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Fatal drowning in the Western Cape, South Africa: a 7-year retrospective, epidemiological study

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ABSTRACT

Introduction Drowning is a neglected public health threat in low-income and middle-income countries where the greatest drowning burden is observed. There is a paucity of drowning surveillance data from low-resource settings, particularly in Africa. Understanding local epidemiological factors will enable the development of context-specific drowning prevention initiatives and the appropriate allocation of resources.

Aim The primary aim of this study was to describe the epidemiology of fatal drowning in the Western Cape, South Africa.

Method This retrospective study describes fatal drowning incidents captured in the Western Cape vital registration system between 2010 and 2016. Data were obtained from the Forensic Pathology Services of the Western Cape Government. One-way analysis of variance was performed to detect a trend in mean drowning mortality rates between 2010 and 2016. χ^2 tests for independence were performed to detect differences in the distribution of variables between groups.

Results A total of 1391 fatal drownings occurred in the Western Cape between 2010 and 2016, with an age-adjusted drowning mortality rate of 3.2 per 100 000 population. Rates were fourfold higher in men compared with women. Children, particularly young children aged 0–4 years, and young adult men between 20 and 34 years of age were identified to be at high risk of fatal drowning. Drowning occurred predominantly in large, open bodies of water with concentrations in summer and public holidays.

Conclusions The Western Cape drowning prevention strategy should prioritise interventions to reduce drowning in children and young adult men, with a targeted focus on festive periods such as public holidays.

lacking, resulting in a poor knowledge base for the development of prevention strategies.^{3,4} The 2014 WHO Global Report on Drowning identified 10 key priority actions for preventing drowning but acknowledged that these interventions are largely based on data from high-income countries and may not be appropriate for LMIC settings.² Rigorous descriptions of injury epidemiology are considered a prerequisite to developing targeted and effective injury prevention interventions.⁵ There is therefore a need for increased surveillance and epidemiological data in low-resource settings, particularly in Africa where there are currently few formal surveillance programmes in order to appropriately address the drowning burden.

South Africa is a middle-income country with a quadruple burden of disease including pretransitional diseases, non-communicable diseases, HIV/AIDS and injury.⁶ According to the Global Burden of Disease Study 2016, the unintentional drowning mortality rate in South Africa has decreased from 5.09 per 100 000 population at the turn of the century to 3.95 per 100 000 population in 2016.⁷ An estimated 2083 lives and 122 479 disability-adjusted life years were lost due to unintentional drowning in 2016.⁷ There is limited literature describing drowning epidemiology in South Africa; however, previous research suggests that the burden and epidemiology of fatal drowning differs between the three coastal and six inland provinces.^{8,9} The Western Cape is a coastal province of South Africa with a population of 5.8 million people (StatsSA 2011 census). In 2017, a number of government departments and non-governmental organisations identified the need for collaboration and coordination of the many small-scale drowning prevention efforts within the province.¹⁰ The Western Cape Government: Directorate for Disaster Management therefore commissioned the collaborative development of a provincial drowning prevention and water safety strategy. However, there is a paucity of published data describing the epidemiology of fatal drowning within the province. The first phase of this project involved a situational analysis of fatal drowning epidemiology within the province, one of just a few with comprehensive mortality data over time, in order to inform the development of recommendations for drowning prevention. The aim of this study was therefore to describe the epidemiology of fatal drowning in the Western Cape between 2010 and 2016 in order to guide the prioritisation and evaluation of context-specific drowning prevention strategies in the Western Cape.

INTRODUCTION

Drowning is the process of respiratory impairment resulting from submersion or immersion in a liquid medium, with outcomes classified as death, morbidity or no morbidity.¹ In 2012, fatal drowning accounted for approximately 372 000 deaths worldwide, making it the world's third leading cause of unintentional injury mortality.² Over 90% of these drowning deaths occur in low-income and middle-income countries (LMICs).² In 2000, the WHO African region reported the highest drowning mortality rate worldwide at 13.1 per 100 000 population, and in 2012, it was estimated that the WHO African region accounted for 20% of the global drowning mortality burden.^{2,3}

The full burden of drowning in Africa is likely underestimated as routine surveillance data is



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Methodology

This retrospective, epidemiological study includes deidentified data describing all fatal drowning incidents recorded by the Western Cape Government: Department of Health: Forensic Pathology Services (FPS) between 1 January 2010 and 31 December 2016. All unnatural deaths in South Africa are required to undergo an autopsy by the appropriate provincial FPS for medicolegal purposes.⁹ All unnatural deaths for which the provincial pathologist confirmed the primary cause of death to be unintentional drowning, regardless of the aetiology or nature of the incident, were included in this study (personal communication: K Jones, FPS). Descriptive data including the age and sex of victims, and the location, date and time of drowning incidents were extracted from the FPS database.

StatsSA provided the Western Cape population data from the 2011 national census and the 2016 community survey.^{11 12} Mean population growth rates were calculated from the difference between 2011 and 2016 population estimates and used to calculate the annual population estimates for each age group in the Western Cape between 2010 and 2016. Age-specific and sex-specific drowning mortality rates were calculated for 5 year age groups, and the WHO World Standard Population was used to calculate age-standardised drowning mortality rates (per 100 000 population) for men, women and the total population. Total population mortality rates were additionally adjusted for sex distribution. The 95% CIs for these estimates are provided where appropriate. One-way analysis of variance was performed to detect a trend in mean drowning mortality rates between 2010 and 2016. A t-test was performed to detect differences in mean drowning mortality rates between men and women, and

children and adults. Descriptive data, including age, location of drowning incident by body of water and the time, day and season of drowning incident, are presented as proportions. χ^2 tests for independence were performed to detect differences in the distribution of these variables between adults and children, and between men and women where appropriate. Statistical significance was set at $p < 0.05$.

These findings are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for reporting observational studies.¹³

RESULTS

The age-standardised sex-adjusted drowning mortality rate for the Western Cape between 2010 and 2016 was 3.2 per 100 000 population (95% CI 3.1 to 3.3; $n = 1391$). Table 1 presents the age-specific and sex-specific mortality rates in each age group. Children (0–19 years) accounted for 39.1% of fatal drowning incidents, with an age-standardised sex-adjusted drowning mortality rate of 3.8 per 100 000 population (95% CI 3.8 to 3.8). This rate was significantly higher than that observed for adults (3.0 per 100 000 population (95% CI 3.0 to 3.0); $p < 0.0001$). The highest age-specific mortality rate was observed in children younger than 5 years old (4.8 per 100 000 population).

The age-standardised mortality rate for men (5.3 per 100 000 population; 95% CI 5.0 to 5.6) was fourfold higher than that for women (1.2 per 100 000 population; 95% CI 1.0 to 1.3; $p < 0.0001$). The drowning mortality rate was significantly higher in men compared with women in every age group except those between 70 years and 79 years (table 1). In women, the

Table 1 Drowning mortality rates for the Western Cape, 2010–2016

Age (years)	Number of fatal drowning incidents	Age-specific mortality rates (per 100 000 population)			Male:female ratio	P values*
		Male	Female	Total		
0–4	191	5.7	3.8	4.8	1.5	0.024
5–9	130	6.3	1.1	3.7	5.6	<0.001
10–14	111	5.0	1.7	3.4	2.9	0.003
15–19	106	5.8	0.5	3.1	12.6	<0.001
20–24	136	5.7	1.0	3.4	5.8	<0.001
25–29	147	6.6	0.6	3.6	11.9	<0.001
30–34	114	5.9	0.7	3.3	9.0	<0.001
35–39	85	4.5	0.9	2.7	5.0	0.001
40–44	75	4.8	0.3	2.5	14.0	0.001
45–49	57	3.4	1.1	2.2	3.3	<0.001
50–54	69	5.4	1.2	3.2	4.3	0.010
55–59	50	5.2	1.0	2.9	5.3	<0.001
60–64	40	4.3	2.0	3.0	2.2	0.014
65–69	20	4.0	0.4	2.0	10.8	0.005
70–74	25	5.4	2.2	3.6	2.4	0.065
75–79	6	2.3	0.7	1.3	3.3	0.119
80+	9	4.9	0.7	2.2	6.6	0.032
Age unknown	20					
		Mortality rates (per 100 000 population)†				
		Male	Female	Total		
Children (0–19)	538	5.7 (5.7–5.8)	1.9 (1.8–1.9)	3.8 (3.8–3.8)	3.1	<0.0001
Adults (20+)	838	5.2 (5.2–5.2)	0.9 (0.9–0.9)	3.0 (3.0–3.0)	5.7	<0.0001
Total	1391	5.3 (5.0–5.6)	1.2 (1.1–1.3)	3.2 (3.1–3.3)	4.3	<0.0001

*Male versus female mortality rates.

†Age standardised and sex adjusted. The 95% CI for drowning mortality rate is indicated in parentheses.

Table 2 The distribution of fatal drowning by body of water in the Western Cape, 2010–2016

Location by body of water	Children		Adults		All		
	0–4 years	5–19 years	Male	Female		Male	Female
Ocean and lagoons	1.6 (3)	22.5 (78)	17.6 (72)	6.9 (9)	39.3 (276)	23.6 (30)	28.6 (398)
Ponds, dams and lakes	15.2 (29)	37.2 (129)	32.8 (134)	18.5 (24)	24.2 (170)	18.1 (23)	25.5 (355)
Rivers and canals	11.0 (21)	20.5 (71)	17.2 (70)	16.9 (22)	25.5 (179)	40.2 (51)	23.7 (329)
Swimming pool	34.0 (65)	15.3 (53)	20.6 (84)	26.2 (34)	6.1 (43)	10.2 (13)	12.5 (174)
Fresh water and storage tanks	22.0 (42)	4.3 (15)	9.1 (37)	15.4 (20)	3.1 (22)	3.1 (4)	6.0 (84)
Bath	16.2 (31)	0.3 (1)	2.7 (11)	16.2 (21)	1.8 (13)	4.7 (6)	3.7 (51)
Total	191	347	130	408	703	127	1391
P value	P<0.0001*		P<0.0001†		P<0.001‡		
	P<0.0001§						

p<0.0001^d

Values are proportions with numbers (n) in parentheses. P-values indicate significance of Chi-square test for independence for ^a0–4 years vs 5–19 years, ^bmale vs female children, ^cmale vs female adults, and ^dchildren vs adults. Total n=1391, age and/or sex unknown in 23 cases.

Values are proportions with numbers (n) in parentheses. P-values indicate significance of Chi-square test for independence for

*0–4 years versus 5–19 years.

†Male versus female children.

‡Male versus female adults.

§Children versus adults. Total n=1391, age and/or sex unknown in 23 cases.

highest mortality rate was observed in children younger than 5 years old (3.8 per 100 000 population). In men, the highest mortality rate was observed in young adults aged 25–29 years (6.6 per 100 000 population), closely followed by children aged 5–9 years old (6.3 per 100 000 population). There was no significant trend in drowning mortality rate over time in neither children (p=0.796), adults (p=0.867) nor the total population (p=0.992). Furthermore, there were no significant differences in the age (children vs adults; p=0.946) nor sex (p=0.323) distribution of fatal drowning incidents when analysed by year. Based on the observed age-specific mortality rates (table 1), further analyses were therefore performed separately for children (0–4 years; 5–19 years) and adults (20–34 years; 35+ years) on the whole 7-year dataset (n=1391).

Fatal drowning incidents occurred most frequently (77.8%) in large, open bodies of water (table 2). The distribution by body of water was significantly different between men and women ($\chi^2=83.9$; p<0.0001), between children and adults ($\chi^2=175.2$; p<0.0001), between male and female children ($\chi^2=49.6$; p<0.0001) and between male and female adults ($\chi^2=23.8$; p<0.001), but not between young adults (20–34 years) and adults over 35 years of age ($\chi^2=6.5$; p=0.261). Adults were more likely to fatally drown in large, open bodies of water (oceans and lagoons; ponds, dams and lakes; rivers and canals) compared with children (OR 4.5, 95% CI 3.4 to 5.9; p<0.0001). Similarly, older children (5–19 years) were more likely to drown in large, open bodies of water when compared with children aged 0–4 years (OR 10.5, 95% CI 7.0 to 15.8; p<0.0001). Male children were more likely to drown in large, open bodies of water compared with female children (OR 2.9, 95% CI 1.9 to 4.3; p<0.0001), while male adults were more likely to drown specifically in oceans and lagoons compared with female adults (OR 2.1, 95% CI 1.4 to 3.2; p<0.001).

Of the 1391 fatal drowning incidents between 2010 and 2016, 42% occurred in summer (December, January and February), 26% occurred in spring (September, October and November), 17% occurred in autumn (March, April and May) and 15% occurred in winter (June, July and August). This seasonal distribution was different in children compared with adults ($\chi^2=9.3$; p=0.026), where 46% of fatal incidents in children occurred in summer compared with 39% in adults. There was no significant

difference in the seasonal distribution between male and female children, but older children (5–19 years) were more likely to drown in spring and summer compared with children aged 0–4 years (78.4% vs 62.8%; OR 2.1, 95% CI 1.5 to 3.2; p<0.001). Similarly, there was no significant difference in the seasonal distribution between male and female adults, but young adults (20–34 years) were more likely to drown in spring and summer compared with adults older than 35 years (72.3% vs 59.6%; OR 1.8, 95% CI 1.3 to 2.4; p<0.0001).

Overall, 52.2% of fatal drowning incidents occurred on the 5 weekdays (Monday–Friday) and 47.8% occurred on weekends (Saturday and Sunday) and public holidays (figure 1). There was no significant difference in this distribution between male and female children (p=0.800), between male and female adults (p=0.519), nor between the two adult age groups (p=0.507). However, children were more likely to drown during the week compared with adults (55.6% vs 49.8%; OR 1.3, 95% CI 1.0 to 1.6; p=0.037), with younger children being more likely to drown during the week compared with older children (63.4% vs 51.3%; OR 1.6, 95% CI 1.1 to 2.4; p=0.007). It should be noted that there are 12 public holidays celebrated annually in South Africa, and 7.7% (n=107) of all fatal drowning incidents occurred on public holidays, while 8.1% (n=113) of all fatal drowning incidents occurred over a long weekend of three or more consecutive days. The relative risk of a fatal drowning incident occurring on a public holiday or long weekend compared with a normal weekend was 1.20 (95% CI 0.90 to 1.50). In adult men aged 20–34 years, 10.1% and 12.1% of fatal drowning incidents occurred on a public holiday or long weekend, respectively.

The distribution of fatal drowning incidents by time of day is shown in table 3. Fatal drowning incidents occurred most frequently between 12:00 and 19:59, with 65.8% (n=914) of fatal drowning occurring during these 8 hours. There was no significant difference in this distribution between all men and all women (p=0.062), nor boys and girls (p=0.217), but there was a difference between male and female adults ($\chi^2=13.2$, p=0.022). In addition, the distribution by time of day was significantly different between children and adults ($\chi^2=27.9$, p<0.0001), with children drowning more frequently in the early evening compared with adults, and between child age groups ($\chi^2=18.4$, p=0.003) but not between adult age groups (p=0.154).

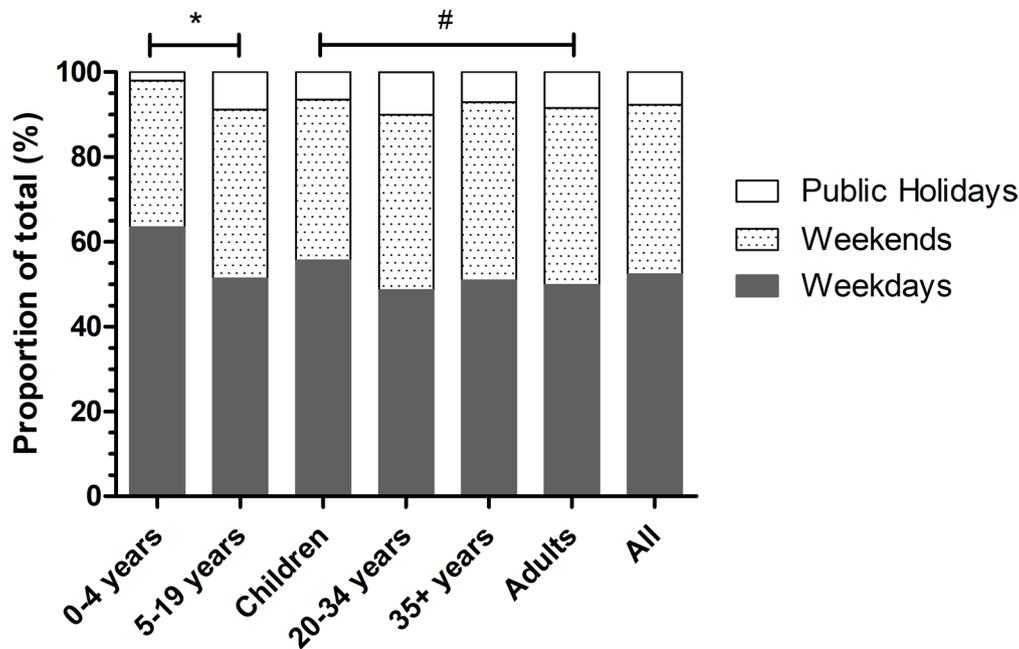


Figure 1 The distribution of fatal drowning in the Western Cape by period of the week, 2010–2016. Figure shows proportion of total: 0–4 years (191); 5–19 years (347); children (538); 20–34 years (397); 35+ years (436); adults (833); all (1391). *Weekends and public holidays versus weekdays, $p=0.007$; #weekends and public holidays versus weekdays, $p=0.037$.

DISCUSSION

In the current study, the age-adjusted and sex-adjusted drowning mortality rate for the Western Cape was 3.2 per 100 000 population between 2010 and 2016. This is similar to that previously reported at a national level (3.0 per 100 000 population)⁸ but higher than that reported for high-income countries with similar climates such as Portugal (0.6 per 100 000 population), Australia (1.1 per 100 000 population) and New Zealand (1.7 per 100 000 population).¹⁴ This difference is consistent with the WHO Global Report on Drowning, which reports that drowning mortality rates in LMICs are approximately threefold higher than those in high-income countries.² In contrast, other LMICs such as Bangladesh (15.8 per 100 000 population)¹⁵ and South Sudan (11.5 per 100 000 population)¹⁶ report even higher drowning mortality rates. In South Africa, high levels of

inequality, poverty, poor infrastructure and ineffective service delivery are likely to contribute to the high rates of observed injury mortality,¹⁷ including that of fatal drowning. Inequality and poverty negatively affect both exposure to injury as well as outcome following injury, as families with few resources experience significant challenges in accessing and complying with the required medical care.¹⁸

The drowning mortality rate in Western Cape children was significantly higher than that observed in adults, with the highest drowning mortality rate observed in the 0–4 years age group at 4.8 per 100 000 population. This distribution is similar to that reported in Bangladesh¹⁵ and other LMICs¹⁹ and further supports the findings of the WHO Global Report on Drowning.² While this finding is consistent with previous analyses of South African drowning mortality demonstrating that children younger than 5

Table 3 The distribution of fatal drowning by time of day in the Western Cape, 2010–2016

Time of day	Children			Adults			
	0–4 years	5–19 years	All	Male	Female	All	All
00:00-03:59	4.7 (9)	2.3 (8)	3.2 (17)	3.6 (25)	4.7 (6)	3.7 (31)	3.5 (49)
04:00-07:59	3.1 (6)	1.7 (6)	2.2 (12)	3.8 (170)	10.2 (13)	4.8 (40)	4.0 (55)
08:00-11:59	17.3 (33)	13.0 (45)	14.5 (78)	22.5 (158)	26.0 (33)	23.1 (192)	19.8 (275)
12:00-15:59	25.7 (49)	41.5 (144)	35.9 (193)	35.6 (250)	30.7 (39)	34.7 (289)	35.3 (490)
16:00-19:59	42.4 (81)	32.0 (111)	35.7 (192)	28.6 (201)	21.3 (27)	27.6 (230)	30.5 (424)
20:00-23:59	6.8 (13)	9.5 (33)	8.6 (46)	6.0 (42)	7.1 (9)	6.1 (51)	7.0 (97)
Total	191	347	538	703	127	833	1390
P value	P=0.003*			P=0.022†			
	P<0.0001‡						

$p<0.0001^c$

Values are proportions with numbers (n) in parentheses. P-values indicate significance of Chi-square test for independence for ^a0–4 years vs 5–19 years, ^bmale vs female adults, and ^cchildren vs adults. Total n=1391, age, sex and/or time unknown in 24 cases.

Values are proportions with numbers (n) in parentheses. P-values indicate significance of χ^2 test for independence

*0–4 years versus 5–19 years.

†Male versus female adults.

‡Children versus adults. Total n=1391, age, sex and/or time unknown in 24 cases.

years of age are particularly vulnerable to fatal drowning,^{8 9 14} the current study has further identified a number of factors that contribute to drowning risk in this age group. In particular, fatal drowning incidents in this age group frequently occurred in the early evening, on weekdays, and were more likely to occur in locations in and around the home. Early childhood is characterised by growing independence and an expanding social environment while still being reliant on caregivers for protection and provision.²⁰ These developmental characteristics, together with multiple contextual factors, place children living in low-income settings at increased risk for drowning.²⁰ For example, the WHO Global Report on Drowning has highlighted the lack of adequate adult supervision as a major risk factor for drowning in this age group.² In South Africa, adequate supervision is compromised by structural inequalities, such as poverty, unemployment and difficult working conditions.^{18 21} Previous research has indicated that South African caregivers who lack the financial means to afford quality day care services often left their children alone at home, or in the care of inexperienced adults or older children, while they sought employment or engaged in other activities.²² Enabling community crèches, such as the *Anchal* implemented in Bangladesh,²³ may help to address many social ills including injury risk, poor foundational education and unemployment. We were not able to describe the absence or presence of adequate supervision during fatal drowning incidents in the current study. However, the distribution of risk factors observed in this age group suggests that improved supervision presents a key area for drowning prevention efforts in the Western Cape. In particular, fatal drowning incidents in this age group frequently occurred in the early evening on weekdays, when care givers are likely to be preoccupied with caring for multiple children and performing household chores²¹ and were more likely to occur in swimming pools, baths and other water in and around the home. Increased awareness of the importance of adequate supervision at home may significantly reduce drowning risk in this age group.

In the current study, men were four times more likely to fatally drown than women. Although this ratio is higher than that observed globally,² higher rates of fatal drowning in men are consistently reported in both high-income and low-income settings.^{3 15 19} The lowest male-to-female ratio was observed in young children (0–4 years), with high differentials observed in older children and young adult men. Injury vulnerability in South African boys has been associated with differing temperament, impulsivity, higher activity levels and less restraint of exploratory behaviour by parents.^{21 24 25} The current study specifically identifies young adult men (20–34 years) as a high-risk group for fatal drowning. In particular, the highest age-specific and sex-specific mortality rate was observed in men aged 25–29 years (6.6 per 100 000 population). A deeper understanding of the factors contributing to risk in this group is limited by the lack of data on activity prior to drowning. However, the distribution of risk factors in this age group suggests that recreational choices may be implicated in the vulnerability to drowning in this group. In particular, this group was more likely to drown in spring and summer, in the afternoon and early evening during weekends and public holidays. Adults were more likely than children to drown in large, open bodies of water and adult men in particular were more likely to drown in the ocean and lagoons when compared with adult women. In South Africa, alcohol use is common during recreational activity among adult men, and there is existing evidence to support a correlation between fatal drowning and blood alcohol levels, both globally² and in South Africa.⁹ While the current study was not able to report on blood alcohol levels at the time of drowning, Donson and van Niekerk⁹

previously reported that approximately 40% of the instances of South African drowning fatalities where blood alcohol level was measured (n=493), were alcohol related. In the city of Cape Town, the largest municipal district in the Western Cape, men were 20 times more likely than women to have a blood alcohol level above the legal driving limit at the time of drowning.⁹ In conjunction with the adoption of risky behaviours and the minimising of health and safety concerns among some adult men while attempting to establish masculinity,^{26 27} this may underpin the higher drowning risk in this group.

The distribution of fatal drowning incidents by part of the week, time of day and season are consistent with periods of increased exposure to water-based recreational activities in the Western Cape. In particular, 42% of fatal drowning occurs in the summer months coinciding with South Africa's largest holiday and festive period in December and early January. Two-thirds of fatal drowning incidents occur between 12:00 and 19:59 and occur disproportionately on weekends and public holidays when compared with the five weekdays. It is particularly important to note the disproportionate prevalence of fatal drowning on public holidays and long weekends. This corroborates recent findings from Australia where fatal drowning incidents were 1.73 (95% CI 1.57 to 1.89) times more likely to occur on public holidays compared with any other day.²⁸ Public holidays are traditionally associated with increased exposure to recreational activities, differing leisure patterns, increased levels of alcohol consumption and travel to unfamiliar locations.^{28–31} These high-exposure periods are therefore key opportunities for targeted drowning interventions and may also guide the preparation and deployment of rescue and emergency services.

The data presented here is limited to fatal drowning incidents in which the body was recovered, and drowning was considered the primary cause of death. It is therefore likely that a number of fatal drowning incidents in which the body was not recovered were not included. In addition, there is currently no information available regarding supervision, activity prior to drowning, blood alcohol levels at time of death, nor the deceased's ability

What is already known on this subject?

- ▶ The South African drowning mortality rate is estimated to be 3.95 per 100 000 population, but little is known about the differences in drowning epidemiology between coastal and inland provinces.
- ▶ There is a paucity of published data describing the incidence and epidemiology of fatal drowning within the Western Cape province of South Africa.

What this study adds?

- ▶ The age-adjusted drowning mortality in the Western Cape, South Africa, is stable at 3.2 per 100 000 population
- ▶ Rates in the Western Cape were fourfold higher in men compared with women and highest in children younger than 5 years of age.
- ▶ Young adult men aged 20–34 years old were observed to be at high risk for fatal drowning.
- ▶ This epidemiological description will serve as baseline data enabling long-term evaluation of Western Cape drowning prevention initiatives.

to swim, which limits the ability to identify behaviours and activities contributing to drowning risk in the Western Cape. We highlight the need for more detailed drowning surveillance that includes robust indicators for a wider array of suspected risk factors in order to adequately inform future interventions. Notwithstanding these limitations, this study contributes to an emerging body of scholarship on drowning in South Africa and, more broadly, in Africa. In particular, we have identified two groups at high risk for fatal drowning in the Western Cape: children, particularly young children aged 0–4 years, and young adult men between 20 years and 34 years of age. Further in-depth analyses of the specific factors contributing to risk in each of these high-risk groups identified is warranted. The data presented here provide a baseline measure of drowning mortality within the Western Cape as well as an indication of factors that may contribute to drowning risk. This baseline measure will allow for provincial level evaluation of drowning prevention interventions over time and enable informed decision making that is vital in resource constrained settings.

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Contributors CJS conceptualised the study and was responsible for data collection and analysis, as well as preparation of the manuscript for submission. AS and RA drafted the manuscript. AVN provided project oversight. All authors contributed to interpretation of the findings and critical revision of manuscript drafts. All authors reviewed and approved the final manuscript.

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Competing interests None declared.

Patient consent Not required.

Ethics approval Approval for this study was obtained from the University of Cape Town Human Research Ethics Committee (HREC 590/2017) and the Western Cape Government: Department of Health.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data presented here were formally requested from the Western Cape Government: Department of Health: Forensic Pathology Services. Study proposals that have been approved by a formally recognised South African ethical review board may similarly request access to the same data.

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