommended by organizers and competitors. The participants must take precautions themselves and be aware of the various risks to mitigate them.

Study limitations: There are no official data of deaths from open water swimming competitions in Brazil. The swimming organizations generally do not report death data in open water swimming events. Most of the data was collected from the internet, and underreporting may occur. In this research, it was not possible to determine the exact causes of deaths, since most of the data was collected from information available in reports on the internet.

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