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Fatal, unintentional drowning in older people: an assessment of the role of preexisting medical conditions

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Background: The number of older people (aged 65 y and over) is increasing in Australia and chronic medical conditions are common. Aquatic activities provide physical and social benefits; however, understanding the risks related to aquatic activity is important for ongoing health and wellbeing. We explore the impact of preexisting medical conditions on unintentional fatal drowning among older people in Australia.

Methods: Using coronial, forensic, and medical histories from the Australian National Coronial Information System, all cases of unintentional death by drowning (or where drowning was a factor) among older people in Australia between July 1, 2002 and June 30, 2012 were investigated. Preexisting medical conditions were reviewed to determine whether they were contributory to drowning.

Results: Of the 506 older people who drowned, 69.0% had a preexisting medical condition. The leading contributory medical condition was cardiovascular disease, followed by dementia, depression, epilepsy, and Parkinson disease. All conditions except cardiovascular disease and depression were overrepresented compared with the proportion of the disease in the population. Falling into water was the most common activity immediately before drowning, especially among those with dementia, whereas those with cardiovascular disease were most likely to drown while swimming.

Conclusions: Preexisting medical conditions contribute to drowning in older people but with unequal contributions. With the prevalence of medical conditions expected to increase as the population ages, targeted education for older people will be important. Risk management will enable older people to safely participate in aquatic activities.

Keywords: Drowning prevention, Elderly, Medical conditions, Risk factors, Water safety, Dementia, Epilepsy, Parkinson disease, Cardiovascular disease

Background

Aquatic activities are common in Australia, both for the purposes of recreation and physical activity. Four aquatic pastimes (swimming/diving, fishing, surf sports, and canoeing/kayaking) are identified among the top 25 forms of sport or physical recreation in the country[1], with an estimated 1 in 10 adult Australians participating in one or more of these aquatic sports each year[2]. Swimming is particularly common among older people. Approximately 5% of people aged 65 years and over swim, making it the fourth most common form of sport and physical recreation in this age group[2]. Private home swimming pools are also popular, present in 11.7% of Australian households[3].

In seniors for whom water sports were important during their working years, water activities can be promoted to preserve quality of life. For those who did not participate in aquatic activities during their working lives, the introduction and adoption of aquatic exercise can be physically fulfilling and socially enriching. For senior, frail men and women who are at particular risk of becoming isolated in their own community, aquatic outreach offers a practical way both to preserve physical mobility and obviate social isolation[4].

Drowning in the elderly is a significant subject in the specific domains of health care, duty-of-care, resource provision, and forensic issues[5]. The normal aging process includes the sequential loss of muscle strength[6], aerobic endurance[7], agility, balance[8], flexibility, and bone density[9]. The hydrostatic buoyancy experienced when participating in aquatic activities slows the rate of such progression in a joint-sparing manner, as well as preserving physical fitness[10] and balance[11]. Low intensity aquatic exercises can benefit seniors with a variety of conditions, including chronic obstructive pulmonary disease[12], osteoarthritis[13] and chronic pain syndrome[14].

Every year, older people drown in Australian waterways[15]. The problem of drowning among older people is likely to be exacerbated by Australia's aging population. People aged

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65 years and over accounted for 14% of the population in 2012 but this is expected to increase to 25% by the year 2101[16]. Predictions indicate that this trend will continue, with significant implications for the quality of life in the "extra years of life won"[17].

Aquatic activities, both for the promotion of health and the enrichment of recreation, are an important feature of this phase of extended life[10–12]. As life expectancy has increased, the number of healthy years lost to disability has also increased[18]. In the general Australian population, 32% of people over the age of 65 years suffer from 1 chronic medical condition, and 49.6% have ≥ 2[19]. Promotion of aquatic activities among seniors, while preserving their safety, continues to challenge planners, resource providers, and health care professionals alike.

Recent studies report a trend in the reduction of fatal immersions, at least in developed countries[20]. An exception to this trend has been the lack of preventive success in reducing adult drowning fatalities, particularly among seniors[21]. By investigating drowning fatalities in older people in terms of the preexisting medical condition(s) most commonly implicated in drowning incidents, we aim to elucidate possible drowning prevention strategies in this age group.

Methods

This study comprised a detailed analysis and total population survey of every unintentional drowning fatality in Australia, recorded across a 10-year period (July 1, 2002 to June 30, 2012). Intentional drowning deaths, aquatic envenomation and animal-related deaths (eg, shark and crocodile attacks) were not included. Cases in which the coroner returned an open finding around the circumstances, or where intent was unknown have been included for analysis as unintentional cases. The paper focuses on older people, that is, those aged 65 years and over, to align with initial eligibility of the Australian Government's aged pension, which is provided as a means-tested supplement to those aged 65 years and over and represents a proxy for retirement in Australia [22].

Exposure

At the mid-survey point (2007), the total population of Australia was 20,827,622 people, with 2,736,610 (1,237,904 males and 1,498,706 females) aged 65 years and over[23].

Country of birth was classified into regions based on the World Health Organization (WHO) regional divisions[24]. In all cases, road distance between the postcode of the incident location and residential postcode was determined using Google Maps (eg, an incident location of Townsville, postcode 4810, and residential postcode of Rockhampton 4700 = 718 km), allowing all cases to be categorized as "not a visitor" (living at a distance of < 100 km from the incident location) or "visitor" (a distance of 100 km or greater).

The prevalence of specific medical conditions in the general community was obtained to provide a comparison between drowning victims and the broader Australian population. The proportions reflect the available data, sourced from 3 data sets; the Australian Bureau of Statistics Australian Health Survey[25], Australian Institute of Health and Welfare Older Australians at a Glance[26], and a report commissioned by Parkinson's Australia[27].

Case-finding

Every case of unintentional fatal drowning in Australia over this time period was identified through privileged access to the Australian National Coronial Information System (NCIS)[28]. Primary case-finding involved identifying every subject in both open and closed coronial investigations, where the person died either from drowning or as the result of an immersion-related incident. The WHO definition of drowning, proposed at the first World Congress on Drowning in 2002, adopted by the International Committee on Resuscitation[29] and formalized by WHO in 2005[30] was utilized. At the time of writing, 8.7% of cases were open (ie, still under investigation).

Data collection

Coronial, forensic, and prior medical history was reviewed for all identified cases. Variables examined included: age, sex, geographic and aquatic location, activity before drowning, and medical history. Data on the presence of preexisting medical conditions was available in the Coronial Finding or Autopsy report within the NCIS (where available electronically). Using the principles of content analysis, 2 members of the research team (J.H.P., a physician and neurologist, and A.E.P.) reviewed each case and ascribed an interpretative determination as to the potential role of the medical condition as a causative factor. These reviews included an assessment of physical disability, and signs and symptoms observed and reported in the fatal drowning incident itself. Information on drug and alcohol consumption was sourced from toxicology reports where available.

Categories of aquatic location and activities before drowning were coded using the Royal Life Saving Society—Australia Drowning Definitions and Coding Manual[31]. Time of incident was coded into 4 groupings for analysis: morning (6:01 AM to 12 PM), afternoon (12:01 PM to 6 PM), evening (6:01 PM to 12 AM), and early morning (12:01 AM to 6 AM). Where time could not be determined, a coding of 9999 (unknown) was used.

Ethics

The Victorian Department of Justice Human Research Ethics Committee granted ethical approval (JHREC reference number CF/13/19798). Special privileged and confidential access to the primary database of the Australian NCIS was granted under restrictions of preservation of individual case confidentiality.

Statistical analysis

Analysis was conducted in IBM SPSS Statistics version 21. Statistical analysis was performed for overall results based on those with and without a preexisting medical condition (ie, "unknowns" were recorded but not included in analysis). Statistical significance was deemed as $P < 0.05$. Odds ratios were calculated for the proportion of cases where a preexisting medical condition was deemed contributory compared with its prevalence in the general population, that is (population prevalence/(1 – population prevalence))/(contributory prevalence/(1 – contributory prevalence)).

For the purposes of analysis, the separate activity categories of "rescue," "rock fishing," "swept away," and "swept in" were grouped together into "other."

Table 1

Demographic data of people who drowned with and without preexisting medical conditions.

	Preexisting Medical Conditions Among Older People Who Drowned [N (%)]					
	Yes	No	Unknown	RR	95% CI	*P*
Sex						
Male	250 (71.6)	20 (74.1)	93 (71.5)	1	—	—
Female	99 (28.4)	7 (25.9)	37 (28.5)	0.99	0.93–1.05	0.78
Age group (y)						
65–74	167 (47.9)	16 (59.3)	75 (57.7)	1	—	—
75 +	182 (52.1)	11 (40.7)	55 (42.3)	0.97	0.91–1.02	0.26
Employment status						
Employed	34 (9.7)	6 (22.2)	12 (9.2)	1.10	0.96–1.26	0.15
Retired/ pensioner	296 (84.8)	20 (74.1)	103 (79.2)	1	—	—
Unknown	16 (4.6)	1 (3.7)	13 (10.0)	1.00	0.88–1.12	0.94
Visitor status						
Not a visitor	294 (84.5)	19 (70.4)	100 (76.9)	1	—	—
Visitor—overseas	12 (3.4)	2 (7.4)	4 (3.1)	1.10	0.88–1.36	0.41
Visitor—interstate	15 (4.3)	1 (3.7)	7 (5.4)	1.00	0.88–1.14	0.98
Visitor—intrastate	23 (6.6)	4 (14.8)	13 (10.0)	1.10	0.94–1.29	0.23
Unknown	4 (1.1)	1 (3.7)	6 (4.6)	1.17	0.76–1.82	0.47
Season						
Summer	107 (30.7)	5 (18.5)	42 (32.3)	1	—	—
Autumn	77 (22.1)	8 (29.6)	34 (26.2)	1.05	0.97–1.14	0.19
Winter	59 (16.9)	6 (22.2)	25 (19.2)	1.05	0.96–1.15	0.25
Spring	106 (30.4)	8 (29.6)	29 (22.3)	1.03	0.96–1.10	0.41
Day of the week						
Monday	50 (14.3)	6 (22.2)	19 (14.6)	1	—	—
Tuesday	53 (15.2)	3 (11.1)	15 (11.5)	0.94	0.85–1.05	0.30
Wednesday	47 (13.5)	3 (11.1)	16 (12.3)	0.95	0.85–1.07	0.38
Thursday	59 (16.9)	6 (22.2)	26 (20.0)	0.98	0.87–1.11	0.79
Friday	50 (14.3)	6 (22.2)	14 (10.8)	1.00	0.88–1.14	1.00
Saturday	39 (11.2)	2 (7.4)	23 (17.7)	0.94	0.84–1.05	0.28
Sunday	51 (14.6)	1 (3.7)	17 (13.1)	0.91	0.83–1.00	0.06
Time of day						
Early morning (12:01 AM to 6 AM)	21 (6.0)	0	11 (8.8)	NA	NA	NA
Morning (6:01 AM to 12 PM)	128 (36.7)	8 (29.6)	34 (27.2)	1	—	—
Afternoon (12:01 PM to 6 PM)	114 (32.7)	7 (25.9)	47 (37.6)	1.00	0.94–1.06	0.97
Evening (6:01 PM to 12 AM)	86 (24.6)	12 (44.4)	31 (24.8)	1.07	0.99–1.17	0.11
Activity						
Bathing	27 (7.7)	3 (11.1)	3 (2.3)	1.05	0.92–1.19	0.47
Diving	12 (3.4)	1 (3.7)	3 (2.3)	1.02	0.87–1.20	0.79
Fall	100 (28.7)	6 (22.2)	19 (14.6)	1	—	—
Fishing	12 (3.4)	1 (3.7)	4 (3.1)	1.02	0.87–1.20	0.79
Nonaquatic transport	19 (5.4)	2 (7.4)	25 (19.2)	1.04	0.90–1.21	0.58
Other	9 (2.6)	3 (11.1)	9 (6.9)	1.26	0.90–1.75	0.17
Swimming and recreating	71 (20.3)	5 (18.5)	18 (13.8)	1.01	0.94–1.09	0.80
Unknown	49 (14.0)	1 (3.7)	16 (12.3)	0.96	0.91–1.02	0.22
Watercraft	50 (14.3)	5 (18.5)	33 (25.4)	1.04	0.94–1.14	0.45
Location						
Bathtub/spa bath	26 (7.4)	3 (11.1)	3 (2.3)	1.04	0.91–1.19	0.53
Beach	44 (12.6)	5 (18.5)	21 (16.2)	1.04	0.94–1.16	0.45
Lake/dam/lagoon	28 (8.0)	3 (11.1)	13 (10.0)	1.04	0.91–1.18	0.58
Ocean/harbor	51 (14.6)	3 (11.1)	31 (23.8)	0.99	0.91–1.08	0.84
River/creek/stream	88 (25.2)	6 (22.2)	47 (36.2)	1	—	—
Rocks	7 (2.0)	3 (11.1)	5 (3.8)	1.34	0.89–2.01	0.16
Swimming pool	84 (24.1)	1 (3.7)	6 (4.6)	0.95	0.89–1.00	0.07
Other	21 (6.0)	3 (11.1)	4 (3.1)	1.07	0.91–1.26	0.41

Note that some values were missing so totals may not add to 100.

CI indicates confidence interval; NA, not applicable—this occurred where there were no cases therefore relative risk could not be calculated; RR, relative risk.

Results

A total of 506 people aged 65 years and over (363 males, 143 females) drowned in Australia during the study period (**Table 1**). This population accounted for 17.3% of all drowning fatalities in Australia over this time period. The crude unintentional drowning death rate was 1.80 deaths per 100,000 people per year.

The most common country of birth among older people who drowned was Australia (41.1%). When examined by region, 47.0% of people who drowned were born in the Western Pacific, with Europe accounting for a further 20.6% of people. The country of birth was unknown in 30.4% of cases.

Among older people who drowned, 69.0% had a preexisting medical condition. However, information on preexisting medical condition was unavailable in 25.7% of cases. The majority of drowning deaths were male (71.7%), although the frequency of preexisting medical conditions was similar between the sexes (68.9% males and 69.2% females). Approximately half of all people who drowned were aged 65–74 years (51%). The proportion of drowning incidents involving a preexisting medical condition was higher in the older age group (75 + y; 73.4%) than the younger age group (65–74 y; 64.7%). Most deaths occurred in retirees or pensioners, whether a preexisting medical condition was present or not (84.2% of those with; 74.1% of those without) (**Table 1**).

Among those with a preexisting medical condition, the most common activity before drowning was a fall into water (28.7%), followed by swimming and recreation (20.3%), watercraft incidents (14.3%), and "unknown" activities (14.0%) for which the drowning was unwitnessed. Falls into water were also the most common occurrence in the group without medical conditions (22.2%), followed by swimming and recreation and watercraft incidents (both 18.5%). Only 3.7% of cases in this group occurred following an unknown activity. Those with a preexisting medical condition were most likely to drown in rivers, creeks and streams (25.2%), swimming pools (24.1%), or oceans and

Table 2

Preexisting medical conditions by medication usage.

Preexisting Medical Conditions Among Older People Who Drowned	Medication Usage [N (%)]			
	Yes	No	Unknown	Total
Yes	158 (45.3)	104 (29.8)	87 (24.9)	349
No	6 (22.2)	20 (74.1)	1 (3.7)	27
Unknown	12 (9.2)	21 (16.2)	97 (74.6)	130
Total	176	145	185	506

Table 3

Preexisting medical conditions by alcohol consumption.

Preexisting Medical Conditions Among Older People Who Drowned	Alcohol Consumption [N (%)]			
	Yes	No	Unknown	Total
Yes	69 (19.8)	193 (55.3)	87 (24.9)	349
No	5 (18.5)	21 (77.8)	1 (3.7)	27
Unknown	12 (9.2)	25 (19.2)	93 (71.5)	130
Total	86	239	181	506

harbors (14.6%). Among those with no known medical conditions, most drowning deaths occurred in rivers, creeks and streams (22.2%), or beaches (18.5%), with swimming pools only accounting for 3.7% of deaths. More specifically, those with a medical condition were significantly more likely to drown in a swimming pool than other aquatic locations ($\chi^2 = 5.9$; $P < 0.05$) (**Table 1**).

Among those with medical conditions who drowned in swimming pools, 42.9% were aged 65–74 years and 57.1% were aged 75 + years. Drowning deaths most commonly occurred in a home swimming pool (73.8%), followed by public swimming pools (10.7%), or a pool at a place of temporary residence (eg, motel, hotel, resort; 10.7%).

In people with a medical condition, most falls into water occurred around swimming pools (38.0%), followed by rivers, creeks, and streams (33.0%). Those swimming and recreating were most likely to be doing so at swimming pools (56.3%) or the beach (38.0%). Watercraft incidents most commonly occurred in oceans and harbors (60.0%) or lakes, dams, and lagoons (20.0%).

Drowning deaths following a fall into water were more likely to occur in a swimming pool than other aquatic locations ($\chi^2 = 26.7$; $P < 0.05$). Further analysis of those who fell into swimming pools reveals that more were in the older age group (75 + y; 60.5%), than younger (65–74 y; 39.5%). Almost all of these incidents occurred in a home swimming pool (94.7%). Older people who fell into a swimming pool were significantly more likely to do so in a home swimming pool than other types of pools ($\chi^2 = 91.8$; $P < 0.05$).

No significant differences were found in terms of seasonality and time of incident; most fatal drownings occurred in summer (30.7%) or spring (30.4%) among those with medical conditions, and in autumn or spring (both 29.6%) among those without. Drowning incidents occurred on all days of the week, with morning being the most common time of day for those with a medical condition (36.7%) compared with evening (44.4%) for those without (**Table 1**).

Those with a preexisting medical condition were twice as likely to be taking some form of medication when they drowned (45.3%), compared with those without a known medical condition (22.2%) ($\chi^2 = 22.8$; $P < 0.05$) (**Table 2**). A similar proportion of people with and without medical conditions had consumed alcohol before drowning (19.8% of those with; 18.5% of those without) (**Table 3**).

Among those reported as having a preexisting medical condition, the condition was deemed to be contributory in 51.6% of cases. The leading contributory medical conditions were cardiovascular disease (22.3%), dementia (14.0%), depression (4.3%), epilepsy (2.9%), and Parkinson disease (2.6%) (**Table 4**). For those aged 65–74 and 75–84, dementia was nearly 3 times more likely to contribute to the drowning death when compared with its prevalence in the population; however, this effect did not continue for the 85 + age group. Epilepsy was over 5 times more likely to contribute to drowning for all ages and Parkinson disease was 3.4 times more likely to contribute to drowning for those aged 65–74 years; however, it was less likely for those over 74 years when compared with its prevalence in the general population. Other reported contributory conditions included respiratory disorders (eg, emphysema, chronic lung disease), mental health disorders (eg, psychosis), nervous system disorders (eg, motor neurone disease, myotonic muscular dystrophy), and ear disorders (eg, labyrinthitis, Meniere's disease) (**Table 4**).

Those with contributory cardiovascular disease were most likely to drown while swimming and recreating (26.9%), followed by a fall into water (21.8%). For those without contributory cardiovascular disease this was reversed, with falls most common (30.6%), followed by swimming and recreating (18.5%). Falls into water were the most common activity before drowning among those with contributory dementia (69.4%), accounting for more than two-thirds of incidents. Those without contributory dementia most frequently drowned while swimming and recreating (23.0%) or after a fall (22.0%). It was common for dementia sufferers to wander away from residential facilities, unseen by carers or family members, and get into difficulty following an unexpected fall into water (**Table 5**).

Older people with contributory depression commonly drowned as a result of an unknown activity (53.3%) or bathing (20.0%), compared with those without contributory depression who fell into water (29.3%) or were swimming and recreating (20.7%) (**Table 5**).

People with contributory cardiovascular disease most often drowned in swimming pools (21.8%) or rivers, creeks, and streams (17.9%). Those with contributory dementia were most likely to drown in rivers, creeks, and streams (42.9%) or swimming pools (24.5%), while those with contributory depression were equally likely to drown in a bathtub/spa bath, at the beach, lakes, dams, and lagoons or rivers, creeks, and streams (all 20.0%) (**Table 6**).

Almost three-quarters of people were found to have a cardiovascular condition at autopsy. Of these, 12.0% were taking cardiovascular-related medication at the time of death.

Discussion

Older people take part in a wide range of aquatic activities before fatal drowning, in a variety of locations. As the population ages, it is clear that the prevalence of preexisting medical conditions will increase, making the issue of fatal drowning among older people even more pertinent. The majority of older drowning victims in

this study had at least 1 preexisting medical condition (69.0%), but given that this information was unavailable in 25.7% of cases, it is possible this is an underrepresentation of the true prevalence.

Key issues identified were that older people with dementia, Parkinson disease, and epilepsy are at a greater risk of drowning compared with those with other preexisting medical conditions. Although cardiovascular disease was the most common preexisting medical condition among fatal drowning victims, its prevalence is far greater in the general population. Secondly, while alcohol consumption was common before drowning (1 in 5 older persons recorded positive readings for alcohol in their blood at autopsy), there was no difference between those with and without preexisting medical conditions.

Like drowning in other age groups[32], males were more likely (71.7%) to drown; however, the role of preexisting medical conditions had a similar impact in both males and females. This indicates that medical conditions impact upon fitness, ability, and survival in the water for both sexes. As age of the drowning victim increased, so too did the prevalence of preexisting medical conditions.

The most common incident before drowning was falling, both in those with and without preexisting medical conditions; however, a greater proportion of drowning deaths occurred in those suffering from a medical condition. Fatalities in swimming pools were almost 7 times more likely in those with preexisting medical conditions than those without, with this being the most common location for falls into water. Another key difference between those with and without medical conditions was the proportion in the unknown category, indicating that the person was alone when they drowned. This was almost 4 times more likely among those with preexisting medical conditions than those without.

Dementia was the second most common preexisting medical condition among older drowning victims in this study. A large proportion of these occurred following an unknown incident, suggesting the person may have wandered away from carers and the drowning was unwitnessed. Previous research suggests that people with dementia are twice as likely to experience a fall as older people without cognitive impairment[33,34].

Those with dementia, epilepsy, and Parkinson disease are overrepresented when compared with the general population. Older people with these diseases require greater supervision and support in and around water. This may include the wearing of location/water-activated bands especially for those who live near an aquatic location or have a swimming pool at home. As home swimming pools are a common risky location for drowning deaths in older Australians, further work is required to understand whether design changes may help to reduce the risk of drowning.

Older people should also be encouraged to take medicines as directed; an important strategy in managing medical conditions. Previous research suggests that up to half of patients do not take medication as prescribed by their doctor, and this has implications for treatment effectiveness, future treatment decisions, and overall quality of life[35]. Optimal management of health conditions will minimize the risk they pose to older people while in, on, or around water. In addition, it is recommended that people avoid recreating alone; swimming with a friend or relative to ensure help is nearby if required. Given the high proportion of people participating in an unknown activity before drowning (14.0%), it is clear that many people do not heed this advice.

Addressing barriers to aquatic participation is an important step in facilitating active, healthy lifestyles for older people. Impaired

Table 4

Prevalence of medical conditions in the Australian population compared to older people who drowned.

	Australian Population		Preexisting Medical Conditions Among Older People Who Drowned (%)		Contributory Preexisting Medical Conditions Among Older People Who Drowned (%)		Odds Ratio for Contributory Effect (CI)		
	65–74 y (%)	75+ y (%)	65–74 y (%)	75+ y (%)	65–74 y (%)	75+ y (%)	65–74 y (%)	75+ y (%)	Source of Data
Cardiovascular disease	49.7	61.5	73.7*	74.7*	28.1	17.0	0.40 (0.22–0.71)	0.13 (0.07–0.25)	ABS Australian Health Survey[25]
Depression	10.8	10.4	9.0	12.1	4.2	4.4	0.36 (0.11–1.16)	0.40 (0.13–1.25)	ABS Australian Health Survey[25]
Epilepsy	0.6	0.4	4.8	3.8	3.0	2.7	5.12 (0.32–83.08)	6.91 (0.25–193.49)	ABS Australian Health Survey[25]

	65–74 y (%)	75–84 y (%)	85+ y (%)	65–74 y (%)	75–84 y (%)	85+ y (%)	65–74 y (%)	75–84 y (%)	85+ y (%)	65–74 y (%)	75–84 y (%)	85+ y (%)	
Dementia	1.9	8.4	22.4	6.0	22.2	23.4	5.4	21.5	23.4	2.95 (0.55–15.77)	2.99 (1.27–7.00)	1.06 (0.55–2.05)	AIHW Older Australians at a Glance[26]
Parkinson disease	1.1	2.1	2.94	3.6	2.2	4.3	3.6	1.5	2.1	3.36 (0.39–28.93)	0.71 (0.09–5.88)	0.71 (0.12–4.25)	Parkinson's Australia[27]

*This proportion includes cases where abnormal cardiac pathology was detected at autopsy but was not necessarily diagnosed during the person's lifetime.

Table 5

Noncontributory and contributory preexisting medical conditions by activity.

	Activity [N (%)]									
	Bathing	Diving	Fall	Fishing	Nonaquatic Transport	Other	Swimming and Recreating	Unknown	Watercraft	Total
Medical condition										
Cardiovascular disease										
Yes	17 (6.6)	10 (3.9)	70 (27.0)	12 (4.6)	12 (4.6)	8 (3.1)	58 (22.4)	29 (11.2)	43 (16.6)	259
No	10 (11.1)	2 (2.2)	30 (3.33)	0	7 (7.8)	1 (1.1)	13 (14.4)	20 (22.2)	7 (7.8)	90
Dementia										
Yes	0	0	34 (66.7)	0	2 (3.9)	0	3 (5.9)	11 (21.6)	1 (2.0)	51
No	27 (9.1)	12 (4.0)	66 (22.1)	12 (4.0)	17 (5.7)	9 (3.0)	68 (22.8)	38 (12.8)	49 (16.4)	298
Depression										
Yes	5 (13.5)	0	13 (35.1)	0	0	0	7 (18.9)	12 (32.4)	0	37
No	22 (7.1)	12 (3.8)	87 (27.9)	12 (3.8)	19 (6.1)	9 (2.9)	64 (20.5)	37 (11.9)	50 (16.0)	312
Epilepsy										
Yes	3 (20.0)	1 (6.7)	3 (20.0)	0	0	0	3 (20.0)	3 (20.0)	2 (13.3)	15
No	24 (7.2)	11 (3.3)	97 (29.0)	12 (3.6)	19 (5.7)	9 (2.7)	68 (20.4)	48 (13.8)	48 (14.4)	334
Parkinson disease										
Yes	1 (9.1)	0	5 (45.5)	0	0	0	2 (18.2)	3 (27.3)	0	11
No	26 (7.7)	12 (3.6)	95 (28.1)	12 (3.6)	19 (5.6)	9 (2.7)	69 (20.4)	46 (13.6)	50 (14.8)	338
Contributory medical condition										
Cardiovascular disease										
Yes	8 (10.3)	3 (3.8)	17 (21.8)	7 (9.0)	3 (3.8)	2 (2.6)	21 (26.9)	5 (6.4)	12 (15.4)	78
No	19 (7.0)	9 (3.3)	83 (30.6)	5 (1.8)	16 (5.9)	7 (2.6)	50 (18.5)	44 (16.2)	38 (14.0)	271
Dementia										
Yes	0	0	34 (69.4)	0	2 (4.1)	0	2 (4.1)	11 (22.4)	0	49
No	27 (9.0)	12 (4.0)	66 (22.0)	12 (4.0)	17 (5.7)	9 (3.0)	69 (23.0)	38 (12.7)	50 (16.7)	300
Depression										
Yes	3 (20.0)	0	2 (13.3)	0	0	0	2 (13.3)	8 (53.3)	0	15
No	24 (7.2)	12 (3.6)	98 (29.3)	12 (3.6)	19 (5.7)	9 (2.7)	69 (20.7)	41 (12.3)	50 (15.0)	334
Epilepsy										
Yes	2 (20.0)	1 (10.0)	2 (20.0)	1 (10.0)	0	0	1 (10.0)	1 (10.0)	2 (20.0)	10
No	25 (7.4)	11 (3.2)	98 (28.9)	11 (3.2)	19 (5.6)	9 (2.7)	70 (20.6)	48 (14.2)	48 (14.2)	339
Parkinson disease										
Yes	1 (11.1)	0	4 (44.4)	0	0	0	2 (22.2)	2 (22.2)	0	9
No	26 (7.6)	12 (3.5)	96 (28.2)	12 (3.5)	19 (5.6)	9 (2.6)	69 (20.3)	47 (13.8)	50 (14.7)	340

movement and mobility issues can pose difficulties for people trying to enter and exit the water. Previous research has investigated the accessibility of health facilities, such as public swimming pools, with regards to physically impaired visitors[36]. Aquatic-specific design features such as transfer walls, ramps, warning textures around the pool perimeter, and pool lifts[36] can assist older people to safely participate in aquatic activities; they are ideal for older people as they are low impact and beneficial for both exercise and rehabilitation. However, it is important for people to be aware of the impact of preexisting medical conditions, particularly the effect they may have on ability and fitness in the water.

It is commonly assumed that those who participate in aquatic activities are healthier than those who do not. However, the data obtained from this study do not support this assumption: it seems that those who drown are not healthier than the broader Australian population, thus highlighting the need for regular health check-ups, whether a medical condition is present or not. This will ensure that chronic conditions are detected early and are appropriately monitored by a doctor who can facilitate timely intervention if required.

Limitations

Open coronial cases may have led to the proportion of drowning cases associated with a preexisting medical condition being underestimated because full documentation was not available. This information was sourced from autopsy reports within the NCIS; however, information was not available for all cases, either because a coroner's examination was not performed, or the report was not made accessible electronically. Inferences have been drawn from the available data, and further research is recommended.

Data were missing for a number of other variables within this study. Analysis involving medication usage and alcohol consumption relied on toxicology results, which were not available for all cases. Similarly, activity before drowning was unknown in a relatively large number of cases, posing a challenge for both data collection and prevention efforts.

The high proportion of people with a cardiovascular condition included cases where abnormal cardiac pathology was detected at autopsy. These cases were then compared with the proportion of people taking related medications. In several cases toxicology information was unknown, either because the report was not made available electronically or because a toxicology screen was not performed. Although this may have impacted the results, it is also likely that several cardiovascular conditions were only detected postmortem at autopsy, rather than being diagnosed during the person's lifetime. Given the age group under investigation, it is reasonable to assume considerable age-related changes would have occurred.

Table 6

Noncontributory and contributory preexisting medical conditions by location.

	Location [N (%)]								
	Bathtub/Spa Bath	Beach	Lake/Dam/Lagoon	Ocean/Harbor	River/Creek/Stream	Rocks	Swimming Pool	Other	Total
Medical condition									
Cardiovascular disease									
Yes	17 (6.6)	35 (13.5)	22 (8.5)	40 (15.4)	61 (23.6)	7 (2.7)	65 (25.1)	12 (4.6)	259
No	9 (10.0)	9 (10.0)	6 (6.7)	11 (12.2)	27 (30.0)	0	19 (21.1)	9 (10.0)	90
Dementia									
Yes	0	4 (7.8)	2 (3.9)	4 (7.8)	21 (41.2)	0	12 (23.5)	8 (15.7)	51
No	26 (8.7)	40 (13.4)	26 (8.7)	47 (15.8)	67 (22.5)	7 (2.3)	72 (24.2)	13 (4.4)	298
Depression									
Yes	5 (13.5)	5 (13.5)	4 (10.8)	3 (8.1)	10 (27.0)	0	8 (21.6)	2 (5.4)	37
No	21 (6.7)	39 (12.5)	24 (7.7)	48 (15.4)	78 (25.0)	7 (2.2)	76 (24.4)	19 (6.1)	312
Epilepsy									
Yes	3 (20.0)	3 (20.0)	1 (6.7)	1 (6.7)	3 (20.0)	0	4 (26.7)	0	15
No	23 (6.9)	41 (12.3)	27 (8.1)	50 (15.0)	85 (25.4)	7 (2.1)	80 (24.0)	21 (6.3)	334
Parkinson disease									
Yes	0	1 (9.1)	1 (9.1)	0	1 (9.1)	0	4 (36.4)	4 (36.4)	11
No	26 (7.7)	43 (12.7)	27 (8.0)	51 (15.1)	87 (25.7)	7 (2.1)	80 (23.7)	17 (5.0)	338
Contributory medical condition									
Cardiovascular disease									
Yes	7 (9.0)	13 (16.7)	9 (11.5)	12 (15.4)	14 (17.9)	1 (1.3)	17 (21.8)	5 (6.4)	78
No	19 (7.0)	31 (11.4)	19 (7.0)	39 (14.4)	74 (27.3)	6 (2.2)	67 (24.7)	16 (5.9)	271
Dementia									
Yes	0	3 (6.1)	2 (4.1)	3 (6.1)	21 (42.9)	0	12 (24.5)	8 (16.3)	49
No	26 (8.7)	41 (13.7)	26 (8.7)	48 (16.0)	67 (22.3)	7 (2.3)	72 (24.0)	13 (4.3)	300
Depression									
Yes	3 (20.0)	3 (20.0)	3 (20.0)	2 (13.3)	3 (20.0)	0	1 (6.7)	0	15
No	23 (6.9)	41 (12.3)	25 (7.5)	49 (14.7)	85 (25.4)	7 (2.1)	83 (24.9)	21 (6.3)	334
Epilepsy									
Yes	2 (20.0)	3 (30.0)	0	1 (10.0)	3 (30.0)	0	1 (10.0)	0	10
No	24 (7.1)	41 (12.1)	28 (8.3)	50 (14.7)	85 (25.1)	7 (2.1)	83 (24.5)	21 (6.2)	339
Parkinson disease									
Yes	0	1 (11.1)	1 (11.1)	0	0	0	3 (33.3)	4 (44.4)	9
No	26 (7.6)	43 (12.6)	27 (7.9)	51 (15.0)	88 (25.9)	7 (2.1)	81 (23.8)	17 (5.0)	340

Conclusions

Preexisting medical conditions contribute to drowning in older people; however, contributions are unequal. This research has highlighted some of the key issues related to drowning prevention within an older demographic, focusing on the occurrence of medical conditions among seniors who drown. A greater understanding of the most commonly involved medical conditions will enable more targeted prevention strategies to be developed and implemented in the future.

With an aging population and increasing life expectancy, the prevalence of medical conditions among the general population is likely to increase, highlighting the need for continued public education around water safety. Older people are at increased risk when in, on, or around water, primarily because of the frequency of preexisting medical conditions and the effects of aging. By managing the risks involved, older people are able to gain the physical and social benefits of aquatic activities while remaining safe.

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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