

Epidemiology of unintentional fatal drowning among migrants in Australia

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Globally, 90% of drowning mortality occurs in low- and middle-income countries, with more than half of the drowning burden experienced by China, India, Pakistan and Bangladesh.^{1,2} The latest Global Burden of Disease Report found Australia to have one of the lowest drowning rates per capita, at a rate of 0.9 per 100,000 population, and an average of 215 drowning deaths in Australia annually,¹ although this is thought to be an under-representation due to the exclusion of transport and flood-related drowning deaths. Annual drowning data published by the Royal Life Saving Society – Australia (RLSSA) include Australian residents, overseas tourists, international students, children, adults, males and females.³ A public perception exists that tourists and migrants are over-represented in drowning deaths, accentuated by media reporting that may not always be accurate.^{4,5} Of total drowning deaths in Australia between 2005 and 2015, 27% were of people born outside of Australia, including migrants and overseas tourists.⁶

Australian context

As of June 2019, approximately 29% of the Australian population were people born outside of Australia and a further 20% had at least one parent who was born overseas.⁷ For one-fifth (21%) of the Australian population, English is not their first language.⁸ The top ten countries of birth outside of Australia include England, New Zealand, China, India, Italy and Vietnam, Malaysia and Sri Lanka.⁷ Adding to Australia's population mix are international students and working holidaymakers who

Abstract

Objective: This study aimed to describe the epidemiology and risk factors contributing to drowning among migrants in Australia.

Methods: A total population retrospective epidemiological study of unintentional drowning deaths in Australia between 1 July 2009 and 30 June 2019 of people born outside Australia (migrants). Cases were extracted from the National Coronial Information System. Descriptive statistics, chi-square and relative risk were calculated. Crude drowning rates were based on country of birth and population in Australia.

Results: There were 572 migrant deaths over the study period, 28.9% of total drowning deaths, 82.9% were male. Twenty-one per cent were aged 25–34 years and 40.8% had lived in Australia for 20+ years. Migrants at highest risk of drowning were from: South Korea (2.63/100,000 95%CI: 0.85–8.25), Taiwan (2.29/100,000 95%CI: 0.27–13.44), and Nepal (2.15/100,000 95%CI: 0.23–11.55). Migrants were more likely to drown when around rocks ($p < 0.001$) compared with Australian-born people, who most frequently drowned in rivers ($p < 0.001$).

Conclusions: Migrants are not over-represented in drowning statistics. However, unique trends were found for drowning among migrants based on country of birth and length of time in Australia.

Implications for public health: Holistic drowning prevention strategies and policies are required to effectively lower drowning risk among migrant communities.

Key words: drowning, epidemiology, migrant, minority populations, risk identification

intend to live in Australia for a period of time.⁹ Migrants settle across Australia; Western Australia (WA), New South Wales (NSW) and Australian Capital Territory (ACT) record the highest proportion of the population born overseas.⁷ Migrants most commonly settle in metropolitan areas, with Sydney, Melbourne and Brisbane consistently reporting the largest increases in migrant settlement.⁷

Australia's changing population brings many benefits, economically, culturally and socially; however, it also brings complexity for the public health and injury prevention sector for ensuring the health and safety of all new

Australians and to meet the needs of different sub-groups of migrants. Social determinants of health, such as cost, language and cultural and religious factors have been identified as barriers for migrants in accessing health services, injury prevention and health promotion programs, including swimming and water safety programs.^{10,11}

Few studies have reported on injury trends among migrants in Australia, including drowning.^{6,12–15} Studies have mainly focused on motor vehicle accidents, falls and work-related injuries and deaths.^{13,14,15} These studies reported that some migrant

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Submitted: October 2020; Revision requested: December 2020; Accepted: February 2021

The authors have stated they have no conflict of interest.

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Aust NZ J Public Health. 2021; Online; doi: 10.1111/1753-6405.13102

adults, predominantly men, were found to be at higher risk of injury-related fatalities.^{14,15} Several Australian studies have reported migrants as being at higher risk of drowning.^{6,16,17} International research suggests that migrants are at higher risk of drowning in high-income countries due to a lack of swimming ability and poor water safety knowledge.¹⁸⁻²⁰ In China, migrant children have been found to be at higher risk of experiencing non-drowning mortality.²¹

Prevention

The World Health Organization's 'Framework of priorities and guiding principles to promote the health of refugees and migrants'²² outlines key objectives that countries should consider when addressing the health needs of migrants, including physical and mental health and access to quality health services and information.²² Few national health strategies and/or policies exist in Australia that specifically focus on the health of migrant or culturally diverse populations.

The Australian Water Safety Strategy²³ is one example of a national strategy that specifically highlights a need to focus on migrant and culturally diverse populations. Multicultural populations, including migrants and overseas tourists, have been identified as a priority for reducing drowning in Australia due to Australia's changing demographics, which is now being reflected in drowning statistics.⁶ It is thought that some migrants come to Australia with limited experience and understanding of water and water safety in the Australian context.^{16,17,24} While research has been undertaken to measure drowning deaths in Australia of people born overseas,⁶ further research is required to understand the burden of drowning specifically among migrant populations in Australia and to identify risk factors to inform drowning prevention strategies.

This study aimed to: 1) describe the epidemiology of drowning; and 2) identify key risk factors contributing to drowning among migrant populations in Australia.

Methods

This was a total population retrospective epidemiological study of unintentional drowning deaths in Australian waterways among migrants in Australia for the 10-year period from 1 July 2009 to 30 June 2019 (Australian financial years), as this covers

summer. Briefly, data were sourced from the RLSSA National Fatal Drowning Database and cross-referenced with the Australian National Coronial Information System (NCIS). The process for sourcing drowning death data has been outlined previously and can be accessed for further details.²⁵ As of 1 August 2020, 95.5% of cases were closed (i.e. no longer under coronial investigation).

Inclusion criteria

The intent of the study was to explore drowning among migrants in Australia. For the purposes of this study, migrants were defined as someone who had a residential address and was living in Australia at the time of death. This study excluded international students and overseas visitors, including long- and short-term tourists, business visitors and people in Australia for work purposes including those with working holidaymakers' visas. This determination was made by SWP and RCF based on information provided in coronial and police documentation in the NCIS. This definition was not based on visa status, as visa information was rarely recorded in coronial documents. However, documents generally state if a person was in Australia as a tourist, international student or working, e.g. a working holidaymaker or on a business trip. While some people in these groups may have been residing in Australia at the time of death, it is likely they were only intending on living in Australia for a specified period of time and intended to return home as per their visa requirements.⁹ Refugee status was unknown in most cases unless stated in the coroner's report; they were therefore included as migrants for the purposes of this study. SWP initially scanned NCIS documentation for country of birth, residential or visitor status and length of time in Australia. Cases where residency or visitor status was unclear were discussed with RCF and a decision was made to include or exclude based on all available information.

Variables

Variables analysed in this study included: financial year; age (child 0–17, adult 18–64 and older adult 65 years and over); sex; country of birth; time spent in Australia; season, time of day, and location of drowning; activity being undertaken prior to drowning; and the presence of alcohol, drugs and pre-existing medical condition(s). In accordance with previously published definitions, data for variables such as location of drowning and

activity being undertaken immediately prior to drowning were categorised and coded from case file documentation as per the Royal Life Saving National Fatal Drowning Data Dictionary and Coding Manual²⁶ (Table 1).

The time spent in Australia was known in 50.5% of migrant drowning deaths and based on information sourced from the NCIS, coroner's findings and police reports, and was analysed by single year of residency in Australia. Countries were categorised and analysed by the World Health Organization (WHO) Region,²⁷ noting that some countries included in this study are not recognised by the WHO, e.g. Taiwan (Table 3).

Seasons in Australia are as follows: summer (December to February); autumn (March to May); winter (June to August); spring (September to November). Time of drowning was coded into early morning (12:01 am to 6.00 am), morning (6:01 am to 12.00 pm), afternoon (12:01 pm to 6.00 pm), and evening, (6:01 pm to 12.00 am). Information relating to alcohol and drugs involvement was sourced from toxicology and autopsy reports in the NCIS. A blood alcohol concentration (BAC) greater than or equal to 5 grams of alcohol per 100 millilitres of blood (BAC \geq 0.05%), was considered contributory to the drowning (the upper legal limit in Australia for operating a motor vehicle). Drugs were classified as: legal (medication) and illegal (illicit). Information regarding swimming ability was sourced from coroners and police reports. Where recorded, swimming ability was classified as competent swimmer, poor swimmer or non-swimmer. These definitions may not be reflective of the actual skills of the person, consistent with other research on the real versus perceived swimming skills from an individual and third-person perspective.^{28,29,30}

Data analysis

Data analysis was conducted using SPSS version 26.³¹ Descriptive statistics were utilised, as well as chi-square (χ^2) tests for independence and non-parametric tests for significance ($p < 0.05$). A Bonferroni correction³² has been applied where multiple categories within the one variable were analysed (location and activity), therefore statistical significance was deemed as $p < 0.007$ (location) and $p < 0.008$ (activity), respectively (Table 1). Chi-square analysis was calculated to determine differences between migrants and Australian-born. Relative risk (RR) with a 95% confidence interval (CI) and

drowning rates were calculated for country of birth using Australia as the control group. Variables with an 'unknown' were excluded from RR and chi-square analysis.

Drowning rates per 100,000 population by country of birth (COB) were calculated using the 10-year average population residing in Australia between 2009 and 2019, based on Australia's estimated resident population by country of birth measured at 30 June each year from the Australian Bureau of Statistics (ABS).⁷ Population data of COB by state/territory are only available for census years in Australia, and thus, 2016 population data were used with a 10-year average calculated for the deaths.⁷ For the purposes of this study, England, Scotland, Wales and Northern Ireland were coded to the United Kingdom (UK). An overall drowning rate was calculated for the UK using the process described above.

Ethics

Ethics approval for this study was granted by the James Cook University Human Research Ethics Committee (H7693) and the Department of Justice and Regulation Human Research Ethics Committee (CF/19/5301).

Results

Over the study period (1 July 2009 to 30 June 2019), there were 2,686 unintentional drowning deaths in Australia. Of these, 28.9% (N=776) of people who drowned in Australia were born overseas. Of the 776 deaths, 572 people were identified as migrants and 204 as visitors to Australia (excluded from the rest of the analysis). Country of birth was unknown in 40 cases. Migrants drowned at a rate of 0.86 per 100,000 overseas-born population compared to 1.1 per 100,000 Australian-born population.

Characteristics of migrants who fatally drowned

Males accounted for 82.9% of migrant drowning deaths. The highest proportion of drowning deaths was of people aged 25–34 years (21.0%), mean age for all was 46.6 years, standard deviation (SD) = 20.6, age range 1–95 years. Children (0–17 years) accounted for 3.1% (n=18) of migrant drowning deaths. Due to the small number of deaths involving children, the rest of the analysis focuses on adult migrants.

Overall, the highest proportion of migrant deaths occurred in NSW (40.8%), followed by

Table 1: Definitions of drowning location and activity being undertaken immediately prior to drowning, based on the Royal Life Saving Drowning Database and Coding Definitions Manual.²⁶

Variable	Definition
Location	
Based on where the drowning incident occurred	
Beach	Beach
Lake/Dam (lakes)	Lake, dam, lagoon, swimming holes, gorges.
Ocean/Harbour	An open expanse of water that is generally accessed via a jetty or watercraft i.e. not the sandy shore of a beach entry.
River/Creek (rivers)	River, creek, stream, channel, estuary, flood plain, weir. A natural waterway fed by other bodies of water. Can vary in water flow, length, width, and depth.
Rocks	Rock formations, cliff faces or rocky outcrops generally alongside the ocean, often when rock fishing, walking/standing on rocks.
Swimming Pool	A permanent or temporary excavation, structure or vessel that is capable of filling with water to a depth of 300mm or more and is solely intended or principally used for human aquatic activity. Does not include spa baths.
Other	Where small counts under <5% were recorded, includes bathtub/spa bath, fishpond, marina, jetty/wharf.
Activity	
Activity being undertaken immediately prior to drowning, where known.	
Boating	Is defined as using motor or wind powered vessels of all sizes, and including yachts. Personal watercraft (PWC), also known as jet skis, are included in this category as these are motor powered.
Diving	The sport or activity of exploring or swimming under water. This category includes activities related to diving where the person was already in and or submerged by water prior to drowning e.g. spear fishing.
Fall	Unintentional entry into the water from land. Intention may be unknown – particularly in cases of children where intention may have been to be in the water. For example: fall whilst walking near water, fall whilst playing near water, fall whilst cleaning the pool. The authors acknowledge this is not an 'activity' per se, but drowning occurred as a consequence of falling into the water and not related to any other activity.
Rock Fishing	Fishing from rocks, rocky outcrops, cliffs. Includes where people were conducting this activity and fell or were swept into the water subsequently.
Swimming and recreating (hereafter swimming)	Already in the water either partially or fully submerged while performing recreational or swimming activities. Includes people who were in the water prior to drowning and includes activities such as swimming, wading, playing and floating.
Other	Includes activities where small counts were presented <4% and includes: bathing, non-aquatic transport (e.g. car), watercraft (e.g. surfing, kayaking/canoing), swept into the water (e.g. swept off rocks) or swept away (e.g. in floodwater).
Unknown	Activity was unknown and has been removed for data analysis purposes.

Queensland (20.4%) and WA (16.0%). There were no statistically significant differences in rates between migrants compared to Australian-born when explored by state/territory. Rates of migrant deaths were highest in Tasmania and Northern Territory (2.5 and 2.3 per 100,000 overseas-born, respectively). The majority (72.6%) of migrants drowned in their home state/territory, within 100km of their place of residence. Drowning deaths most frequently occurred in summer (42.5%) and on a Sunday (21.9%). Almost half (49.0%) occurred in the afternoon.

Migrant adults (18+ years) most frequently drowned at rivers (21.9%) or beaches (21.7%). Swimming was the most common activity being undertaken immediately prior to drowning (28.7%). More than one-quarter (27.1%) of adults recorded alcohol present, ($\chi^2 = 177.70; p < 0.001$) of which 60.0% recorded a BAC $\geq 0.05\%$. Drugs were recorded in 31.8% of migrant drowning deaths, ($\chi^2 = 13.77; p < 0.001$) of which 23.3% were known to be illicit drugs (Table 2). Swimming ability

was only recorded in 18.0% of cases, of which more than half (55.7%) were thought to be poor or non-swimmers. A pre-existing medical condition was recorded in 40.1% of cases, most commonly cardiac conditions.

Analysis of drowning by country of birth (adults 18 years+)

Migrants from the UK (13.2%), China (10.4%), New Zealand (8.1%), India (5.1%) and South Korea (4.8%) recorded the highest numbers of drowning deaths (Table 3). Countries of migrant origin that recorded the highest drowning rates by residential population in Australia were South Korea (2.63 per 100,000 population), Taiwan (2.29 per 100,000 population) and Nepal (2.15 per 100,000), all of whom do not have English as an official language (Table 3).

Residency time in Australia among migrants could be determined in 50.5% of cases. Of those, 40.8% had lived in Australia for 20 years or more (long-term migrants); those who had

been in Australia for ≤ 5 years accounted for 36.7% (Table 2). When analysed by length of residency time in Australia by age, 66.1% of long-term migrants were aged 55 years and over. In contrast, 65.1% of migrants who had been in Australia for ≤ 5 years were aged between 18 and 34 years.

When analysed by country of origin and length of residency time in Australia, China and India accounted for the highest number of people who had been in Australia for ≤ 5 years (China 23.8%, India 20.6%), followed by

Ireland (12.7%) and South Korea (11.1%). In contrast, the highest proportions of long-term migrants were from the UK (34.6%), Vietnam (14.8%) and New Zealand (13.6%).

The Western Pacific Region (36.9%) followed by Europe (33.6%) were the most common WHO regions represented among the registered drowning deaths. Length of residency time in Australia varied by region of origin; Europe (61.0%) recorded the highest proportion of long-term migrants compared to the Western Pacific Region (34.9%), while

the South East Asian Region recorded the highest proportion of residents of ≤ 5 years. More than half (54.4%) of migrant drowning deaths were people from non-English-speaking countries.

Location and activity by country of birth

Migrant adults were significantly more likely to drown from rocks ($\chi^2 = 76.876$; $p < 0.001$) than Australian-born adults, who were most likely to drown in rivers ($\chi^2 = 26.205$; $p < 0.001$). Migrants were significantly more likely to be swimming ($\chi^2 = 35.79$; $p < 0.001$) and rock fishing ($\chi^2 = 83.557$; $p < 0.001$) compared with Australian-born residents who were more likely to drown while boating ($\chi^2 = 19.927$; $p < 0.001$) or diving ($\chi^2 = 10.732$; $p < 0.001$), see Table 2.

Swimming was the most common activity for both groups at beaches (migrants 59.3% and Australia-born 43.9%). At rivers, people most often drowned as a result of an unintentional fall for both groups, with swimming being the second activity for migrants at rivers (26.1%) and non-aquatic transport for Australian-born (22.5%).

People born in China accounted for the highest proportion of migrants who drowned after falling or being swept off rocks (26.0%) and in swimming pools (17.4%). People born in India accounted for the highest proportion of migrants who drowned at beaches (13.3%). People from New Zealand and the UK accounted for the leading groups of migrants who drowned in rivers (11.1% and 5.4%), lakes/dams (10.0% each) and ocean/harbour locations (11.9% and 22.0%).

Beaches were the most common location of drowning for residents who had been in Australia for ≤ 5 years (27.4%) and for 6–10 years (33.3%), whereas residents between 15 and 20 years most frequently drowned from rocks (61.5%). Long-term residents for 20+ years were equally likely to drown at beaches and rivers (18.6% each). Swimming was the leading activity prior to drowning for all groups, except for residents who had been in Australia between 16 and 20 years, who most commonly drowned after falling or being swept off rocks (53.8%).

Discussion

Drowning is a public health issue globally and in Australia that has a significant impact on families, communities and society. The

Table 2: Drowning deaths in Australia between 1 July 2009 and 30 June 2019 comparing Australian born and migrant adults (18+ years) by sex, age, location of drowning and activity immediately prior to drowning, presence of alcohol and drugs, and time in Australia (N=1,870).

	Migrants Adults 18+ years (n=544)		Australian-born residents Adults 18+ years (n=1,326)		χ^2 (P-value)
	N	%	N	%	
Male	448	82.4	1077	81.2	0.328 ($p=0.600$)
Female	96	17.6	249	18.8	
Adult 18 - 64 years	405	74.4	1001	75.5	0.224 ($p=0.638$)
Older adult 65+ years	139	25.6	325	24.5	
State and Territory					
ACT	11	2.0	13	1.3	1.098 ($p=0.293$)
NSW	222	40.8	476	35.9	0.131 ($p=0.738$)
NT	13	2.4	63	4.8	7.522 ($p=0.006$)
QLD	111	20.4	308	23.2	4.514 ($p=0.037$)
SA	19	3.5	63	4.8	3.686 ($p=0.064$)
TAS	17	3.1	74	5.6	8.868 ($p=0.003$)
VIC	64	11.8	173	13.0	4.543 ($p=0.034$)
WA	87	16.0	156	11.8	9.005 ($p=0.003$)
Aquatic Location^a					
Beach	118	21.7	221	16.7	6.561 ($p=0.012$)
Lake/Dam	46	8.5	122	9.2	0.262 ($p=0.609$)
Ocean/Harbour	67	12.3	227	17.1	6.716 ($p=0.010$)
River/Creek	119	21.9	449	33.9	26.205 ($p < 0.001$)
Rocks	93	17.1	63	4.8	76.876 ($p < 0.001$)
Swimming Pool	65	11.9	115	8.7	4.758 ($p=0.031$)
Other	36	6.7	129	9.7	-
Activity^b					
Boating	47	8.6	220	16.6	19.927 ($p < 0.001$)
Diving	45	8.3	59	4.4	10.732 ($p < 0.001$)
Fall	71	13.1	162	12.2	0.246 ($p=0.644$)
Rock Fishing	69	12.7	30	2.3	83.557 ($p < 0.001$)
Swimming and recreating	156	28.7	257	19.4	35.79 ($p < 0.001$)
Other	110	20.2	447	33.7	-
Risk factors					
Alcohol	150	27.1	453	34.2	177.70 ($p < 0.001$)
Drugs ^c	176	32.4	504	38.0	13.77 ($p < 0.001$)
Time in country (where known)					
<5 years	106	36.7	-	-	-
5 - 10 years	33	11.4	-	-	-
10 - 15 years	19	6.6	-	-	-
15 - 20 years	13	4.5	-	-	-
20 years and over	118	40.8	-	-	-

Notes:

A modified Bonferroni test has been applied.

a: $p=0.007$

b: $p=0.008$.

c: Includes medication and illicit substances

economic impact of a single fatal drowning in Australia has been estimated at \$4.25 million and, for a non-fatal incident, \$400,000.³³

A recent literature review suggested that migrants are at higher risk of drowning in Australia and internationally, for reasons including inadequate knowledge of water safety and aquatic environments and lack of swimming and water safety skills.^{2,11} The newest iteration of the Australian Water Safety Strategy³⁴ specifically identifies multicultural populations, including migrants, as one of five priority areas for reducing drowning. This study reported that migrants in general in Australia were not over-represented in drowning statistics when compared to their Australian-born peers. However, certain sub-populations recorded a greater drowning rate than the Australian-born population. Furthermore, unique risk factors for migrant drowning were identified, such as country of birth and residential time in Australia, when analysed by location and activity prior to drowning. These findings provide new insights that may reduce the impact of drowning among Australia's migrant communities.

Who is drowning?

Overall, this study found consistent trends for drowning among both migrants and Australian-born people, including over-representation of males, alcohol, drowning

in the summer months and in the afternoon. Research consistently reports that men over-estimate their ability and underestimate drowning risk.^{28,35,36,37} However, migrant men may be harder to reach than the general Australian male population due to cultural and social factors. Strategies to engage with migrant men need to be co-designed with the community for greatest impact.

This study also identified differences in drowning trends between migrants and those born in Australia. Migrants were more likely to drown when swimming or rock fishing at beaches and around rocks, in comparison with those born in Australia, who were more likely to drown while boating or diving at river or ocean locations. This information provides further insights into people's participation and behaviour around different aquatic locations.

More than one-quarter of drowning deaths among migrants involved alcohol, similar to Australian-born drowning statistics. However, this may be a sensitive subject for some communities due to cultural and religious beliefs. Safety messages focusing on alcohol should be carefully considered, and not just a translation of current campaigns, to ensure messages are received well by migrant communities.

The highest numbers of migrant drowning deaths were reflective of the countries with the highest overseas populations in Australia,

being the UK, China, New Zealand, India and Vietnam.⁶ Migrants from these countries were more likely to have resided in Australia for a longer period. In contrast, people from South Korea, Taiwan and Nepal recorded the highest rates of drowning and were more likely to be recently arrived migrants.

These results suggest that both recent and long-term migrants may be at high risk of drowning. Key factors contributing to drowning for these groups were identified. Long-term migrants were more likely to be aged 55 years and over and from English-speaking countries and are thought to have been exposed to community water safety messages and campaigns since living in Australia. In contrast, recent residents (≤ 5 years) were more likely to be younger and come from non-English-speaking countries. The authors postulate that recent migrants may not previously have been exposed to water safety education campaigns or programs. These findings were similar to a Canadian study exploring migrants' unintentional injury risk and residential time, where drowning risk was found to be highest among recent migrants.¹⁸

This study shows a need for drowning prevention agencies to pay attention to migration patterns; for example, the Nepalese population has experienced a rapid growth in Australia over the last decade,⁸ which is now being reflected in drowning statistics.

Table 3: Migrant drowning deaths by top 10 countries of birth, World Health Organization (WHO) Region, language, drowning rates by residential population in Australia and RR (95% CI), 1 July 2009 and 30 June 2019.

Country of birth	Frequency	Percent ^a	WHO Region	English as an official language Yes/No	Residential pop. in Australia (10-year av.)	Drowning rates per 100,000 pop. (10-year av.)	RR (95%CI)
Australia				Yes	16,992,848	0.99	1
United Kingdom	75	13.2	Europe	Yes	1,200,767	0.62	0.61 (0.30 - 1.21)
China	59	10.4	Western Pacific	No	506,380	1.17	1.08 (0.48 - 2.40)
New Zealand	46	8.1	Western Pacific	Yes	564,857	0.81	0.80 (0.33 - 1.94)
India	29	5.1	South East Asia	Yes	454,135	0.64	0.60 (0.19 - 1.87)
South Korea	27	4.8	Western Pacific	No	10,2671	2.63	2.66 (0.85 - 8.25)
Vietnam	26	4.6	Western Pacific	No	23,2127	1.12	1.17 (0.38 - 3.65)
Germany	17	3.0	Europe	No	119,885	1.42	1.52 (0.38 - 6.07)
Italy	17	3.0	Europe	No	196,306	0.87	0.93 (0.23 - 3.71)
Ireland	14	2.5	Europe	Yes	87,096	1.61	1.04 (0.15 - 7.42)
Nepal	12	2.1	South East Asia	No	55,904	2.15	1.63 (0.23 - 11.55)
Greece	11	1.9	Europe	No	115,873	0.95	0.78 (0.11 - 5.57)
Malaysia	11	1.9	Western Pacific	Yes	148,889	0.74	0.61 (0.09 - 4.34)
Philippines	11	2.0	Western Pacific	Yes	236,297	0.47	0.38 (0.05 - 2.73)
Taiwan	11	1.9		No	48,052	2.29	1.89 (0.27 - 13.44)
USA	11	2.0	Americas	Yes	101,108	1.09	0.90 (0.13 - 6.39)

Notes:

^aPopulation and rates include all ages as unable to breakdown of population by age and COB.

a: Only the top ten countries are included in the table, but total out of all countries represented in the data, therefore does not add up to 100%

Based on 10-year average drowning deaths and 10-year average population.

Currently WHO does not include Taiwan in any of their region

Drowning and injury prevention agencies more broadly need to respond to Australia's changing demographics and be flexible in designing strategies to meet the needs of these emerging communities.

While migrants may be more receptive to health promotion messages and acting on these after being in their new country for a number of years, a different approach is required for new arrivals.^{18,19,24} Collaboration between settlement support agencies, education providers and drowning prevention agencies is needed to understand the best time to provide and deliver safety information for maximum effectiveness. Furthermore, safety information needs to be culturally sensitive and communicated appropriately to ensure that messages are understood and reach the intended audience.^{24,38,39}

Where and when does drowning among migrants occur?

NSW and Queensland recorded the highest proportion of migrant drowning deaths, reflective of where migrants are settling.⁷ Surprisingly, Victoria reported low rates of drowning among migrants despite a large overseas-born population.⁷ Migrants in the NT and Tasmania drowned at a higher rate compared to their Australian-born counterparts, despite Tasmania and NT recording among the lowest populations of migrant residents. These results emphasise the importance of making drowning prevention interventions available for migrants across Australia, not only in the states/territories with the highest populations, to ensure that all migrants have access to lifesaving information.

Overall, drowning among migrants commonly occurred at rivers and beaches, during the summer months, on a Sunday, and in the afternoon. These findings indicate that people are likely to be visiting aquatic locations in their leisure time, perhaps for family outings or social gatherings. Drowning prevention campaigns should consider focusing on safety messages that are relevant for the wider family and community rather than just the individual.

The location of drowning differed between different groups, based on residency time and country of origin. Long-term migrants were more likely to drown at rivers, compared to recent migrants who most frequently drowned at beaches. Recent migrants may be

eager to experience the aquatic environments that Australia offers but may have limited experience in engaging in recreation around different water environments.^{19,24,39,40} When analysed by country of origin, people from China and South Korea were more likely to drown around rocks compared to other migrants, and people from India most frequently drowned at beaches.

Activity being undertaken prior to drowning

Migrants were significantly more likely to drown when undertaking activities like swimming and rock fishing when compared with Australians. These findings are not new. Rock fishing is a popular activity for migrants, particularly among those from Asian countries, in Australia and New Zealand.^{16,40-42} Recent coronial inquests in Australia recommended mandatory lifejacket wearing when rock fishing to prevent drowning deaths.⁴³ Subsequently, the NSW Government introduced through legislation the compulsory wearing of lifejackets when rock fishing from December 2016.⁴⁴ The success of this initiative to reduce drowning is yet to be evaluated, with few local governments opting in to regulate and enforce this Act.⁴⁵ A long-term education campaign in New Zealand was successful in increasing lifejacket wear among culturally diverse rock fishers over a decade,⁴² indicating that adopting safety behaviours takes time, especially when focusing on people from diverse backgrounds. Furthermore, research suggests that rock fishing safety interventions need to be multi-faceted and involve the rock-fishing community.⁴⁰⁻⁴²

Swimming was the leading activity being undertaken prior to drowning for both migrants and Australian-born people. The WHO promotes swimming and survival skills as a protective factor for drowning for all ages.^{46,47} However, it is thought that many adults migrate without having any formal swimming or water safety education in their home country, putting them at higher risk of drowning.²⁴ Swimming ability was not well recorded in this dataset to determine if poor swimming is a key factor in migrant drowning deaths. It is known that some people, especially males, participate in aquatic activities regardless of ability and because they over-estimate their skills.^{19,20,28,37,48}

Given these findings, prevention agencies should consider tailoring water safety programs and campaigns reflective of the

locations where communities gather, and the key activities people undertake. Future water safety interventions should be informed or co-designed with communities for effectiveness.

Policy implications

The health and safety of new residents settling in Australia is a priority. Cross-sectoral collaboration is needed to tackle this public health issue, with no single agency or department solely responsible. The WHO Action Plan²² promotes the health of migrants and refugees, and drowning prevention can be linked to the following principles: ensuring equitable access to health services; people-centred refugee, migrant and gender-sensitive health systems; whole-of-government and whole-of-society approaches; and participation and social inclusion.²² This study found that, on average, 57 migrants drown in Australia each year, with nearly one-quarter having lived in Australia for less than five years. Based on the cost of drowning presented earlier, migrant drowning deaths equate to a cost of \$2.42 billion. Currently, the Australian migrant health requirements⁴⁹ focus on physical health conditions and communicable disease. The relevant government departments should consider updating these migrant health requirements to include an assessment of prospective migrants for personal safety awareness and knowledge, in preparation for their new lives and Australian culture, and for the prevention of premature morbidity and mortality. One solution would be to provide information on drowning and other injury risks in migration information prior to migrants leaving their home country.

The Australian Water Safety Strategy^{23,34} is one of the few public health strategies in Australia that specifically identifies migrants as a key area for reducing morbidity and mortality. The Strategy also recognises that poor swimming skills and water safety knowledge contribute to drowning risk, which may be linked to increased drowning risk among migrants as previously discussed. Swimming and water safety education programs are public health interventions that reduce drowning risk and provide additional health benefits for non-communicable conditions such as cardiovascular disease, diabetes and mental health, particularly as people age.^{50,51} Health promotion programs that incorporate swimming and water safety skills should be considered to support a holistic health

and wellbeing strategy for migrants that addresses drowning as well as broader health issues, thus reducing the future burden on the Australian health system.

The highest numbers of migrant deaths were of people from non-English-speaking countries. A challenge for the drowning prevention sector is to ensure that strategies and interventions meet the needs of these populations and navigate challenges pertaining to social determinants of health, such as income, language and cultural factors. Drowning prevention agencies should work with health and education agencies and communities to ensure that safety information is made accessible, whether via hard copy, electronic or face-to-face communication.³⁸ Additionally, policies should ensure that water safety is embedded into adult education curriculums, and support practical swimming and water safety lessons, where appropriate. Settlement support agencies have a role to play as conduits in providing vital safety information to migrant families and communities, especially if they are being settled in homes with swimming pools, or in proximity to waterways.

Implications for further research

This study identified several areas for further research in relation to drowning among Australian migrants. Migrant children only accounted for 3% of drowning deaths in this study. Further research is required to determine if children from migrant backgrounds (including children born in Australia and of migrant parents) are at higher risk of drowning than Australian-born children, to inform tailored drowning prevention programs and campaigns.

Swimming was the leading activity prior to drowning; however, swimming ability was not well recorded in the dataset to enable strong conclusions to be drawn between a lack of swimming skills and drowning among this population. Research exploring swimming and water safety skills of migrant adults and participation in swimming and water-based activity is required to better inform the design and delivery of drowning prevention strategies. This study highlighted rock fishing as a leading activity prior to drowning among migrants; additional research examining the use of lifejackets and long-term changes in knowledge, attitudes and behaviour among migrant rock fishers is recommended.

Some cultures have a strong connection to water, and water plays a role in religious and cultural events.³⁷ However, this was not captured in coronial reports and warrants further exploration in relation to the drowning risk among migrant populations. Qualitative research should be undertaken to address this gap in knowledge to better inform drowning prevention interventions.

International students were not included in this study, as discussed in the methods. Australia was a popular destination for international students prior to the COVID-19 pandemic; the number of student visas granted in Australia increased 50% over the last decade (2009–2019), with the highest numbers of students enrolled from China, India, Nepal, Brazil and Vietnam.⁵² In recent years, several drowning deaths have occurred of international students in Australia and this is an area of focus for drowning prevention agencies. While this study focused on migrants, some studies have explored drowning among international students and visitors.^{39,53} Further research is needed to fully understand the drowning risk for everyone in Australia, and what makes certain sub-groups at higher risk of drowning.

Strengths and limitations

This study has enabled a greater understanding of who is drowning in Australia and acknowledges that not all migrant populations may experience the same risk factors. These findings support the need for tailored drowning prevention strategies and health promotion programs for populations identified as being at higher risk.

Due to using coronial files to inform this report, gaps in data and inaccuracies in reporting the country of birth, time of residency, and specific country rather than region (e.g. the UK, Ireland, and Korea) were present. Of the total drowning deaths over the study period, country of birth and residency status was unknown in 18% of cases; therefore, actual numbers of drowning deaths among migrants may be higher. Due to limited information regarding ethnicity and cultural background recorded in coronial files, it was difficult to ascertain if cultural and/or language barriers were a contributing factor for drowning, especially among long-term residents.

Difficulties arose in distinguishing those who were born overseas but moved to Australia as a child and had spent their whole life in

Australia. Australian citizenship was rarely mentioned in the documents. This study only included data on first-generation migrants and did not include children of migrants (i.e. second-generation) as they were born in Australia. The authors concede that using country of birth does not account for a person's ethnicity or culture (self-identified), which may be more applicable and relevant when designing and targeting prevention strategies to ensure that a broader audience has access to this vital information, regardless of their country of birth.

This study is cross-sectional and therefore conclusions drawn are only representative of the time period explored. A limitation of this study was that the drowning rates and relative risk were calculated using estimated population statistics per 100,000 head of population derived from census data.⁶ Variables, such as swimming ability, is not routinely captured in coronial data, and if so, was largely unknown and based on a family member's or friend's perception of the deceased person's swimming ability, rather than actual ability. Visa status was often unavailable and residential status may be under-reported. It is recommended that visa status is routinely included in coronial investigations. Nevertheless, this study has provided a greater understanding of the drowning profile of an identified high-risk population for drowning in Australia.

Conclusion

This study highlighted that migrants are not over-represented in drowning statistics but do have different drowning patterns, necessitating an altered focus for prevention for achieving the Australian Water Safety Strategy vision of a nation free from drowning. These findings emphasise that prevention strategies need to be tailored for different types of migrant populations and should consider the determinants of health. Cross-sectoral collaboration is required to understand the cultural nuances and differences between migrant groups, such as language, cultural background, education, and skill level, to effectively reduce drowning rates among migrant communities. Drowning prevention strategies should be made available to both new arrivals and long-term residents to ensure people live happy and healthy lives in Australia.

Acknowledgements

This research is supported by Royal Life Saving Society – Australia. Research at Royal Life Saving Society – Australia is supported by the Australian Government.

Lead author SMW-P's doctoral studies are supported through an Australian Government Research Training Program Scholarship and the James Cook University Doctoral Research Cohort Program.

Funding to publish this article open access was granted James Cook University Higher Degree by Research Enhancement Scheme 2020.

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