Article

A South African Epidemiological Study of Fatal Drownings: 2016 – 2021

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Abstract: Drowning is a serious public health concern. Low middle income countries are mostly affected, as they carry 90% of the global drowning burden. The purpose of this epidemiological study is to provide a comprehensive overview of fatal drownings in South Africa between 2016 and 2021. The data used for the study was obtained from the South African Police Service. Descriptive statistics were used to summarise data. Statistical analysis included a t-test and chi-square test. The results indicate that the average fatal drownings per annum is 1477 in South Africa, with a drowning rate of 2.54 per 100 000 population from 2016 - 2021. The KwaZulu-Natal province had the highest incidence of drowning. The 0 – 4-year category has a high prevalence of drowning amongst all the age categories. More males drowned in South Africa compared to females. The study highlights key areas of concern these include age, sex, race, province, type of water body and time of day. This information is crucial to inform drowning prevention initiatives in South Africa.

Keywords: drowning; epidemiology; low-and-middle-income; South Africa

1. Introduction

Over recent years, research into fatal drownings has increased, highlighting fatal drownings as a serious public health concern [1]. The World Health Organization (WHO), together with various organisations, have been at the forefront of advocating for drowning prevention interventions [2]. However, for drowning prevention interventions to be targeted, this requires guidance from epidemiological data [3]. Most epidemiological studies have taken place in developed countries, and as such, the recommended drowning prevention interventions are designed for this target audience and may not be applicable to low-and-middle income countries (LMICs) [4].

LMICs have been referred to as having the highest burden of global drownings [5]. Approximately 90% of the annual global drownings occur in LMICs [6, 7, 8]. Furthermore, Africa has been reported to have the highest drowning rates [5]. Varying reasons have been cited as contributing factors for the high burden of fatal drownings in LMICs, which include but not limited to the lack of drowning prevention initiatives, the lack of regulations and policies related to drowning prevention, insufficient water safety awareness and education campaigns, and no basic swimming skills [6, 9, 10].

The key variables identified in various studies pertaining to fatal drownings include age, sex, location, day and time of fatal drowning incidents [6, 11]. Race is an important variable in South Africa, as it provides crucial information in terms of risk factors affecting a particular racial group [12].

In LMICs, fatal drowning incidents are prevalent in children under the 5-year age group. A report in 2013 indicates that 50% of drownings occur in children between 0 – 4 years [13]. In Bangladesh, 43% of drowning deaths occur in children between 12 and 59 months [7]. Often drownings amongst children 0 – 4 years have happened within 3 to 20m of the home and where there was no adult supervision [8, 14].

Several studies indicate that fatal drownings are more prevalent in males than females [6, 13, 15]. Numerous reasons have been cited in connection with why males are more likely to drown; these include increased exposure to water, males being more confident about their swimming ability than females, cultural bias, and males were more likely to take risks [6, 16].

Drowning has also been categorised into small and large bodies of water; the findings of these studies was that most drownings occur in small bodies of water [6]. Freshwater has been reported as a more prevalent site for fatal drownings [17]. LMICs have a higher incidence of freshwater drownings, especially since freshwater drownings often include cisterns, wells and small bodies of water [6]. For instance, freshwater drownings in Bangladesh accounted for 80% of drownings [18]. The highest fatal drowning incidence in Australia was reported in natural water locations [19].

Whilst there has been an increase in drowning prevention research wherein 1995 there were nine countries represented in drowning research, in the time 2015 to 2020, there were 79 countries represented [1]. In the top ten countries list of drowning published research, Africa does not appear in this list and only two LMICs appear in the top ten [1]. Evidence indicates that of the sixteen peer-reviewed drowning publications, eleven articles are from South Africa [20]. These publications in South Africa are limited to particular regions in terms of drowning epidemiology, which therefore necessitates the country's epidemiological fatal drowning study.

The rationale for undertaking this study is to understand the fatal drowning epidemiology in South Africa and to develop appropriate drowning prevention interventions in response to the findings. This retrospective epidemiological study aims to provide a comprehensive overview of fatal drownings in South Africa between 2016 and 2021.

2. Materials and Methods

A death in South Africa is reported using a Death Report Form (Form BI – 1680) which is often completed by a medical officer and/or South African Police Services (SAPS) [21]. Since drowning is classified as an unintentional injury or unnatural death, it will be reported to SAPS, who will open a case for further investigation.

The SAPS has given approval for the use of their drowning recorded data for the period of 2016 to 2021. All identifying information for the data received was omitted, this included unique SAPS case numbers, names, and surnames of the deceased. In addition, ethical approval was received from Pharma Ethics, an independent organization awarding ethical approval to non-academic organizations such as the National Sea Rescue Institute.

The drowning data available included age, race, sex, location of drowning, circumstance of drowning, date, day and time of the drowning incidence. Descriptive statistics were used to summarise data, and the results were presented using frequency tables and graphs. Drowning mortality rates and age-standardised drowning rates, per 100,000 population were calculated.

Age-standardised drowning mortality rates (per 100,000 population) for sex (males and females) and race (Blacks, Coloureds, Indians and Whites) were calculated. The 2021 South African mid-year population estimates were used to calculate all age-adjusted rates [22]. The t-test and chi-square were used to investigate whether drowning fatalities differed between males and females, and across race groups respectively.

3. Results

In Table 1, the number of drowning incidents per year for the period 2016 to 2021 is presented, with the highest incidence of drownings being recorded as 1526 in 2021 and the average drowning per annum for the period being 1477.

Table 1. Drowning Mortality Rates per annum.

Year	Fatal Drownings	Population Size[23]	Drowning Mortality Rate per 100 000 population
2016	1519	56207646	2,70
2017	1482	57009756	2,60
2018	1463	57792518	2,53
2019	1471	58558270	2,51
2020	1401	59308690	2,36
2021	1526	60978505	2,50
Average	1477	58309231	2,54

Location and Timing

The KwaZulu-Natal province has the most reported drownings, with 2114 drownings recorded from 2016 to 2021, followed by the Eastern Cape, Gauteng, and the Western Cape, this is depicted in Figure 1.
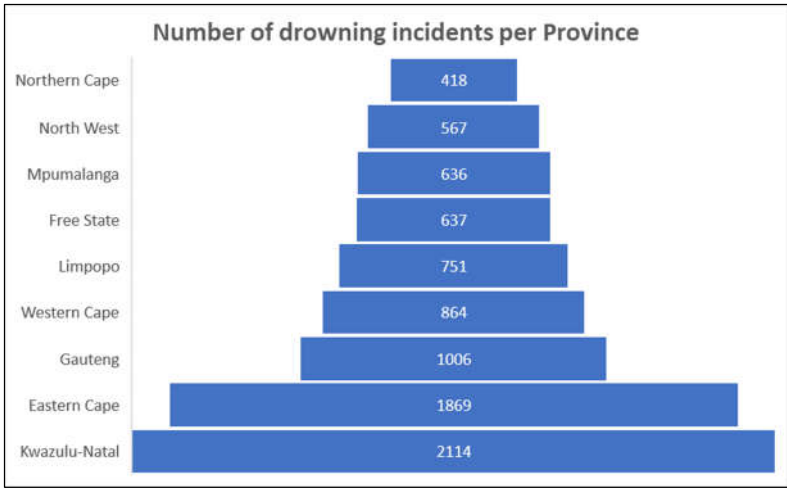

Figure 1. Number of Drowning Incidents per Province, 2016 to 2021.

The place and circumstance of the drownings was categorised into freshwater (which includes canal, dam, dipping tank, ditch, donga, gully hole, lagoon, mineshaft, reservoir, river, stormwater pipe, stream, swamp, well etc.), pool or swimming pool, ocean (which includes harbour, sea or salt water), around the home (which includes bath, bucket of water, drum of water, fish pond, fountain, toilet, septic tank) and other (where it is not specified). The highest number of drownings occurred in freshwater, with 3713 drownings reported from 2016 to 2021; this is illustrated in figure 2.
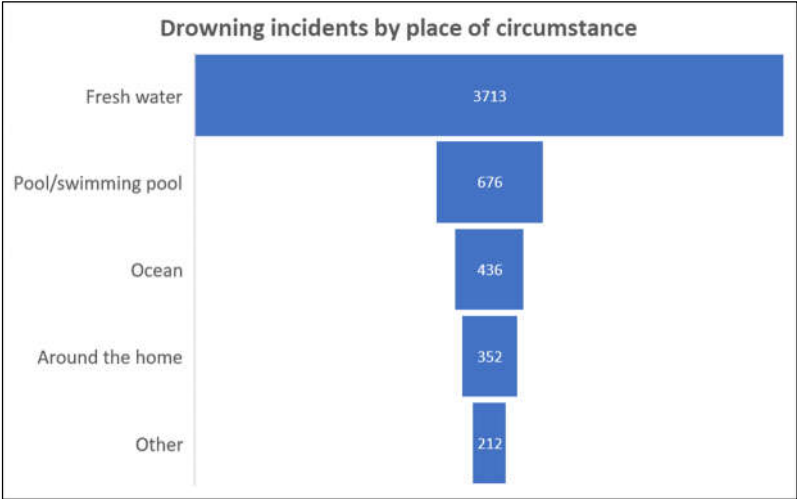
Figure 2. Drowning Incidence by Place of Circumstance in South Africa, 2016 – 2021.

During the month of January, the number of fatal drownings was recorded as 1171, whereas February was 931 and November, 882. Sundays was the day of the week when fatal drownings (n = 1591) occurred more frequently, followed by Saturdays (n = 1503). Fatal drownings have been most frequently reported as occurring between 16h00 – 19h59 (n = 2639).

Sex and Age

The results indicate that fatal drowning incidents are the highest amongst males, representing 5820 drownings between 2016 and 2021, whereas only 1357 females drowned during that period.

Table 2 illustrates the sex-and-age-specific drowning rates in South Africa between 2016 and 2021. Males had the highest drowning rate (per 100,000 population) in all age groups, with the highest age-specific drowning rate being 56 males per 100,000 population amongst the 0 – 4 years from 2016 to 2021.

The overall age-adjusted female drowning rate is 4 people per 100,000 population; and for males, the overall age-adjusted male drowning rate is 17.8 people per 100,000 population for the period 2016 to 2021.

The age group where the most fatal drownings occurred from 2016 to 2021 was the 0–4-year category, with 2755 incidents and an age-adjusted drowning rate of 48 per 100,000 population. The other age group where the fatal drowning incidence was high included the 5 – 9 years, 10 -14 years and 15 – 19 years, as shown in Table 2. The male: female ratio results (>1) indicate that drowning fatalities were higher in males than in females. The t-test indicates that there was a statistically significant difference between the proportions of drownings of males and females (p-values > 0.05).

Table 2. Gender and Age Specific Drowning Rates in South Africa, 2016 – 2021.

Age	Number of drowning incidents	Age-specific drowning rates (per 100000 population)				
		Males	Females	Total	Male: Female ratio	P values
0-4	2755	56	39	36,9	1,4	< 0.002
*5-9	763	20	6	12,7	3,3	< 0.0001
*10-14	803	21	6	13,5	3,3	< 0.0001
15-19	508	17	3	9,9	5,0	< 0.0001
20-24	384	13	3	7,6	4,8	< 0.0001
25-29	420	13	2	7,3	5,3	< 0.0001
30-34	405	12	2	6,9	5,6	< 0.0001
35-39	315	10	2	5,9	4,3	< 0.0001
40-44	266	11	3	6,3	4,0	< 0.0001
45-49	199	10	3	5,6	3,8	< 0.0001
50-54	183	12	2	6,5	5,1	< 0.0001
55-59	123	9	2	5,0	3,9	< 0.0001
60-64	106	11	2	5,6	4,9	< 0.0001
65-69	68	9	2	4,6	6,0	< 0.0001
70-74	65	10	4	6,0	2,5	< 0.0001
75-79	44	10	5	6,5	1,9	< 0.0500
80+	38	11	4	5,9	2,9	< 0.005

Table 3 depicts the age-and race-specific drowning rates. The 0 – 4 years age category, had the highest burden of fatal drownings amongst all the age groups. In particular, the white population group in the 0 – 4 age categories, had the highest age and race specific drowning rate for the period 2016 – 2021, which was 57 per 100,000 population. For the other population groups in this age category, the drowning rates were 41 per 100,000 for the coloured, and 36 per 100,000 for the black population.

Table 3. Number of Drownings per Age Category; South Africa2016-2021.

Age group	Mid-year population size (thousands)	Number of drowning incidents	Drowning rates per 100,000
0-4	5708956	2755	48
5-9	5663296	763	13
10-14	5671023	803	14
15-19	4909941	508	10
20-24	4739305	384	8
25-29	5324134	420	8
30-34	5630643	405	7
35-39	4985251	315	6
40-44	3881731	266	7
45-49	3254138	199	6
50-54	2625390	183	7
55-59	2243823	123	5
60-64	1815810	106	6
65-69	1422604	68	5
70-74	1024345	65	6
75-79	647265	44	7
80+	595323	38	6
Total	60142978	7445	**12**

The cumulative age-adjusted drowning rate per 100,000 population is 12.5 for the coloured racial category from 2016 to 2021. In comparison, the age-adjusted drowning rate per 100,000 population is 11.1 for the black racial category. The age-adjusted Indian drowning rate per 100,000 population is 6.4. Lastly, the age-adjusted drowning rate per 100,000 population is 9 for the white racial category. The chi-square test indicates that there was a statistically significant difference in the proportions of fatal drownings between Black, Coloured, White and Indian population groups (all p-values > 0.05).

Table 4. Age-specific and race specific Drowning Rates in South Africa, 2016 to 2021.

Age	Black	Coloured	Indian/Asian	White	P-values
0-4	36	41	27	57	< 0.0001
5-9	13	15	4	4	< 0.0001
10-14	15	12	2	1	< 0.0001
15-19	10	11	3	4	< 0.0001
20-24	8	11	6	1	< 0.0001
25-29	7	10	5	6	< 0.0001
30-34	7	7	4	4	< 0.0001
35-39	6	8	3	3	< 0.0001
40-44	6	9	6	5	< 0.0001
45-49	5	11	4	6	< 0.0001
50-54	7	7	7	5	< 0.0001
55-59	5	6	5	5	< 0.0001
60-64	6	7	3	5	< 0.0001
65-69	5	4	3	4	< 0.0001
70-74	7	1	2	8	< 0.0001
75-79	7	3	4	7	< 0.0001
80+	9	2	4	5	< 0.0001

Table 5 presents the age-adjusted drowning rates in all South African provinces. As indicated, the highest age-adjusted drowning rate per province for the period 2016 to 2021 was reported for the Northern Cape at 34.4, followed by the Eastern Cape at 23,7, the Free State at 16.8, KwaZulu-Natal at 15.5, Western Cape at 11.0, Limpopo at 10.1, Mpumalanga 10,0, North West at 8.6 and Gauteng at 5.6 being the lowest. To conclude, the crude drowning rate per 100,000 population in South Africa was 12.4 for the period 2016 to 2021. Furthermore, the results indicate that in all the provinces, younger people are more likely to be involved in drowning incidents than older people.

Table 5. Age-specific drowning rates per 100,000 population for South African Provinces, 2016 – 2021.

Age (years)	Age-specific drowning rates (per 100,000 population)								
	EC	FS	GP	KZN	LP	MP	NC	NW	WC
0-4	62	92	33	49	37	52	141	32	44
*5-9	30	11	4	17	10	12	34	8	12
*10-14	30	16	5	17	10	11	40	8	10
15-19	19	12	2	15	11	7	28	6	8
20-24	14	12	2	11	8	5	18	8	11
25-29	20	8	2	11	7	2	27	10	8
30-34	16	9	2	11	7	4	28	6	6
35-39	17	6	2	8	6	5	21	6	4
40-44	19	4	2	10	6	3	19	5	7
45-49	17	6	2	10	4	3	11	4	6
50-54	20	8	1	13	6	2	22	4	4
55-59	16	4	2	8	4	2	4	5	4
60-64	13	5	2	10	6	1	10	4	5
65-69	16	3	1	7	1	5	9	1	4
70-74	16	4	2	10	6	4	8	2	4
75-79	15	9	1	11	6	0	0	2	8
80+	10	7	8	7	6	2	6	0	4
Total	23.7	16.8	5.6	15.5	10.1	10.0	34.4	8.6	11.0

4. Discussion

The average number of fatal drowning incidents that occurred in South Africa from 2016 to 2021 is 1477. This average is far below the average of other LMICs, where the average number of drownings have been reported as 4624 per annum [13]. South Africa globally is listed in the top 45 countries with the drowning rate of 4.06 per 100,000 population [24].

The results indicates that South Africa had an annual fatal drowning rate of 2,54 per 100,000 population from 2016 to 2021, with the highest drowning mortality rate reported in 2016 (2,7 per 100,000 population) and the lowest in 2020 (2,36 per 100,000 population). Although South Africa does not have the high drowning incidence as other LMICs, there remains a concern for the fatal drownings rates reported.

In 2021, 1526 fatal drownings were reported, which is the most drowning incidence that occurred annually in the six-year period of reporting. When comparing the drownings that occurred in 2020 (1401 fatal drownings) to 2021 (1526 fatal drownings), the increase in drownings could be attributed to the ease of restrictions following the reduced burden of COVID-19. Similarly, the low drowning incidence in 2020 could be attributed to the stringent COVID-19 restrictions, which included the ban on alcohol, no access to beaches and public swimming facilities and limitations to gatherings. This suggest that alcohol does play a role in fatal drowning, and this is confirmed by the available literature [15].

The results indicate that drownings are most prevalent in KwaZulu-Natal, with 2114 drownings over the six-year period. Factors which could contribute to the fatal drowning burden include the province being the largest in geographical size, having the most water related environments, experiencing a sub-tropical climate which allows for swimming throughout the year and having the largest population size amongst the nine provinces [25, 26]. This epidemiological information guides drowning prevention strategies and aids the design and implementation of drowning prevention interventions to ensure they are specific for the geographical regions.

Fatal drownings occurred more frequently in freshwater in South Africa during the period 2016 to 2021. This is in keeping with the findings of the LMICs epidemiology of drowning which indicates that drownings are common in small bodies of water, such as cisterns and wells, as they are commonly used [6].

The research findings highlight that the timing of fatal drownings is most likely to occur in January and February; these months are reported as the warmer months in South Africa. Research has indicated that the drowning incidence was higher in warmer months due to the increase in water activities [15]. The day of the week reported as the day when fatal drownings frequently occurred are on Sundays, which is a recreational day when people can go dams, beaches, swimming pools etc. in South Africa. With these results, adequate drowning prevention interventions can be implemented. For example, increasing lifeguard coverage during the months of January and February, especially on Sundays with a focus on the time period 16h00 to 19h59.

In this study, males represent 81% of all fatal drownings from 2016 to 2021 and females 19%. The male: female ratio indicate that males are more likely to drown than females, as the ratios are greater than 1. The t-test indicated that there was a statistically significant difference between the proportions of females and males who drowned (p-value < 0.0001).   Multiple studies have reported that males engage in more physical risky behaviour than females; hence, drownings are more likely to occur. This epidemiological finding highlights targeted education and behaviour modification interventions required for males.

The age-specific drowning mortality rate indicates the 0 – 4 years age group being the highest, with a cumulative drowning incidence of 2755 fatal drownings and a rate of 48 per 100,000. This can be further represented as 1 drowning per day amongst 0 - 4 year-olds. The hypothesis is that the black population in the 0 – 4 year age group has the highest drowning incidence. However, this study has highlighted using the data provided that the highest drowning incidence occurs in the white population amongst the 0 – 4-year age group. The place where most of the drownings occurred, in this age category, took place in the Northern Cape. This is an alarming statistic as drowning is a preventable injury. In addition, the Northern Cape is not an area which has been prioritized for targeted drowning prevention interventions.

The result of the study provided evidence that the black population in South Africa has the highest incidence of fatal drownings (n=6102), for the period 2016 to 2021, cumulatively for all age groups. Further to this, there is statistical significance in the fatal drownings across racial groups. This high incidence of drowning amongst previously disadvantaged groups is influenced by various social determinants such as poverty, education, and infrastructure. Similar differences in drownings amongst racial groups have also been reported in other countries, where black persons are 1.5 times more likely to drown than white persons [27, 28]. The evidence from the study provides vital information in ensuring that drowning prevention interventions are prioritized amongst the most at risk racial groups.

The information gathered from this epidemiological study will assist in informing drowning prevention initiatives and guide the development of regulations and policies that aid drowning prevention.

The drowning data obtained only included fatal drownings that were reported or when a body was recovered. The information does include unreported incidence or where a body was not recovered [29]. The reporting limitation is further complicated by the lack of classification of drownings, this is a global challenge, since drownings related to natural disasters (e.g., floods) are not reported [30]. Stemming from this no drowning prevention interventions are being implemented or prioritized.

Data available did not include information regarding the use of alcohol, swimming ability and whether there was adult supervision. It also did not include what was the pre-event to drowning and if any cardiopulmonary resuscitation was administered. Future studies should include all these variables to determine whether they contribute to drowning fatalities in South Africa.

5. Conclusions

The six-year retrospective epidemiological South African drowning study provides comprehensive data. This data highlights key areas of concerns which will inform South Africa's drowning prevention initiatives.

The time and location of drownings is important as there is a distinct need for targeted drowning prevention interventions. The most prevalent time when drownings occurred is on Sundays, during the time 16h00 – 19h59. The province with the highest incidence of drowning is the KwaZulu-Natal province.

With regards to the age of fatal drownings, the 0 – 4-year age category amongst the white and coloured population, in specific regions in South Africa such as the Northern Cape, Free State and Eastern Cape requires priority. Males in all age categories should be the focus of drowning prevention initiatives which could include swimming skills programme, education in schools and the promotion of personal flotation devices in water sports. Across all age categories the black population group had the highest incidence of drowning. Specific interventions relevant and appropriate to this population group are required.

Recommendations from this study include the improvement of the collection of fatal and non-fatal drowning data. This data would contribute significantly to the design, development and implementation of drowning prevention interventions that are specific to South Africa. The drowning data would also allow various organisations to measure the impact of their drowning prevention interventions.

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