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Unintentional Bathtub Drowning Deaths Among Those Aged 65 Years and Older in Australia

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Cover Page Footnote

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Abstract

When compared with other age groups, fatal drowning rates among seniors have stayed static. This study identifies causal factors in unintentional bathtub drowning deaths among people aged 65 years and over. This study is a 10-year (2003-2012) total population retrospective survey of all unintentional bathtub (baths, spa baths and showers) drowning deaths afflicting people aged 65 years and over. Data were sourced from the Australian National Coronial Information System. Risk factors and circumstantial variables were analysed including sex, age, activity prior to drowning, alcohol, drugs, pre-existing medical conditions, living circumstances, time until found, and performance of cardio-pulmonary resuscitation (CPR). There were 32 fatalities (20 females, 12 males); 41% drowned after a fall into the bath. High blood alcohol (≥0.05%) was disproportionately represented. Twenty-six people (81%) had a pre-existing medical condition, deemed contributory in 19 cases including cardiac (n=9) and sarcopenia or frailty (n=5). Of those with medical conditions, 69% had blood levels of prescribed drugs, commonly analgesics (n=10). Seven cases recorded both drugs and alcohol. In half of all fatalities (50%), the person resided alone. In ten cases (31%) the person was not found for one or more days. Bathtub drowning afflicting the elderly poses an unmet challenge. This study has identified five areas for targeted prevention: Pre-existing medical conditions, alcohol, falls in the bath, review of medications; and if practical, advising family members of bathing. Increased awareness of drowning among this age group (and carers) is required as the aged population increases.

Keywords: Drowning prevention; bathing; sarcopenia and frailty; cardiovascular disease; falls; pharmacology

Introduction

There is a universal trend towards the reduction of unintentional fatal drowning in developed countries. The exception has been the lack of preventive success in reducing drowning rates among seniors (Mahony, Peden, Franklin, Pearn, & Scarr, 2017; Peden, Franklin, & Queiroga, 2017). This preventive challenge will intensify (Ayers, Barzilai, Crandall, Milman, & Verghese, 2017) as worldwide the elderly population (i.e., 60 years and older) is predicted to double between 2017 and2050 (World Health Organization, 2015).

Drowning prevention, like all injury reduction efforts, is effective only if programmes are targeted at specific "at risk" groups. For the older population, drowning in domestic bathtubs is an under-recognised preventative challenge (Suzuk, Hikiji, & Fukunaga, 2017). Research has identified the causes and preventive stratagems of relevance to childhood bathtub drowning (Pearn & Nixon, 1977; Peden, Franklin, & Pearn, 2017). By way of contrast, the literature is relatively silent on bathtub drowning afflicting seniors (Hu & Baker, 2010; CDC, 2012). We report here a 10-year analysis of all unintentional bathtub drowning deaths involving people aged 65 years and older in Australia.

Method

This study is a detailed retrospective case study analysis of unintentional bathtub drowning fatalities. All drowning deaths of people aged 65 years and older were drawn from a total population dataset comprising every unintentional drowning fatality in Australia between 1-July-2002 to 30-June-2012. All intentional drowning deaths (e.g., suicide, homicide) and those of natural causes (e.g. coronary occlusion) were excluded. All deaths were designated by the coroner as drowning, either as the primary or a contributory cause of death. This age cut-off (65 years) represents a proxy for retirement in Australia (Australian Government, 2015). We defined "bathtubs" as any bathroom facility used for personal ablutions (Royal Life Saving Society – Australia, 2017).

Case Finding

Every case of unintentional fatal drowning in Australia over this time period was identified through privileged, confidential access to the Australian National Coronial Information System (NCIS) (Victorian Institute of Forensic Medicine, 2017). The process for sourcing drowning data from the NCIS has been published previously (Peden, Franklin, Mahony, Barnsley, & Scarr, 2017). This study used the World Health Organization definition of drowning (van Beeck, Branche, Szpilman, Modell, & Bierens, 2005).

Data Collection, Coding and Analysis

Prior medical history, coronial and subsequent forensic details were reviewed. Variables examined included age group, sex, medical history, drowning location, activity immediately prior to drowning, and drug and alcohol forensic findings. Bathtub drowning deaths were compared to all other drowning locations. Additional variables collected and coded from NCIS reports included living circumstances of victim, pre-event knowledge of the victim's bathing, time until found, and information on cardio-pulmonary resuscitation (CPR).

Data on the presence of pre-existing medical conditions were available from the NCIS. Each case was reviewed and ascribed an interpretative determination as to the potential role of any recorded medical condition as a causative factor by J.P., the medical author. These reviews included an assessment of physical disability and frailty, and signs and symptoms observed and reported. Details of drug and alcohol consumption were sourced from toxicology reports. Drugs were coded within their therapeutic class (UBM Medica, 2011). A contributory level of alcohol was a blood alcohol concentration (BAC) reading of $\geq$0.05%. Season of drowning in Australia spans the following months: Summer (December, January, February), Autumn (March, April, May), Winter (June, July, August) and Spring (September, October, November). Univariate analysis and chi-squared tests were undertaken with a significance level of $p<0.01$.

Ethics

The Victorian Department of Justice Human Research Ethics Committee (JHREC) granted ethical approval (CF/07/13729; CF/10/25057, CF/13/19798).

Results

There were 32 fatalities, of which the mean age was 75.2 years, 44% were aged 65-74 years (Table 1). Females were significantly more likely to drown in bathtubs than other aquatic locations (X^2=20.7; p<0.001). Almost a third (31%) of cases were known to involve a contributory level of alcohol, a figure which was higher than that known to apply to other aquatic locations (X^2=8.5; p<0.01).

Table 1. Demographic and causal factors by bathtub and all other locations of unintentional fatal drowning among people aged 65 years and over, Australia, 2002/03-2011/12 (N=510)

	Total		**Bathtub**		**Other Location**		**X^2**
	N	**%**	**N**	**%**	**N**	**%**	**(p value)**
Total	510	100.0	32	6.3	478	93.7	-
Sex							
Male	369	72.4	12	37.5	357	74.7	20.7
Female	141	27.6	20	62.5	121	25.3	(p<0.001)
Age group							
65-74 years	260	51.0	14	43.8	246	51.5	0.8 (p=0.664)
75-84 years	188	36.9	13	40.6	175	36.6	
85+ years	62	12.2	5	15.6	57	11.9	
Pre-existing medical condition							
Yes	353	69.2	26	81.3	327	68.4	4.9
No	29	5.7	3	9.4	26	5.4	(p=0.087)
Unknown	128	25.1	3	9.4	125	26.2	-
Blood alcohol concentration (≥0.05%)							
Yes	59	11.6	10	31.3	49	10.3	8.5
No	277	54.3	17	53.1	261	54.6	(p=0.004)
Unknown	174	34.1	5	15.6	168	35.1	- *
Drugs							
Yes	182	35.7	18	56.3	165	34.5	4.8
No	151	29.6	9	28.1	143	29.9	(p=0.092)
Unknown	177	34.7	5	15.6	170	35.6	-
Season of drowning incident							
Summer	155	30.4	5	15.6	150	31.4	7.3
Autumn	118	23.1	5	15.6	113	23.6	(p=0.063)
Winter	96	18.8	10	31.3	86	18.0	
Spring	141	27.6	12	37.5	129	27.0	

* X^2=13.9; p=0.001

Fourteen victims had measurable blood alcohol, ten of whom (31% of all bathtub drowning victims) had a blood alcohol level (greater than 0.05g/100mL) believed to be contributory to the drowning event.

Twenty-eight people (87%) drowned in the bathtub, three in spa-baths (10%) and one in the shower (3%). All but one case occurred in the person's own home. Forty one percent drowned after falling into the bath. (Table 2) There were no sex (not shown) or age differences by prior activity, pre-existing medical condition, alcohol, drugs, or season of drowning incident (Table 2).

Table 2. Demographic and causal factors by age group in unintentional fatal drowning in bathtubs among people aged 65 years and over, Australia, 2002/03-2011/12 (N=32)

	Total		**65-74 years**		**75-84 years**		**85+ years**		**X^2 (p value)**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
Total	32	100.0	14	43.8	13	40.6	5	15.6	-
Sex									
Male	12	37.5	7	58.3	3	25.0	2	16.7	2.1
Female	20	62.5	7	35.0	10	50.0	3	15.0	(p=0.350)
Activity immediately prior to drowning									
Bathing	19	59.4	10	52.6	7	36.8	2	10.5	1.8
Fall	13	40.6	4	30.8	6	46.2	3	23.1	(p=0.409)
Pre-existing medical condition									
Yes	26	81.3	10	38.5	11	42.3	5	19.2	4.1
No	3	9.4	3	100.0	0	0.0		0.0	(p=0.128)
Unknown	3	9.4	1	33.3	2	66.7	0	0.0	-
Blood alcohol concentration (≥0.05%)									
Yes	10	31.3	6	60.0	4	40.0	0	0.0	2.9
No	17	53.1	7	41.2	6	35.3	4	23.5	(p=0.240)
Unknown	5	15.6	1	20.0	3	60.0	1	20.0	-
Drugs									
Yes	18	56.3	7	38.9	8	44.4	3	16.7	1.9
No	9	28.1	6	66.7	2	22.2	1	11.1	(p=0.389)
Unknown	5	15.6	1	20.0	3	60.0	1	20.0	-
Season of drowning incident									
Summer	5	15.6	2	40.0	1	20.0	2	40.0	4.4
Autumn	5	15.6	2	40.0	3	60.0	0	0.0	(p=0.626)
Winter	10	31.3	4	40.0	4	40.0	2	20.0	
Spring	12	37.5	6	50.0	5	41.7	1	8.3	

Bathtub drowning deaths commonly occurred in the evening (18:01h-00:00h) (41%), followed by the morning (06:01h-12:00h) (28%), afternoon (12:01h-18:00h) (28%) and early morning (00:01h-06:00h) (3%). Twenty-six

victims (81%) had a pre-existing medical condition (Table 1), of which 19 (59%) were believed to be contributory to the fatality. Cardiac conditions were the most common (47%), followed by sarcopenia or frailty (26%) (Table 3).

Table 3. Attributed pre-existing medical conditions, total population survey, Australia, 2002/03-2011/12 (n=26)

	Contributory	**Possible contributory**	**No impact**	**Total**
Cardiac	9	5	0	**14**
Epilepsy	2	0	0	**2**
Sarcopenia or Frailty	5	0	0	**5**
Syncope / Other	3	0	2	**5**
Total	**19**	**5**	**2**	**26**

Of the 26 victims with a pre-existing medical condition, 18 (56%) had blood levels of legally prescribed drugs (Table 1). The most common category of medications present was analgesics (n=10), followed by anti-anxiety (n=6) and anti-depressant medication (n=6) (Table 4). Anticonvulsants were recorded in two cases. The number of medications used ranged from one to six medications (mean 2.4). There were no cases where illicit drug use was recorded. In seven cases, both drugs and a contributory level of alcohol were recorded.

Table 4. Pre-existing medical conditions by drug involvement in bathtub drowning fatalities among people aged 65+ years, Australia, 2002/03 to 2011/12 (n=26)

	Drugs - Yes	**Drugs - No**	**Drugs - Unknown**	**Total**
Cardiac conditions	9	2	3	**14**
Epilepsy	1	1	0	**2**
Sarcopenia or Frailty	5	0	0	**5**
Syncope / Other	1	4	0	**5**
Total	**16**	**7**	**3**	**26**

In half of all cases (50%), the person resided alone; 38% resided with family, namely spouse (58%), adult children (8%) or other family members (33%), 3% had a visiting carer and in 9% of cases, living circumstances were unknown. In 69% of cases the person didn't tell anyone that they were going to take a bath. In ten cases (31%) the person was not found for one day or longer after they had died in the bath. None of these factors were found to be

statistically significant by age group (Table 5). In nine cases (28%) CPR was performed, most commonly by a family member or ambulance officer.

Discussion

Bathtub drowning is a rare but regularly occurring cause of death among the elderly in Australia. Such deaths often generate disproportionate overtones of guilt among relatives and carers (Sheldon, 1998). A significant proportion was related to pre-existing medical conditions (commonly cardiac and sarcopenia or frailty). Forty-one percent drowned as a result of a fall into the bathtub and females were more likely to drown in the bath when compared to males. Aquatic immersion in warm water stimulates reflexes in the autonomic nervous system, decreasing sympathetic tone whilst increasing vagal influence (Perini & Veicsteinas, 2003). Those with pre-existing cardiac conditions may be selectively more prone to immersion-induced dysrhythmias (Lippmann & Pearn, 2012).

In 31% of cases, the person who drowned had a pre-existing medical condition but did not have blood levels of prescribed medications (Franklin, Pearn, & Peden, 2017). While it is not able to be derived from coronial files whether the person who drowned was aware of the medical condition or not, this finding justifies the need for the elderly to regularly see a general practitioner (GP) for check-ups and to assess prescribed medications.

Alcohol is a contributory factor for elderly fatal bathtub drowning. Further work is needed to understand the role alcohol plays. We noted that BAC levels ranged from 0.007% to 0.310% (n=15) of which 67% were ≥0.05%. There is a higher proportion of people who drown in the bath who have been drinking compared to other drowning locations (X^2=8.5; p=0.004). It should be noted that those who drowned in the bath were more likely to be tested for the presence of alcohol and therefore a definitive result, be it yes or no, for alcohol consumption was achieved.

Challenges for Prevention

Preventative stratagems, which reduce the likelihood of falls into the bath, are obvious and include installation of handrails, non-slip matting, and potentially the accompaniment of another person when getting in and out of the bath (Bhasin, Gill, Reuben, Latham, Gurwitz, Dykes, et al, 2017). In this study, half of all victims lived alone. We believe that the challenges for prevention include intensified counselling of risk, care options, alarm systems, exploring the role of the medical practitioner, especially GPs, geriatricians and gerontologists, as well as understanding the role of bathing in the elderly, and mitigating the risk of falls.

Table 5. Circumstantial variables by age group for bathtub drowning fatalities among people aged 65+ years, Australia, 2002/03 to 2011/12 (N=32)

	Total		**65-74 years**		**75-84 years**		**85+ years**		**X^2 (p value)**	**Male**		**Female**		**X^2 (p value)**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**		**N**	**%**	**N**	**%**	
Total	32	100.0	14	43.8	13	40.6	5	15.6	-	12	37.5	20	62.5	-
Living circumstances														
Lives alone	16	50.0	2	12.5	11	68.8	3	18.8	2.101 (p=0.350)	4	25.0	12	75.0	2.811 (p=0.245)
Lives alone, carer visit	1	3.1	1	100.0	0	0.0	0	0.0		1	100.0	0	0.0	
Lives with family	12	37.5	9	75.0	1	8.3	2	16.7		5	41.7	7	58.3	
Unknown	3	9.4	2	66.7	1	33.3	0	0.0	-	2	66.7	1	33.3	-
Did they tell anyone they went to take a bath?														
Yes	4	12.5	3	75.0	0	0.0	1	25.0	2.955 (p=0.228)	1	25.0	3	75.0	0.193 (p=0.660)
No	22	68.8	9	40.9	10	45.5	3	13.6		8	36.4	14	63.6	
Unknown	6	18.8	2	33.3	3	50.0	1	16.7	-	3	50.0	3	50.0	-
Time until found														
Less than 2 hours	5	15.6	2	40.0	1	20.0	2	40.0	2.360 (p=0.670)	2	40.0	3	60.0	0.269 (p=0.874)
2 hours – 23 hours	7	21.9	4	57.1	2	28.6	1	14.3		2	28.6	5	71.4	
1 day or more	10	31.3	5	50.0	4	40.0	1	10.0		4	40.0	6	60.0	
Unknown	10	31.3	3	30.0	6	60.0	5	50.0	-	4	40.0	6	60.0	-

The prevention of falls is a complex area that involves psychosocial (Peel, McClure, & Hendrikz, 2007) and health-related factors (Peel, McClure, & Hendrikz, 2006), environmental modification and systems that alert others when a fall occurs (Lord, Menz, & Sherrington, 2006). While there have been significant advances in alarm systems it is unclear if people wear these, or have access to them, in the bathroom (Edwards & Jones, 1998). The use of rails and non-slip bath mats may reduce the risk of a fall while in the bath. As medical conditions play a significant contributory role in bathtub drowning deaths, increased GP and carer awareness will help. Showering is a safer solution especially where showering aids such as chairs are used.

Limitations

Due to people being found alone, detailed information on how the victim came to be in the bath was unknown. There were also those cases where alcohol and pre-existing medical conditions were unknown due to the lack of an autopsy (9%). Bathing deaths in the elderly and children is a relatively unexplored area and while some information is missing, this data can be used by the coroner to inform future investigations and by GPs to aid in education of patients and therefore prevention.

Conclusions

Drowning deaths among elderly people in the bathtub are rare but regularly occurring and continue to constitute an unmet challenge of preventable deaths in a vulnerable population. This study highlights five areas where prevention can be targeted: pre-existing medical conditions, alcohol, the bathing environment leading to a fall, review of medications, and if practical, letting family members know you are bathing. In enacting prevention stratagems early, as the aged population increases, it is hoped lives will be saved.

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