



DROWNING DEATHS IN AUSTRALIAN RIVERS, CREEKS AND STREAMS: A 10 YEAR ANALYSIS

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Royal Life Saving is focused on reducing drowning and promoting healthy, active and skilled communities through innovative, reliable, evidence based advocacy; strong and effective partnerships, quality programs, products and services; underpinned by a cohesive and sustainable national organisation.

Royal Life Saving is a public benevolent institution (PBI) dedicated to reducing drowning and turning everyday people into everyday community lifesavers.

We achieve this through:

- Advocacy
- Education
- Training
- Health Promotion
- Aquatic Risk Management
- Community Development
- Research
- Sport, Leadership and Participation
- International Networks

We are guided by the values of: Safety, Quality, Integrity and the Humanitarian tradition and have been serving the Australian community for over 119 years.

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EXECUTIVE SUMMARY

This report details the number of drowning deaths in Australian rivers, creeks and streams across the last 10 financial years and the circumstances around those deaths. Rivers have consistently been the aquatic location with the highest number of drowning deaths in annual Royal Life Saving National Drowning Reports and subsequent Australian Water Safety Strategies have highlighted the importance of reducing drowning deaths in rivers in order to achieve a 50% reduction in all drowning deaths experienced in Australia by the year 2020. A review of drowning deaths allows for patterns to be identified and evidence-based strategies for drowning reduction can be developed.

Data on all known drowning deaths in rivers across the last 10 financial years (1 July 2002 to 30 June 2012) has been sourced from the National Coronial Information System (NCIS), State and Territory Coronial Offices and the media. It has been collated and analysed by the Royal Life Saving Society – Australia.

Between 1 July 2002 and 30 June 2012, a total of 2,965 people died as a result of drowning in Australian waterways. Of these 735 people drowned in rivers, creeks and streams, accounting for 25% of all drowning deaths experienced in Australian waterways across this ten year period.

Males accounted for 80% of all river drowning deaths across the period of this study. The male burden in river drowning deaths was most prominent in the 25-34 years age group where males accounted for 92% of all drowning deaths experienced in people in that age group.

New South Wales, as the most populous State, experienced the highest number of river drowning deaths across the 10 year period of this report, with 246 deaths or 34% of all river drowning deaths. When examining rates per 100,000 population, the Northern Territory experienced the highest average annual rate of river drowning deaths per 100,000 population, with a rate of 1.81 compared to a national annual average of 0.35 drowning deaths per 100,000 population.

The Northern Territory's drowning rate is also over 2.5 times greater than the next closest State, Tasmania, with a rate of 0.66 per 100,000 population. The male rate of drowning in the Northern Territory was the highest of any State or Territory with a rate of 3.19 males drowning per 100,000 population. The average rates per 100,000 population for female drowning deaths in rivers across the States and Territories of Australia were highest in the Northern Territory (0.30), followed by Queensland (0.26) followed by Tasmania (0.24).

Almost three quarters (74%) of people who drowned in rivers, did so within 100kms of their home postcode. This provides strength to the argument that public awareness and drowning prevention strategies should be targeted at the local community level to ensure greatest efficacy.

The largest proportion of drowning deaths in rivers took place in areas deemed Inner Regional (29.7%). A concerning, 10% took place in areas considered to be Very Remote. By their very definition, areas deemed Very Remote are isolated from basic services such as medical services. Therefore first responder skills in CPR and first aid are vital, as is education among those living in Remote and Very Remote areas about how to minimise the risk of drowning in rivers.

When river drowning deaths are segmented and analysed by drainage division, the North East Coast division of Queensland had the highest number of drowning deaths, with 27% of all river drowning deaths during the 10 year period of this study. This was followed by the Murray-Darling Basin (21%) and the South East Coast region of New South Wales (19%). By river system, the Murray River experienced the highest number of drowning deaths across the 10 years, followed by the Brisbane River and the Yarra River.

Falls into water were the most common activity being undertaken immediately prior to drowning in rivers (20%), followed by accidents involving non-aquatic transport (18%) and swimming and recreating (15%). Males were more likely to drown as a result of intentionally interacting with water or intentionally entering the water as a result of fishing, jumping in, undertaking a rescue and using watercraft. Females were more likely to drown in rivers as a result of unintentionally entering the water, either as a result of being swept away by floodwaters or a non-aquatic transport accident.

Summer experienced the highest proportion of river drowning deaths with 39% of the total number of deaths, followed by Spring (23%). Interestingly, Winter experienced one-fifth of all river drowning deaths (146 drowning deaths) and saw a greater number of drowning deaths than occurred in Autumn (131 drowning deaths).

Analysis of the data showed that 17% of all river drowning deaths were known to be related to flooding. The State of Queensland experienced 56% of all known flood related drowning deaths in rivers. Over half (56%) of all drowning deaths that took place in flooded rivers were as a result of either being swept in or deliberately entering floodwaters in non-aquatic transport. Further work must be conducted within the community to highlight the dangers of flooded rivers.

Indigenous people drowned at a rate of 1.58 per 100,000 population in rivers, a rate that is 4.4 times that of the general population. Almost half (46%) of drowning deaths in Indigenous Australians occurred in the 25-44 years age range. Over half of all Indigenous people that drowned in rivers (54%) were known to have a positive reading for alcohol in their bloodstream when they drowned. Alcohol was also known to be a contributing factor in 64% of all cases where Indigenous people intentionally entered floodwaters. Culturally appropriate strategies to prevent drowning in Indigenous Australians should be developed that highlight the dangers of floodwaters and alcohol consumption whilst recreating in, on or near rivers.

Alcohol was known to be involved in 37% of all river drowning deaths. There were a further 252 cases (representing 35% of all river drowning deaths) where information on the involvement of alcohol was not available. This suggests the involvement of alcohol in river drowning deaths could be larger than currently known.

Drowning deaths known to involve alcohol accounted for almost half (49%) of all drowning deaths in the 45-54 years age group. A key issue identified during analysis of the data was the extremely large amounts of alcohol being consumed prior to drowning deaths in rivers. Half of all drowning victims whose blood alcohol concentrations were deemed to be contributory (i.e. a Blood Alcohol Content equal to or greater than 0.05g/L) had a Blood Alcohol Content of 0.2 or higher. This level of alcohol in the bloodstream is four times that of the legal driving limit.

Twenty seven percent of all river drowning victims recorded some form of drug in their bloodstream when they drowned. In just over a third of these cases, the drugs were known to be illegal, the most common of which were cannabis and methamphetamine. Of the legal drugs detected, commonly occurring types were anti-depressants, anti-convulsants and cardiovascular agents such as anti-arrhythmic drugs.

The analysis of river drowning data, clearly indicates a significant issue related to alcohol consumption, in rivers across Australia. Although better reporting is required, drowning prevention strategies for rivers must include information on the risks of interacting with rivers when under the influence of alcohol, alcohol and medications and/or alcohol and illicit drugs.

Linked to the issue of medication use is the finding that 37% of all river drowning victims were known to have an underlying medical condition. Logically underlying medical conditions were more common in middle aged and elderly people with people aged 45-54 and 75+ accounting for 38% of all drowning victims in rivers known to have underlying medical conditions. Further research is required around the true contribution of underlying medical conditions to river drowning risk.

This report makes a number of recommendations aimed at expanding our knowledge of river recreational patterns and to reduce drowning deaths in Australian rivers. These include enhanced understanding of the risks of floodwaters, increased awareness and enforcement of legislative requirements regarding use of watercraft whilst under the influence of alcohol in rivers and improving CPR and first aid skills in Remote and Very Remote areas.

Further research is also required around the recreational patterns and risk profiles of river drowning black spots and improving our understanding of river user's attitudes towards the risks and hazards present in rivers.



RECOMMENDATIONS

- Conduct situational and geographical analysis of river drowning black spot environments nationally. This analysis would collect data on hazards and risk treatments and enhance understanding of usage and recreational patterns at known drowning black spots. This model for environmental audits should be piloted at a State level before utilising the findings to expand nationally.
- Utilise the findings on geographical location of river drowning deaths to partner with catchment authorities to design, implement and evaluate effective, locally targeted drowning prevention strategies.
- Develop, implement and evaluate public education strategies to enhance understanding of the legislative requirements and risks associated with operating watercraft whilst under the influence of alcohol. Consider a collaborative approach with State and Territory police and maritime agencies to enhance awareness of the rules around operating watercraft, the risks associated with consuming alcohol when operating or travelling on watercraft and encourage increased enforcement through breath testing in river environments.
- Develop public education strategies that highlight the risks of consuming alcohol and undertaking aquatic activity in or recreating alongside rivers, creeks and streams. These strategies should primarily be aimed at men and particularly target those aged 25-64 years.
- Partner with Indigenous groups to develop culturally appropriate strategies to prevent drowning among Indigenous Australians. Messages should target Indigenous people living in Remote and Very Remote areas and address the risks associated with undertaking aquatic activity when under the influence of alcohol and/or drugs and the risks of entering floodwaters.
- Integrate river safety knowledge and skills into school based water safety programs to boost awareness of common hazards and risks present in river environments.
- Explore strategies to strengthen first responder skills in cardio-pulmonary resuscitation (CPR) and first aid, particularly in areas deemed Remote and Very Remote.
- Conduct awareness raising activities around the risks associated with recreating in and driving through floodwaters.
- Work with the National Coronial Information System (NCIS), State and Territorial Coronial Offices and the police to enhance reporting around the toxicological profile and underlying medical conditions of river drowning deaths in Australia.
- Review the 41 cases of drowning deaths in rivers with associated coronial recommendations to look at common themes and potential additional strategies for reduction.
- Explore the benefits of conducting qualitative research with men aged 15-34 years regarding recreational activities undertaken in rivers and attitudes towards risky behaviours such as consuming alcohol and drugs.



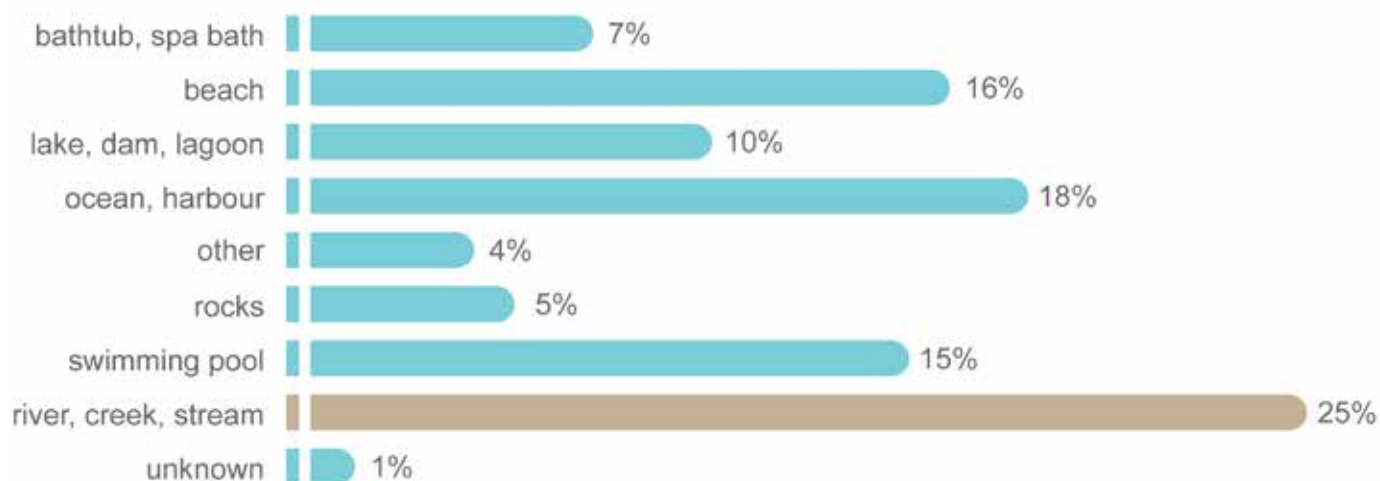
BACKGROUND

Inland waterways such as rivers, creeks and streams, lakes, dams and lagoons are common areas for recreation. Such recreation can be undertaken in the water such as boating and swimming, and within public spaces alongside these waterways such as fishing and walking.

Unfortunately, engaging with such changeable and potentially risky natural aquatic environments poses a risk of drowning. Australia has experienced consistently high numbers of drowning deaths in inland waterway locations over the last 10 years and subsequent Australian Water Safety Strategies have identified inland waterways as a priority area for achieving a 50% reduction in drowning deaths by the year 2020¹.

Over the 10 year period of this study (2002-03 to 2011-12) rivers, creeks and streams accounted for 25% of all drowning deaths, the single most common location for drowning deaths in Australia. To this end, this report focuses on the drowning deaths that have occurred in rivers, creeks and streams over the past 10 financial years.

Figure 1: Drowning deaths by location as a percentage of all drowning deaths in Australia, between 1 July 2002 and 30 June 2012 (N=2,965)



DROWNING DEATHS IN RIVERS: A REVIEW OF EVIDENCE BASED STUDIES

This section is dedicated to a brief review of knowledge about drowning deaths in inland waterways, specifically those occurring in rivers, streams and creeks and to examine factors that contribute to these incidents. This cannot be seen as a systematic review but is intended to help set the background for the present study through the identification of key issues that will be of importance in informing the development of strategies and policies to prevent drowning in these aquatic environments.

This section aims to provide an updated understanding of:

- Risk factors for drowning in inland waterways
- Epidemiology of drowning in rivers, creeks and streams worldwide
- Drowning prevention strategies in place and effectiveness evaluation

Risk factors for drowning in inland waterways

Inland waterways cover all water on the landward side of a nation's territorial waters and include not only rivers, creeks, streams, dams, lakes and lagoons, but also irrigation channels and water tanks. These water bodies can prove dangerous to human health due to several hazards that might be present. Types of hazards encountered include:

- Physical hazards
- Cold, heat and sunlight
- Water quality
- Algae and their toxic products
- Chemical and physical agents
- Dangerous aquatic organisms

The flat, still surface of an inland waterway can give a false sense of security. Currents, even in seemingly tranquil waterways, can be hazardous. Swimmers can also get caught by submerged objects, which are present in many of these waterways. Additionally, changing seasonal patterns, flooding and other effects of nature can cause inland waterways to change, sometimes within the space of minutes and hours.

The types of hazards encountered in inland waterways affect those exposed to them equally. On the other hand, other risk factors, such as age, exposure to risk, risk taking behaviours and extreme weather events, can enhance or diminish the overall drowning risk.

For children under the age of 9, a lack of supervision, the absence of barriers (or deficient barriers) and poor swimming and water safety skills, have been reported as being the major risk factors for drowning in inland waterways for that age group ^{2 3 4}.

In high-income countries (HICs), children under 5 years old drown mainly in home environments (swimming pools, baths, spas) while bathing or after falling into the water, whereas children and adolescents aged 5 to 19 years old drown mostly in inland waters while swimming and recreating ^{5 6 7}.

However, for children in low and middle income countries (LMICs) in Asia, swimming pools are not a factor in child drowning deaths ^{4 8 9 10}. Most drown in rural areas and while engaging in non-recreational activities or daily activities. The omnipresence of water sources and consequent water hazards and the daily risk of drowning are key points of difference between LMICs and HICs. These results emphasise that the socio-economic and cultural features of each community have an effect on the exposure to risk and, as a consequence, affect the overall risk for drowning.

The increase in risk taking behaviours across adolescence and early adulthood may be due to a false sense of security and increased risk taking behaviour whilst recreating with peers rather than parents ⁶. Other factors such as the use of alcohol, drugs, jumping into the water and unsafe use of watercrafts also add to the overall risk of drowning in inland waterways.

In later stages of life (over 50 years old) the main activities prior to drowning are falls into water and watercraft accidents ^{5 11}. Understanding the risk factors for falls in older people will provide vital information for the development of strategies to prevent drowning in this age group. Additionally, water safety education is imperative for this age group not only for personal safety but also to help others in need, as they are increasingly assuming the role of carers of their grandchildren, especially during school holidays, particularly if they recreate around the water.

Across all age groups, there is an over-representation of males in drowning statistics in many countries, especially in those where aquatic recreation is popular, except for children under 5 where the differences are usually not as definitive ^{5 10}. Recent studies showed that males are more frequently exposed to water than females and spend longer in water, were more likely to use surfing equipment and mainly used a surf zone located further from the shore in deeper water ^{12 13 14}.

Naturally, people who work in aquatic environments are at a higher risk of drowning. Once more, cultural and social features of the communities might enhance the risk exposure, as it is the case of riparian* fishermen. A study conducted in Brazil ¹⁵ with fishermen living and working on a river on the North of the country, tried to identify the fishermen's perceptions of their exposure to risk factors. Interestingly, despite being aware of their exposure to risks particularly during flood season, they failed to identify single causes for water-related injuries and diseases. The study showed that exposure to drowning risk factors is high mainly due to risk taking behaviours, such as unsafe use of watercrafts, absence of PFDs, and a lack of swimming skills.

A similar study conducted in Alaska, USA, revealed that many cases of fatal falls overboard on commercial fishing vessels happened due to unsafe use of equipment and/or risk taking behaviours, namely alcohol consumption ^{16 17}.

* A riparian zone is the interface between the land and a river or stream. They may be natural or engineered for soil stabilisation or restoration.

Additionally, people participating in aquatic sport activities in inland waterways, such as canoeing, kayaking and rafting are more liable to getting injured and drowning¹⁸.

The relevant number of drowning deaths where alcohol consumption and extreme weather events were known to be involved deserves a separate note. In Australia 30% of drowning deaths are associated with alcohol and 35% with boating¹⁹.

Alcohol and boating

Alcohol is known to be a risk factor for drowning and there are a number of factors that could be expected to increase the risk of injury for persons involved in swimming and other water-related activity when combined with alcohol^{20 21 22}.

In Australia, many drowning victims have high levels of alcohol in their blood^{5 23 24}. Alcohol has long been recognised as an important risk factor for road traffic related injuries but recently it is being recognised as an important risk factor in other forms of transportation, including boating²⁵. Some studies over the last two decades^{16 17 25 26 27} have described the prevalence of alcohol use among recreational and commercial boaters and passengers around the world. All the studies have reported concerning high percentages of blood alcohol content among boaters and urged for preventive measures to be implemented. The beliefs and risk perception among boaters was also subject to analysis by several researchers^{28 29}. The results indicated that boaters believe passengers can safely drink more than operators. Respondents also thought that people on boats at rest could safely drink more than people on boats in motion. A study²⁹ found an association between formal boater training and unsafe boating practices. This association was related to the probable reduced risk perception and inadequacies of boater training programs. Such programs seldom mention the risks of alcohol use while boating. Decisions to mandate formal training should be informed by these results; if mandated, training should address the risks of alcohol use while boating, and should be renewed frequently enough to offset reductions in risk perception. Conversely, Miller and Pikora²⁶ reported that, in Australia, the odds of not having a drink among both boat operators and passengers were associated with having completed a boating education course and with carrying children less than 12 years on board. Based on those findings, the authors recommended that efforts to decrease boating related incidents, such as through education and legislation measures should be monitored over time to determine the effects of these strategies upon safety behaviours. In Australia four States have legislation prescribing maximum blood alcohol content for operators of recreational boats¹⁹.

Studies published so far have, to our knowledge, all pointed out that alcohol consumption significantly increases the likelihood of immersions resulting in drowning during aquatic activities, especially when boating. Nevertheless, further information is required to plan, implement and evaluate prevention strategies.

This might include, as suggested elsewhere²⁰, better information on alcohol use, and attitudes to alcohol use, in association with recreational aquatic activity, and the nature and extent of increased risk associated with alcohol use as well as the evaluation of interventions.

Epidemiology of drowning in rivers, creeks and streams worldwide

Most studies on epidemiology of drowning around the world focus on children (mainly under 5 years old). As a result the circumstances surrounding drowning in the youth and adult population are largely unknown and need to be further investigated. Few reports and papers have been published reporting studies on the epidemiology of drowning in rivers, creeks and streams. Those identified are summarized below.

In Canada, inland water drowning accounted for 66% of all drowning deaths between 1991 and 2000³⁰. In Bangladesh, during the period from 1985-2000, 989 deaths from drowning were reported, of which 359 occurred in ponds, 134 in ditches, 64 in canals, and 35 in rivers. Analysis of seasonal variations revealed that most deaths due to drowning occurred during April-October, i.e. mostly during the monsoon months. There are known limitations in formal death data collection in countries such as Bangladesh with few drowning deaths being recorded through formal channels such as hospital admissions.

Additionally, studies from Turkey, Malaysia, South Africa and Iran reported that most drowning deaths occurred in rivers^{4 31 32 33 34}. In the last year toddlers and young children drowned Australia's inland waterways mostly after falling into the water⁵. However, as people age and gain some swimming skills and their risk taking behaviour increases, adolescents and young adults drowned in rivers, creeks and streams, mostly while swimming and recreating⁵. For middle aged adults before 50 years old, the main activity immediately prior to drowning in rivers, creeks and streams was the use of watercraft and for elderly people (after 65 years old) falls into the water was the most common activity immediately prior to drowning in rivers, creeks and streams. In 2012, Royal Life Saving published a report on a 9 year analysis of drowning deaths in inland waterways in New South Wales³⁵. This report examined inland waterway drowning deaths (that is rivers, creeks, streams and lakes, dams and lagoons) that occurred in New South Wales between 1 July 2002 and 30 June 2011. Of the 937 fatal drowning deaths recorded in NSW over last nine financial years, 28% occurred in inland waterways. 45% of all drowning deaths that occurred in inland waterways occurred in rivers and 84% of drowning victims in inland waterways were male. Non-aquatic transport, using watercraft, swimming and recreating and falls were the most common activities prior to drowning. Additionally, alcohol was known to be involved in 32.7% of all river, creek and stream drowning deaths.

Similar analysis over the same period in the Northern Territory found that 50% of the 74 drowning deaths in the Northern Territory had occurred in rivers, with 15% directly related to flooding³⁶.

The report also found that 38% of those who drowned were Indigenous and alcohol was found to be present in the bloodstreams of 51% of drowning deaths of people aged 15 years and over. The report made three recommendations, one of which was the importance of developing a culture of water safety as a community, such as using PFDs and avoiding alcohol when undertaking aquatic activity.

Reports from other States and Territories have also identified rivers, creeks and streams as relevant locations to be considered in future drowning prevention programs due to high burden of drowning associated ³⁷ ³⁸. A study categorising multiple drowning incidents that occurred in Turkey between 2005 and 2008 ³⁹, showed that most of the drowning incidents (68.5%) occurred in fresh water.

Flood related drowning deaths

Floods are caused by a variety of factors but excessive rainfall has been the cause of many flood events ⁴⁰. The unusual movement of low-pressure system, storm surges, failure of dams and heavy melting of snow/ glaciers are the other causes of floods. Similarly, floods are also intensified by several human factors such as human encroachments over the channel limits, changes in land use and deforestation with significant socio-economic impacts worldwide. During flood season, water overflows the natural levees and triggers tremendous losses to housing, agricultural land, standing crops and other properties. Flood related Government Departments can do more to implement mitigation measures. In terms of economic loss and spatial extent, flood is considered to be the most destructive natural disaster ⁴¹ ⁴².

Of all weather related disasters that occur in the USA, floods are the main cause of death, and most flood related deaths are attributed to flash floods. A total of 1,185 deaths were associated with 32 flash floods, on average 37 deaths per flash flood. 93% of the deaths were due to drowning and 42% of these drowning were car related. The other drowning occurred in homes, at campsites, or when persons were crossing bridges and streams ⁴³.

A study published in 2005 ⁴⁴ reported the analysis of 247 flood disaster fatalities from 13 flood cases from Europe and United States. Two thirds of the deaths occurred through drowning. The report states that males are highly vulnerable to dying in floods and unnecessary risk taking behaviour contributes significantly to flood disaster deaths. Based on the results, the authors of this study made recommendations to prevent loss of life in floods. Examples of such recommendations are:

- To provide a more solid basis for the formulation of prevention strategies,
- Better systematic recording of flood fatalities, especially those caused by different types of floods in all countries

Drought in Australia has heightened the risk of drowning, especially for young children around drainage channels. Literally, thousands of open-air drain networks and creeks throughout Australia, which remain dry during drought, can become deadly with a short but intense rainstorm kilometres away (incidents related to flooding in open air drainage channels).

At least 73 persons died as a direct result of floods in Australia in the period of 1997–2008 ⁴⁵. The same study reported that: the largest number of fatalities occurred in New South Wales and Queensland; most fatalities occurred during February, and among men (71.2%); people between the ages of 10 and 29 and those over 70 years were overrepresented among those drowned; there was no evident decline in the number of deaths over time. Additionally, the study reported that 48.5% fatalities were related to motor vehicle use and 26.5% fatalities occurred as a result of inappropriate or high-risk behavior during floods.

In the United States of America, drivers and passengers who drown while trapped in their vehicles or exiting from vehicles account for most flood-related deaths ⁴⁶. Nonetheless, little has been known about crash circumstances or risk factors for flood-related motor vehicle injury. Risk factors for driving into flooded roads should be better understood and information widespread particularly to people living in regions prone to flooding. A study from the USA published in 2007 ⁴⁷ attempted to shed some light on this subject and suggested that people who do not take warnings seriously are more likely to drive through flooded roads, as are people aged 18–35, and those that do not know that motor vehicles are involved in more than half of all flood fatalities. Particularly, this study indicates that in Denver, people who have not experienced a flood previously and those who do not know they live in flood-prone areas were also more likely to drive into flooded roads. This kind of studies need to be undertaken in other areas of the world, namely in Australia, because it will be helpful to inform public awareness programmes and public safety police enforcement activities ⁴⁵.

Drowning prevention strategies

Data collection and analysis provide the unique chance to identify drowning risk factors and opportunities for drowning prevention strategies to be effectively implemented. Several studies in the last few decades ⁴ ⁵ ⁸ ³⁴ ⁴⁸ ⁴⁹ ⁵⁰ ⁵¹ ⁵² have documented, with different levels of detail and accuracy, relevant drowning risk factors and reported some prevention measures, implemented both in Low- and High- Income countries. Every prevention strategy needs a multifaceted approach and drowning prevention is not an exception. In HICs ⁵⁰ a number of important messages have been emphasised including: constant supervision of infants by adults around bodies of water and, for older children and the remainder population, not swimming alone or in remote/ unguarded sites. Furthermore, in such countries, parents, adolescents and homeowners with pools on their property, have been increasingly advised to obtain training in basic life support techniques as studies have shown that if initiated promptly, resuscitation by a bystander, before the arrival of emergency personnel, results in significantly better neurological outcomes ⁵³ ⁵⁴. Additionally, all children should learn to swim even though only recently have studies been conducted to assess the relationship between swimming lessons, swimming ability and the risk of drowning.

Fencing in HICs has been shown to reduce childhood drowning in swimming pools and it has been suggested that it could prevent about one-fifth of drowning among children less than 5 years old in USA ⁸.

However, since the circumstances and risk factors are not the same all over a single country, this study suggested that additional strategies are needed to prevent all childhood drowning even in HICs. It is, for example, frequent that drowning in rural areas of HICs such as USA, Australia and Canada and in LMICs occurs more often in natural bodies of water and irrigation canals. In such environments there's still an enormous lack of tested drowning prevention interventions. Even though the environment might be the same, the culture and particular setting vary greatly within and across countries throughout the world. So, where no local data is available or resources are scarce it is still possible to use studies from other countries and identify the domestic translation of their findings.

Recently, some interesting studies have been published regarding the implementation of drowning prevention programs in Bangladesh^{49 55 56 57}. The community acceptability of two supervision tools was assessed in one of this pilot studies⁴⁹ and the statistical analysis of 2,694 observations revealed that children were directly supervised or protected by a preventive tool in 96% of the researchers visits and that the "playpen" was more accepted than the door barrier. Researchers from Bangladesh have recommended some interventions to reduce the number of deaths due to drowning in rural Bangladesh, which include: (a) increasing awareness among mothers and close family members about the risk of drowning, (b) door-fencing, and (c) filling of unused ditches and water holes around households.

In 2012, at the Australian Water Safety Conference in Sydney, a study about the ACT experience on drowning reduction strategies for inland waterways was presented. The study revealed that a number of risk treatment strategies were common to both locations including the removal of swimming/diving platforms, education programs, development and implementation of Emergency Action Plans, separation of swimming and boating areas, implementation of a safety signage system, provision of lifeguard services and the provision of public access rescue equipment⁵⁸.

It is true that awareness of risk factors for drowning in swimming pools and at beaches has proved crucial to assist the efforts undertaken in Australia to make public swimming pools and beaches safer. However, little is known about drowning deaths or effective prevention strategies in rivers which makes further research into river drowning deaths imperative⁵⁹.

Successful prevention interventions currently used in developed countries are often not transferable into developing countries due to differences in both the setting and the available resources. Water safety education programs need to be adapted to the specific setting where the program is going to be implemented. A study published in 2012⁶⁰ reported that an adapted water safety education program developed by the American Red Cross for primary students in Grenada was effective. Participants' water safety knowledge increased by 15% after training. Hence, with cultural modifications and outsourcing, the authors suggested that it is possible to effectively implement water safety programs to different settings than those to which they were initially developed.

Even though studies evaluating the costs and effectiveness of drowning prevention strategies are still scarce a few have been published and are likely to help overall injury and mortality reduction programs targeting drowning.

A recent study presented the cost-effectiveness results of a low-cost injury and drowning prevention program in Bangladesh⁵⁶. It showed that childcare centres and swimming lessons are highly cost-effective interventions that can be scaled to other countries. A 3 year drowning prevention campaign focused on increasing the use of life vests among children aged 1 to 14 years old was evaluated⁶¹. The study reported that a community-wide drowning prevention campaign resulted in a statistically significantly, although modest, increase in reported life vest use and ownership among children aged 1 to 14 years. Some authors suggested that promotion campaigns have had more success than some policies⁶². Their study confirmed that drowning prevention handouts of high quality content could be found online. However, authors also alerted that when searching online, parents and carers of children might frequently be guided to resources of diminished quality and poor content. It is, therefore, important that websites maintain the most recent and relevant information from trusted sources.

Another study in rural China, suggests that health education programs can improve children's perception on water safety and reduce their risk behaviours as well as on the incidence of non-fatal drowning in rural areas⁶³. One year after the intervention was carried out: children's knowledge on drowning prevention improved significantly, rates on risk behaviours dropped from 41% to 32%; the incidence rates for non-fatal drowning decreased by 58.9% (from 5.6% to 2.3%).

It is crucial to further develop and disseminate evidence-based information about which interventions are more effective for which age group under specific circumstances.

Key Findings

- Rivers are a leading location for drowning deaths in both high and low and middle income countries around the world
- Internationally, river drowning deaths are caused by factors such as unsafe use of watercraft (including alcohol consumption and avoidance of Personal Flotation Devices), flooding and a lack of supervision for children
- Effective strategies for prevention of drowning deaths in children include supervision, swimming skills and water safety education

AIMS & METHODS

Aims of the study

- To gain an enhanced understanding of the scale of drowning in rivers, creeks and streams in Australia across the last 10 financial years (1 July 2002 to 30 June 2012)
- To gain an understanding of the circumstances of drowning deaths in rivers, creeks and streams
- To make recommendations for strategies that can be developed for prevention

Methods

Information for this report has been collected from State and Territory Coronial Offices, the National Coronial Information System (NCIS) and media reports. It has been collated and analysed by the Royal Life Saving Society - Australia.

Royal Life Saving uses a media monitoring service (both electronic and print) all year round to identify drowning deaths in the media. This information is then corroborated with information from the NCIS, police and Royal Life Saving State and Territory Member Organisations before being included in this report.

All care is taken to ensure that the information is as accurate as possible. Please note that the figures from more recent financial years may change depending upon the outcomes of ongoing coronial investigations and findings. This report contains information correct as at 12 June 2013. As of this date, 85% of cases analysed were closed.

Exclusions from this data include: suicide, homicide, deaths from natural causes, shark and crocodile attack, or hypothermia where known. All information presented is about drowning deaths or deaths where drowning was a factor (e.g. car rolled into the water and a person drowned).

A river was defined as 'a defined watercourse of considerable size and length, whether flowing or dry, according to the season, and whether a single channel or a number of diverging or converging channels'. A creek was defined as 'a defined watercourse, whether flowing or dry, according to the season, and whether a single channel or a number of channels; usually of lesser size and length relative to a river and ultimately flowing into another creek or a river'. A stream was defined as 'a body of water flowing in a channel or bed, as a river, rivulet or brook'.*

Rivers, creeks and streams can vary in water flow, length, width and depth. A body of water was coded as a river, creek or stream based upon the coding used in the National Coronial Information System and the name of the aquatic location.

The operation of a boat is classified as 'watercraft'. Non-aquatic transport relates to forms of transport not primarily intended for use in the water such as cars, motorbikes and tractors among others.

An intrastate tourist is defined as someone who drowned in a postcode that was 100km or more away from their residential postcode, but was within the same State or Territory as their residential postcode. The distance between the two postcodes was calculated using Google Maps. An interstate tourist is defined as someone who drowned in a postcode that was a different state to their residential postcode. An international tourist was someone who had a residential postcode as being from overseas and drowned in an Australian postcode.

A drowning death was coded as flood-related if a natural disaster code was used alongside the case in the NCIS or if any of the case documentation (such as the coroner's finding or the police report) mentioned that the river was in flood.

Rates per 100,000 population were determined using the Australian Bureau of Statistics (ABS) population estimates from the last month of a particular financial year, for example June's 2003 statistics were used for the 2002-03 financial year rates.

Rates per 100,000 population for Indigenous Australians were calculated using the Australian Bureau of Statistics (ABS) population estimates. As these estimates span from 2002 to 2011, rates for the 2002-03 financial year were calculated using the June 2002 population estimates.

A Blood Alcohol Content equal to or above 0.05mg/L was considered contributory. Additionally, for the purposes of this study, all prescribed medications were considered to be legal. The abuse of prescription drugs (i.e. recorded at toxic levels) or illicit drugs such as cannabis and methamphetamine were considered illegal drugs.

Due to State government legislation regarding ownership of the Murray River, drowning deaths that occur in the Murray and Tweed Rivers are considered NSW drowning deaths and are investigated in NSW coronial courts, regardless of whether the incident occurred in NSW or not. Therefore these drowning deaths are included in NSW drowning statistics.

*Definitions sourced from the Macquarie Dictionary

RESULTS

Descriptive Epidemiology of Drowning

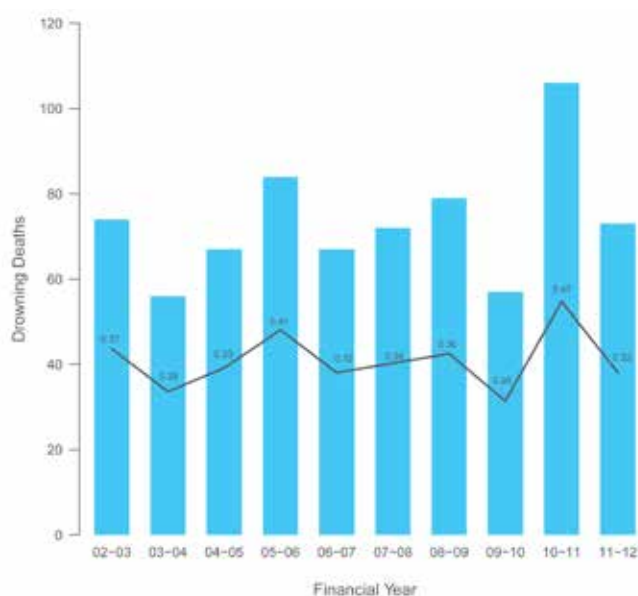
Who drowns?

Between 1 July 2002 and 30 June 2012, there were 735 drowning deaths in Australian rivers, creeks and streams (henceforth referred to as rivers). Drowning deaths in rivers varied from a low of 56 drowning deaths in the 2003/04 financial year to a high of 106 drowning deaths in 2010-11. When examining rates of drowning per 100,000 population, the rate has varied across the 10 year period of this study, from a low of 0.26 drowning deaths per 100,000 population in the 2009-10 financial year to a high of 0.47 in 2010-11.

The number of drowning deaths in rivers in the 2011-12 financial year was just 1.4% lower than the 10 year national average. When examining the rate of drowning deaths per 100,000 population the rate of 0.32 per 100,000 drowning deaths in 2011-12, is just 0.03 lower than the 10 year average rate of 0.35.

Between December 2010 and February 2011 (2010-11 financial year), northern NSW and Queensland experienced catastrophic flooding that saw 22 people die from drowning in rivers, creeks and streams across the two States. Flooding is a key concern when examining drowning deaths in rivers and is worthy of closer examination later in this report.

Figure 2: Drowning deaths in rivers, creeks and streams by financial year and rate per 100,000 population between 1 July 2002 and 30 June 2012 (N=735)



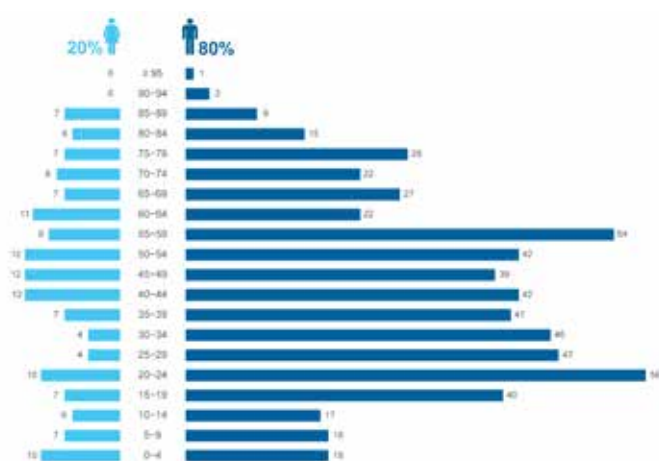
Gender differences and age split

Males accounted for 80% of drowning deaths in rivers across the 10 financial year period of this study. The burden of male drowning was even more pronounced when examining drowning deaths by age groups and sex.

Males accounted for 92% of drowning deaths in the 25-34 years age group. In people aged 15-17 years and 18-24 years, males accounted for 89% and 84% of all drowning deaths respectively. The male burden in river drowning deaths was the least pronounced in the 0 to 4 years age group with males accounting for 64% of all drowning deaths in this age group. In all other age groups, males accounted for over 72% of drowning deaths in rivers.

When examining drowning deaths as rates per 100,000 population by sex, male drowning deaths nationally varied from a low of 0.43 in 2003-04 to a high of 0.70 in 2010-11. This is compared to a ten financial year average rate of 0.56 male drowning deaths per 100,000 population. Compared to males, females experienced a rate of drowning per 100,000 population that varied from a low of 0.08 per 100,000 population in 2009-10 to a high of 0.25 in 2010-11. The 10 year average rate for females was a rate of 0.14 per 100,000 population.

Figure 3: Drowning deaths by age group and sex in rivers, creeks and streams, between 1 July 2002 and 30 June 2012 (N=735)



Key Findings

- 735 drowning deaths in rivers, creeks and streams between 1 July 2002 and 30 June 2012
- Drowning deaths varied from a low of 56 in 2003-04 to a high of 106 in 2010-11
- The 10 year average drowning rate is 0.35 per 100,000 people
- The rate of river drowning deaths also varies from 0.26 drowning deaths per 100,000 population in the 2009-10 financial year to a high of 0.47 in 2010-11
- Males accounted for 80% of drowning deaths in rivers, creeks and streams
- The male burden of drowning was most pronounced in the 25-34 year age group, where 92% of those who drowned were male

Where do drowning deaths in rivers, creeks and streams occur?

State and postcode of incident

As the most populous State, NSW was also the State with the highest number of river drowning deaths with 246 drowning deaths (34% of all river drowning deaths in Australia). Queensland was the State with the second highest number of river drowning deaths with 219, followed by Victoria with 98 river drowning deaths.

When examining drowning deaths by rate per 100,000 population by State or Territory of the drowning incident, the Northern Territory has an average rate of 1.81 drowning deaths per 100,000 population per year across the 10 years. This is a rate that is over 2.5 times higher than the next closest State, Tasmania with a rate of 0.66 per 100,000. Queensland was the State with the third highest average rate of drowning across the ten years, with a rate of 0.52 per 100,000 population.

The Australian Capital Territory has the lowest average drowning rate across the 10 year period of this report with a rate of just 0.09 per 100,000 population, having experienced 3 river drowning deaths across the 10 year period of this report.

When examining drowning deaths by State and Territory and sex, the Australian Capital Territory experienced the largest burden of male drowning deaths with 100% of the three deaths that took place there being male. This was followed by the Northern Territory, where 92% of river drowning deaths across the ten financial year period were of males. With respect to rates per 100,000 population by sex and State or Territory, the Northern Territory had the highest rate of male drowning, with an average 3.19 males drowning per 100,000. This was followed by Tasmania with an average male drowning rate of 1.10 per 100,000 population and Queensland with an average rate of 0.77 per 100,000 drowning deaths for males in rivers.

The average rates per 100,000 population for female drowning deaths in rivers across the States and Territories of Australia were highest in the Northern Territory (0.30) followed by Queensland (0.26) and Tasmania (0.24).

When examining river drowning deaths by visitor status, it is apparent that the majority of drowning deaths in rivers occur within the victim's local area. Almost three quarters (74%) of all people who drowned in rivers nationally across the 10 financial year of this study drowned within 100kms of their home postcode. A further 13% were classified as Intrastate visitors meaning they drowned within their home State or Territory but in a postcode that was greater than 100kms from their residential postcode. Visitor status could not be determined for a further 6% of cases. Just 2% of river drowning victims were overseas tourists.

The male burden in river drowning deaths was most pronounced in the Interstate visitor category, where males accounted for 90% of all river drowning deaths where the victim drowned in a different State or Territory to the one where they resided. The Northern Territory was the State or Territory with the highest proportion of drowning deaths by visitors to their drowning location, when compared to residents. 38% of all river drowning deaths in the Northern Territory were some form of visitor to that location, either residing over 100kms from their drowning location, living in a different State or having drowned in Australia whilst an overseas tourist. Almost half (44%) of all international tourist drowning deaths occurred in rivers in Queensland.

Key Findings

- New South Wales experienced the highest number of river drowning deaths with 246, followed by Queensland with 219 and Victoria with 98
- The Northern Territory had the highest average drowning rate with 1.81 drowning deaths per 100,000 population
- The Northern Territory also had the highest average drowning rate for men with a rate of 3.19 per 100,000 population
- Average female drowning rates per 100,000 population were highest in the Northern Territory (0.30) followed by Queensland (0.26) and Tasmania (0.24)
- Almost three quarters (74%) of people were not visitors to the location where they drowned
- Northern Territory had the highest proportion of visitor drowning deaths to non-visitor drowning deaths
- Almost half (44%) of all international tourist drowning deaths took place in Queensland

Figure 4: Drowning deaths by incident postcode for river drowning deaths between 1 July 2002 and 30 June 2011 (N=735)

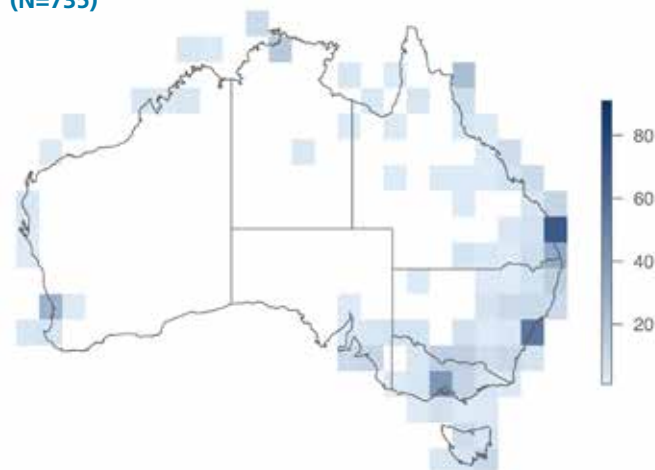
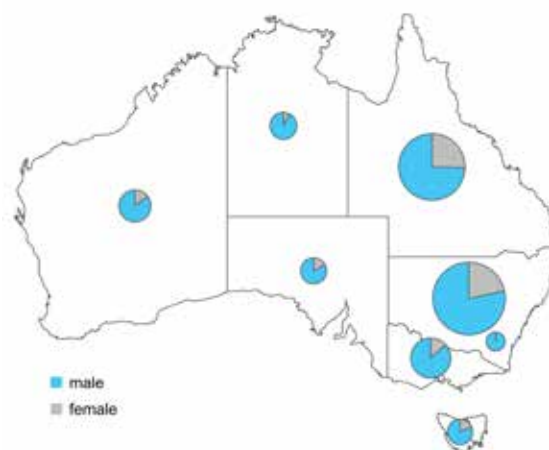


Figure 5: State of drowning deaths by sex of drowning victim between 1 July 2002 and 30 June 2012 (N=735)



Remoteness classification of incident

The highest percentage of drowning deaths in rivers occurred in areas deemed Inner Regional (30% of all river drowning deaths across the 10 financial year period of this study). The high proportion of drowning deaths that occur in areas classified as Major Cities and Inner and Outer Regional follows population density patterns, i.e. we are likely to see a higher number of drowning deaths in areas where more people live, work and recreate.

The proportion of men drowning when compared to women was most pronounced in areas deemed Major Cities and Remote with 84% of victims in those remoteness classifications being male. The highest proportion of female drowning took place in areas deemed Inner Regional with 24% of drowning deaths in that classification being females.

Thirty six percent of all drowning deaths in Very Remote areas were of people aged between 25 and 44 years of age. In areas deemed Outer Regional, the largest number of deaths took place in the 55-64 years age group.

Sixty eight percent of drowning deaths as a result of non-aquatic transport took place in Inner Regional and Outer Regional locations. Falls into water were most likely to occur in Major Cities, with over one third of all drowning deaths as a result of falls into water taking place in Major Cities (38%). Twenty percent of all swimming and recreating drowning deaths took place in areas considered to be Very Remote.

When examining alcohol by remoteness classification of incident, the highest proportion of drowning deaths where alcohol was involved was in the Outer Regional remoteness classification (40% of all drowning deaths in that remoteness classification). This was closely followed by Very Remote with 39% of cases in that remoteness classification recording a positive reading for alcohol. Thirty seven percent of cases in areas deemed Major Cities were known to have recorded a positive reading for drugs.

Of concern, is the 10.3% of river drowning deaths that take place in areas deemed Very Remote. Access to timely medical assistance in Very Remote areas is made all the more difficult due to isolation from major services. Therefore promoting an increased awareness of the risks of undertaking aquatic recreation alone in isolated areas and the importance of first aid and first responder skills is also important.

Key Findings

- The highest percentage of drowning deaths in rivers, creeks and streams occurred in Inner Regional areas
- River related drowning deaths by remoteness classification largely follow population density patterns
- 10.3% of all drowning deaths in rivers, creeks and streams occurred in areas classified as Very Remote

Figure 6: Percentage of river drowning deaths by remoteness classification of incident postcode between 1 July 2002 to 30 June 2012 (N=735)



Geographical location of drowning incident

River drowning deaths across the last 10 financial years, have been grouped and coded based on the Australian Government Bureau of Meteorology's Topographical Drainage Divisions and River Regions⁶⁴. When examining river drowning deaths by drainage division, the North East Coast division of Queensland saw the highest concentration of river drowning deaths with 198 or 27% of all river drowning deaths across the period of this 10 year study (Figure 7).

The drainage division with the second highest number of drowning deaths was the Murray Darling Basin division with 157 drowning deaths or 21% of all drowning deaths experienced across Australian rivers. The drainage division with the third highest number of drowning deaths in rivers was the South East Coast region of New South Wales with 141 drowning deaths or 19% of all drowning deaths.

The top three drainage divisions accounted for 67% of all river drowning deaths in the last 10 years in Australia.

Within these drainage divisions, there were river systems that consistently experienced high numbers of drowning deaths.

With respect to frequency of drowning death by river system, the Murray River was the single river system that experienced the highest burden of drowning deaths across the 10 year period of this study with 43 deaths (Table 1).

The burden across the three States that the Murray River spans was 17 drowning deaths in Victoria, 15 in South Australia and 11 in New South Wales.

With respect to the drainage divisions and rivers prone to flooding, 47% of all known flood-related drowning deaths took place in the North East Coast drainage division in Queensland. In fact, 30% of all the drowning deaths that occurred in the North East Coast division were known to be related to flooding.

Sixteen percent of all known flood-related drowning deaths in rivers occurred in the Murray-Darling Basic division and 11% in the South East Coast (New South Wales) division. Twenty one percent of all the drowning deaths that occurred in the Tanami-Timor Sea Coast division were known to be flood-related.

Figure 7: Number of river drowning deaths by river region (N=735)*

* Figure adapted from a figure supplied by the Commonwealth of Australia (Bureau of Meteorology)

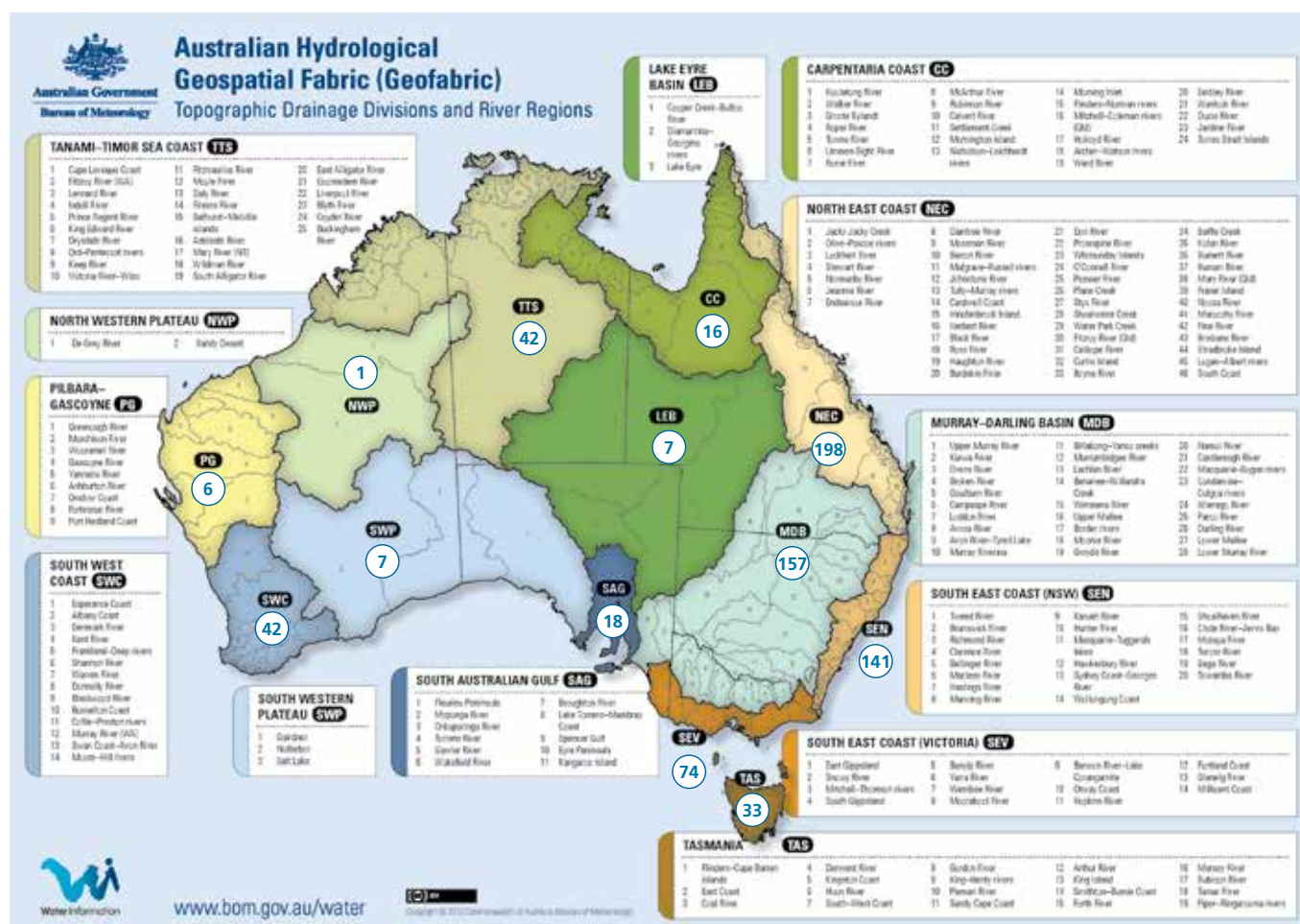


Table 1: River drowning black spots by frequency of drowning deaths and National drainage division (n=194)

Rank	River Name	Catchment Region	Number of river drowning deaths *
1	Murray River	Murray-Darling Basin (MDB)	43 (5.9%)
2	Brisbane River (QLD)	North East Coast (NEC)	33 (4.5%)
3	Yarra River (VIC)	South East Coast (SEV)	29 (3.9%)
4	Swan River (WA)	South West Coast (SWC)	24 (3.3%)
5	Hawkesbury River (NSW)	South East Coast (SEN)	15 (2.0%)
6	Murrumbidgee River (NSW)	Murray-Darling Basin (MDB)	12 (1.6%)
7	Sandy Creek (QLD)	North East Coast (NEC)	11 (1.5%)
8	Derwent River (TAS)	Tasmania (TAS)	9 (1.2%)
9	Katherine River (NT)	Tanami-Timor Sea (TTS)	9 (1.2%)
10	Macquarie River (NSW)	Murray-Darling Basin (MDB)	9 (1.2%)

* % of all river drowning deaths

An analysis of river drowning deaths by drainage division and river system can provide evidence-based information for the effective targeting of public education and hazard reduction strategies. The next step is to conduct physical audits of these river black spots to determine common hazards and risk treatments being used, determine visitation rates and patterns of recreational activity and access points to the river among other topics of information that could be gathered.

Key Findings

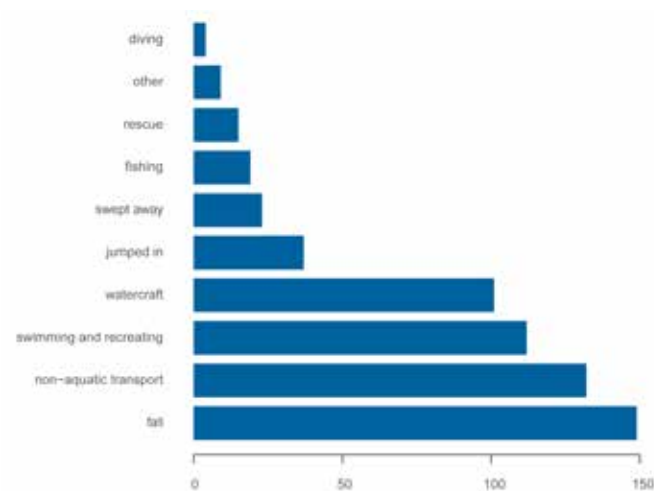
- The North East Coast drainage division in Queensland saw the highest number of river drowning deaths across the 10 year period of this study with 198 (27%)
- This was followed by the Murray-Darling Basin division with 21% of all river drowning deaths and South East Coast division of New South Wales with 19%
- The Murray River was the single river system with the highest number of drowning deaths with 43 (5.9%)
- This was followed by the Brisbane River (4.5% of all drowning deaths) and the Yarra River (3.9%)
- 30% of all river drowning deaths in the North East Coast (QLD) drainage division were known to be flood related
- 21% of all drowning deaths in the Tanami-Timor Sea Coast division of northern Western Australia and the Northern Territory were known to be flood-related

Activity immediately prior to drowning

The data across the 10 financial years of this study indicate a diverse range of activities being undertaken at rivers (Figure 8). Falls into water were the most common activity being conducted immediately prior to drowning in rivers in Australia accounting for 20% of all drowning deaths in rivers. This was followed by accidents involving non-aquatic transport (18%) and swimming and recreating (15%). Activities that fell into the "Other" category included evading police capture (6 deaths), canyoning, checking a pump and being thrown into the river by friends.

Activity prior to drowning was unknown in almost one fifth (18%) of all river drowning deaths, indicating there are a number of people undertaking aquatic activity in river environments alone which can increase their risk of drowning. This may also highlight the remote nature of some river locations and indicates a potential lack of witnesses to a number of drowning incidents.

Figure 8: Activity immediately prior to drowning in rivers, between 1 July 2002 and 30 June 2012 (n=601)



When looking at the differences in activities undertaken by males and females prior to drowning, some interesting observations can be determined from the data (Figure 9). Males accounted for 100% of river drowning deaths as a result of fishing and 93% of river drowning deaths as a result of a rescue attempt and 92% of river drowning deaths as a result of jumping into the water and using watercraft.

Females accounted for approximately half (52%) of all river drowning deaths as a result of being swept away by floodwaters and 34% of all river drowning deaths as a result on non-aquatic transport accidents indicating women were more likely to drown as a result of an unintentional entry into the water when compared to the activities males generally undertake prior to drowning.

When examining activities immediately prior to drowning in rivers by age group of the victim, some trends emerge. Falls into water peaked in the elderly and very young age groups. Twenty two percent of all fall related drowning deaths occurred in the 75+ years age group, and 14% in the 0-4 years age group. When grouping age groups, 41% of all drowning deaths in rivers as a result of falls took place in people aged 55 years or older.

As is logical, drowning deaths where the activity immediately prior to drowning was unknown increase substantially from 18 years onwards. Just 2% of drowning deaths where the activity was unknown took place in children and adolescents under the age of 18. Unknown activity drowning deaths peaked in the 45-54 years age group with 31 drowning deaths. This indicates that after adolescence people were less likely to recreate at rivers under the supervision of family and friends and increasingly recreate on their own.

The activity of swimming and recreating prior to drowning in rivers peaked in the young adult and middle ages. Sixty three percent of all drowning deaths in rivers as a result of swimming and recreating occurred in the 18-44 years age group, peaking in the 35-44 years age group with 27 deaths.

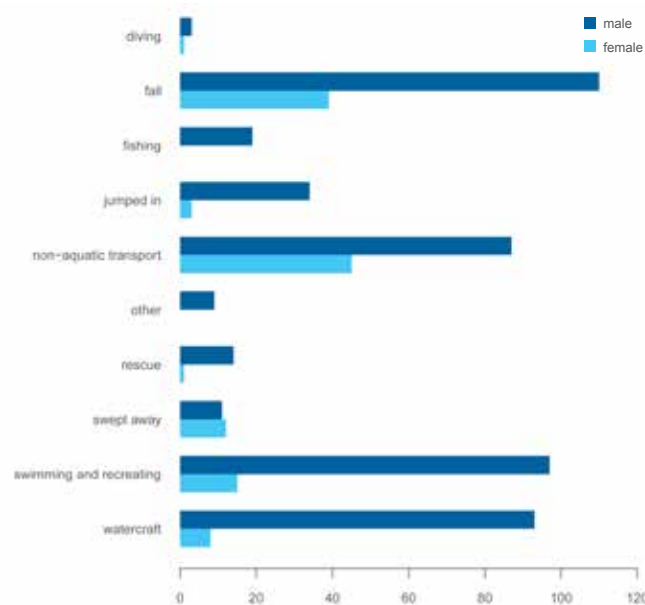
Similarly, drowning deaths as a result of a watercraft accident were consistently high after adolescence and into the early 60s. There were 14 or more drowning deaths in each age group across between 18-24 and 55-64 years as a result of a watercraft accident across the ten year period of this study.

State and Territory trends in activity highlight some interesting findings. Just over one third (38%) of all drowning deaths as a result of non-aquatic transport accidents took place in Queensland, of these 70% were related to driving through or being swept into floodwaters.

Falls into rivers accounted for the highest proportion of drowning deaths in Tasmania (36% of all drowning deaths) followed by South Australia (34%). This may indicate an ageing population in both States. Sixty percent of all river drowning deaths as a result of rescue attempts took place in NSW.

Drowning deaths as a result of swimming and recreating in rivers accounted for the highest proportion of any State or Territory's total drowning deaths in the Northern Territory, where they accounted for 26% of all drowning deaths. This was followed by 21% in Victoria and Western Australia.

Figure 9: Activity immediately prior to river drowning by sex, between 1 July 2002 and 30 June 2012 (n=601)



Key Findings

- Falls into water were the most common activity prior to drowning in rivers (20%)
- This was closely followed by non-aquatic transport accidents (18%) and swimming and recreating (15%)
- Males accounted for 100% of fishing drowning deaths and 93% of deaths as a result of a rescue attempt
- Females accounted for approximately half (52%) of all river drowning deaths as a result of being swept away by floodwaters
- Twenty two percent of all fall related drowning deaths occurred in the 75+ years age group
- Just 2% of drowning deaths where the activity was unknown took place in children and adolescents under the age of 18

When do drowning deaths in rivers occur?

Summer was the season that experienced the largest number of drowning deaths with 287 or 39% of all drowning deaths in rivers across the last 10 financial years. Spring was the season with the next highest number of drowning deaths with 171 or 23% of all river drowning deaths. It is interesting to note that one fifth of all drowning deaths in rivers occurred in Winter (n=146) and more river drowning deaths occurred in Winter than in Autumn (n=131).

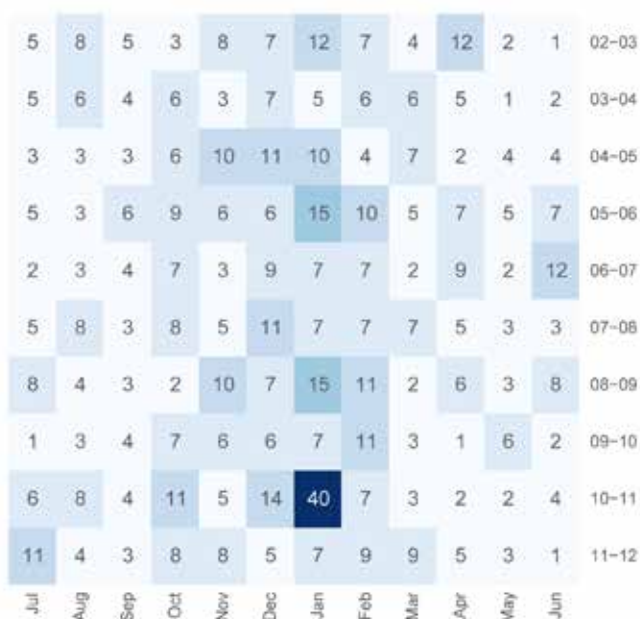
Predictably, the most common activity being undertaken immediately prior to drowning in Summer in rivers was Swimming and Recreating (22% of all Summer river drowning deaths), followed by non-aquatic transport (18% of all Summer river drowning deaths). Eighty seven percent of all drowning deaths in rivers as a result of a rescue attempt occurred in the traditionally warmer seasons of Summer and Spring.

Falls into water were relatively evenly spread across the four seasons, with 29% in both Summer and Winter respectively and 26% in Spring. The largest number of drowning deaths where activity was unknown occurred in Winter (30%), again highlighting the risks of undertaking aquatic activity in, on or around rivers when alone.

Examining the month of river drowning deaths across the last 10 years, Figure 10 indicates that every month for the last 10 financial years, at least one person has drowned in Australia in a river. With respect to the frequency of drowning incidents in rivers, the largest percentage of drowning deaths occurred in January (17%), followed by December (11%).

The month that experienced the lowest number of drowning deaths was May with 31 drowning deaths (4%) across the ten years of the study. Widespread flooding across northern New South Wales and Queensland in January 2011 contributed in large part to the 40 drowning deaths experienced in that month.

Figure 10: Drowning deaths in rivers by financial year and month of incident, between 1 July 2002 and 30 June 2012 (N=735)



Key Findings

- There was no month across the last 10 financial years that did not experience a river drowning death
- 39% of all drowning deaths in rivers took place in Summer
- One fifth of all drowning deaths in rivers took place in Winter
- Swimming and Recreating the most common activity being undertaken prior to drowning in rivers in Summer (22% of all Summer river drowning deaths)
- Falls into water were evenly spread across the four seasons
- The largest number of river drowning deaths where activity was unknown occurred in Winter (30%)

CASE STUDY: FLOOD RELATED DROWNING DEATHS

There were a total of 125 (17%) drowning deaths known to be flood related across the ten financial year period of this study, which represents 17% of all river drowning deaths across the same period. Women accounted for a higher proportion of flood related drowning deaths when compared to the sex split on all drowning deaths in rivers. Women accounted for 38% of all flood related drowning deaths, whilst accounting for 20% of all drowning deaths in rivers.

Overall, people aged 55-64 years experienced the highest number of flood related drowning deaths in rivers with 21 deaths, or 17% of all flood related drowning deaths. When examining flood related drowning deaths by sex, men aged 55-64 (15 deaths) and 25-34 (12 deaths) experienced the highest numbers. For women, the largest number of drowning deaths occurred in the 75+ years age group and the 35-44 years age group, each with 7 drowning deaths of women in flooded rivers.

Queensland experienced over half of all flood related river drowning deaths (56%). The State with the next highest proportion of flood related drowning deaths in rivers was NSW with 22%. Tasmania and Western Australia were the States with the lowest number of flood related river drowning deaths with just 4 drowning deaths across the 10 year period of this study respectively. The largest proportion of flood related drowning deaths occurred in regions considered Inner Regional (33%), followed by Outer Regional (25%) and Very Remote (22%).

Over half (54%) of all the drowning deaths that took place in flooded rivers were as a result of non-aquatic transport, i.e. driving a car across a flooded bridge, road or causeway and being swept in due to the force of the water.

When examining activity by sex in flood related river drowning deaths, men were more likely to drown in flooded rivers as a result of swimming and recreating (89% male) and jumping in (67% male). 100% of those who drowned in flooded rivers whilst using watercraft or conducting a rescue, were male. Women were more likely to drown in flooded rivers after being swept in (75% being female).

When examining activity prior to drowning in flooded rivers with the use of drugs and alcohol, 37% of drowning deaths as a result of non-aquatic transport had positive readings for alcohol and in 18% of cases, some form of drug was also found to be present in the deceased's bloodstream. Flooding and natural disaster related drowning deaths will continue to be an issue in Australia and prevention of river related drowning deaths in times of flood is an aim. Prevention strategies should focus on education of people around the dangers of floodwaters, particularly when using non-aquatic transport.



Key Findings

- 17% (125) of river drowning deaths were known to be flood related
- Women account for 38% of all flood related river drowning deaths compared to 20% for all drowning deaths in rivers
- People aged 55-64 years was the age group that experienced the highest burden of flood related drowning deaths in rivers
- Queensland experienced the highest proportion of flood related drowning deaths in rivers with 56%
- Over half (54%) of all flood related river drowning deaths occurred as a result of non-aquatic transport

CASE STUDY: RIVER DROWNING DEATHS IN VERY REMOTE AREAS

Ten percent (n=76) of drowning deaths in rivers occurred in areas deemed to be Very Remote. The circumstances of drowning deaths in Very Remote areas are worthy of examination in greater detail to determine trends and develop strategies for prevention.

Males accounted for 79% of all drowning deaths in rivers located in Very Remote areas. When examining these deaths by age groups and sex, the burden of males drowning was most prevalent in the 18-24 years age group where 100% of the 5 drowning deaths were men, and the 25-34 years age group, with 93% of those who drowned being male.

Drowning deaths in Queensland account for the largest proportion of river drowning deaths in Very Remote areas (38%), followed by the Northern Territory (37%) and Western Australia (20%). Almost one quarter of the 56 known flood related river drowning deaths occurred in areas considered Very Remote (22%).

The most common activities being undertaken immediately prior to drowning were swimming and recreating (29%) followed by non-aquatic transport (18%) and falls into water (15%). Men were more likely to drown after intentionally entering the water, most commonly as a result of swimming and recreating, accounting for 86% of all swimming and recreating river drowning deaths. Women were more likely to unintentionally enter the water as a result of being swept away from floodwaters (67%).

Alcohol was known to be present in 40% of drowning deaths in rivers. In 87% of cases that recorded a positive blood alcohol reading, the blood alcohol content was equal to or greater than 0.05mg/l and was therefore considered contributory in their drowning death.

When examining alcohol use and sex, 87% of all cases known to involve alcohol in Very Remote areas, were males. When examining activity by sex and alcohol use, 100% of all watercraft related deaths involving males registered positive readings for alcohol. This was followed by 75% of all river drowning deaths as a result of jumping into the water. For females, 67% of all drowning deaths as a result of swimming and recreating in rivers in Very Remote areas registered a positive reading for alcohol. Drugs were present in 11% of Very Remote river drowning deaths. In only two of these cases were the drugs being used illegal (cannabis and methamphetamine).

Thirty six percent of all drowning deaths in Very Remote areas were known to be flood related. Of these, driving non-aquatic transport through floodwaters or being swept into floodwaters whilst in non-aquatic transport accounted for 37% of flood related drowning deaths in Very Remote areas, followed by being swept away (33%).



Key Findings

- 10% (76) of river drowning deaths took place in areas considered Very Remote
- 79% of those who drowned in areas deemed Very Remote were males
- 38% of Very Remote river drowning deaths took place in Queensland, 37% took place in the Northern Territory
- Common activities undertaken immediately prior to drowning were swimming and recreating (29%) followed by non-aquatic transport (18%) and falls into water (15%)
- Almost one quarter (22%) of all known flood related river drowning deaths occurred in areas deemed Very Remote
- Alcohol was known to be present in 40% of drowning deaths in rivers in Very Remote areas.
- In 87% of drowning deaths involving alcohol, the level of alcohol was considered to be contributory

CASE STUDY: ABORIGINAL AND TORRES STRAIT ISLANDER DROWNING DEATHS

Across the 10 financial years of this study, there were 83 people known to be Aboriginal and/or Torres Strait Islander who drowned in rivers. This represents a rate of 1.58 per 100,000 population compared to a rate of 0.35 among the general Australian population. There were a further 111 cases where Indigenous status of the drowning victim was not documented. This indicates that the number of Indigenous people drowning is likely to be higher than currently known.

Of the Aboriginal and Torres Strait Islanders that drowned, 81% were males. Almost half (46%) of all drowning deaths in Indigenous Australians occurred in the 25-44 years age range. Sixty two percent of all drowning deaths in the Northern Territory were Indigenous Australians, compared with 26% in Western Australia and 10% in Queensland. Almost half (47%) of all the drowning deaths that occurred in rivers in areas deemed Very Remote, were of Aboriginal and Torres Strait Islanders.

The most common activities being undertaken immediately prior to drowning for Indigenous Australians were swimming and recreating (33%), falls into water (13%) and non-aquatic transport (12%). Activity immediately prior to drowning was unknown in 16% of cases suggesting many drowning victims were alone when they drowned, or the activity was unwitnessed.

Over half (54%) of all Aboriginal and Torres Strait Islanders who drowned in rivers, creeks and streams in the last 10 years, had positive readings for alcohol in their blood stream when they drowned. Of these, 30 people, or 67% had a Blood Alcohol Content (BAC) reading equal to or greater than 0.05g/L.

Seventeen percent of Aboriginal and Torres Strait Islander drowning victims recorded a positive reading for drugs, the most common of which was cannabis, which was positively recorded in 8 cases. In 5 cases, positive readings for both drugs and alcohol were recorded.

In the 10 years of this study, there were a total of 16 Indigenous Australians who drowned in floodwaters. Sixty nine percent of these entered the water intentionally, either by jumping in, swimming and recreating, knowingly driving across floodwaters or performing a rescue. Alcohol was known to be a contributing factor in 64% of all cases where Indigenous people intentionally entered floodwaters.

Culturally appropriate strategies need to be developed to prevent drowning among Aboriginal and Torres Strait Islanders. Messages should be targeted at males residing or recreating in Remote and Very Remote areas and address the risks associated with undertaking aquatic activity when under the influence of drugs and/or alcohol and the risks of entering flooded rivers.



Key Findings

- 83 people known to be Aboriginal and/or Torres Strait Islander drowned in rivers
- Indigenous people drown at a rate of 1.58 compared to 0.35 for the general Australian population
- Of the Aboriginal and Torres Strait Islanders that drowned, 81% were males
- Almost half (46%) of all drowning deaths in Indigenous Australians occurred in the 25-44 years age range
- Over half (54%) of all Aboriginal and Torres Strait Islanders who drowned had positive readings for alcohol in their blood stream
- 16 Indigenous Australians drowned in floodwaters
- Sixty nine percent of those who drowned in floodwaters entered the water intentionally

CASE STUDY: ALCOHOL AND DRUGS

The high number of alcohol and to a lesser extent, drug related, drowning deaths in rivers across the period of this study, warrants a more detailed examination of the scope of the problem and also the circumstances of these deaths.

Alcohol related river drowning deaths

Alcohol was known to be involved in 37% (274 cases) of all river drowning deaths across the 10 years of this study. There were a further 253 cases where the involvement of alcohol is not known (either toxicological testing was not conducted or the results were not made available), suggesting that the problem may be larger than currently known.

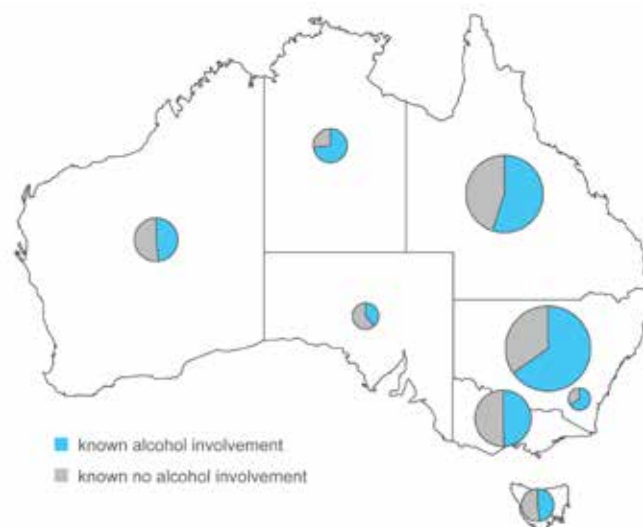
Of the 274 cases known to involve alcohol, 82% of these were male. The highest number of alcohol related drowning deaths in rivers was found in the 45-54 years age group with 51 cases (19% of all alcohol related river drowning deaths), followed by the 25-34 years age group and the 55-64 years (17% respectively).

When looking at the proportion of alcohol related drowning deaths in a particular age group as a proportion of all drowning deaths in that age group in rivers, some different results emerge. Drowning deaths involving alcohol accounted for almost half of all drowning deaths in the 45-54 years age group (49%), followed by 47% in the 55-64 years age group and 46% in the 25-34 years age group.

When analysing river drowning deaths by known alcohol involvement and age group and sex, the highest proportion of male drowning deaths occurred in the young adolescent and adult age groups. All of the alcohol related drowning deaths in the 15-17 years age group were males, followed by 91% male in the 25-34 years age group and 87% male in the 18-24 years age group. The highest proportion of alcohol related river drowning deaths in females occurred in the older age groups. Twenty eight percent of all known alcohol related drowning deaths in the 55-64 years age group were females, followed by 25% in the 75+ years age group and 22% in the 45-54 years age group.

When examining alcohol involvement as a proportion of all drowning deaths in each State and Territory, the Australian Capital Territory had the highest proportion of alcohol related drowning deaths (67%), followed by the Northern Territory (56% of all drowning deaths) and Victoria (41% of all drowning deaths). The Australian Capital Territory, the Northern Territory, New South Wales and Queensland, all reported a higher number of known alcohol related drowning deaths than non-alcohol related drowning deaths (Figure 11).

Figure 11: Alcohol involvement by State and Territory as a proportion of all drowning deaths (where alcohol was known to be involved or known not to be involved) in the State or Territory, river drowning deaths between 1 July 2002 and 30 June 2012 (n=482)



When season of drowning incident and known alcohol involvement are analysed, alcohol related river drowning deaths are reasonably evenly spread throughout the seasons, with Autumn having the highest proportion of alcohol related drowning deaths with 40% of all deaths in Autumn known to involve alcohol, followed by Winter (38%) and Spring (37%).

The role of alcohol in activity prior to drowning is also interesting to examine. Unsurprisingly, alcohol was most likely to be present in river drowning deaths as a result of diving and jumping into the water, with alcohol being found to be present in 75% and 73% of drowning deaths in these activity categories respectively. This was followed by involvement in 46% of swimming and recreating drowning deaths. Of high concern is the involvement of alcohol in watercraft (40%) and non-aquatic transport (36%) drowning deaths.

When examining alcohol related drowning deaths by sex and activity immediately prior to drowning, men accounted for 100% of all alcohol related drowning deaths in rivers as a result of fishing, performing a rescue and activities classified under "other". Males also accounted for 95% of all alcohol related drowning deaths as a result of a watercraft accident. Females accounted for the highest percentage of alcohol related drowning deaths in the categories of diving (33%), non-aquatic transport (32%) and falls into water (25%).

Drowning deaths where alcohol was judged to be contributory

A blood alcohol concentration equal to or higher than 0.05g/L (the legal limit for operating a motor vehicle in Australia) was deemed to be contributory in the drowning death. For river drowning deaths over the past 10 years, 68% of cases where alcohol was known to be involved were deemed to be contributory.

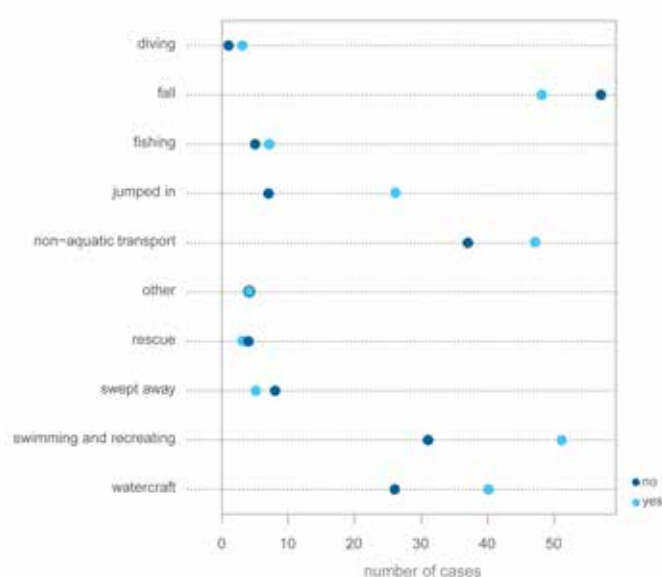
Of those deemed to be contributory to the drowning death, males continue to account for 82%. Drowning deaths involving a contributory level of alcohol were most likely to occur in people aged 45-54 years (84% of all alcohol-related drowning deaths in this age group), followed by the 18-24 and 25-34 years age groups (74% each).

On a State and Territory basis, South Australia had the highest proportion of river drowning deaths where alcohol was deemed contributory, with 80% of all alcohol related drowning deaths recording Blood Alcohol Levels deemed contributory. This was followed by Tasmania with 77% contributory and Victoria with 73%.

Falls into water was the activity with the highest number of drowning deaths where alcohol involvement was deemed to be contributory, accounting for 19% of all river drowning deaths (Figure 12). This was followed by non-aquatic transport accidents and swimming and recreating, both categories representing 18% of all contributory alcohol related drowning deaths in rivers respectively.

Half of all drowning deaths where alcohol was deemed to be contributory, had a blood alcohol content of 0.2 or higher, 4 times the legal driving limit. Seventeen percent had a blood alcohol reading of 0.3 or higher. The highest blood alcohol content recorded was a reading of 0.523, which is 10.5 times the legal limit.

Figure 12: Known activity by known alcohol involvement (both yes and no) for all drowning deaths in rivers between 1 July 2002 and 30 June 2012 (n=414)



Drug related drowning deaths

When examining the contribution of drugs (both legal and illegal) to river drowning deaths over the last 10 financial years, drugs were known to be present in the bloodstream in 195 cases, or 27% of all river drowning victims. As with reporting of alcohol involvement in drowning deaths, the presence of drugs in the bloodstream of river drowning victims was unknown in 39% of cases.

Female river drowning deaths known to involve some form of drug accounted for 30% of all female drowning deaths, and 26% of all male drowning deaths. When looking at the sex split of the total of cases known to involve some form of drugs, males account for 77% of all drug involved cases of river drowning and females 23%.

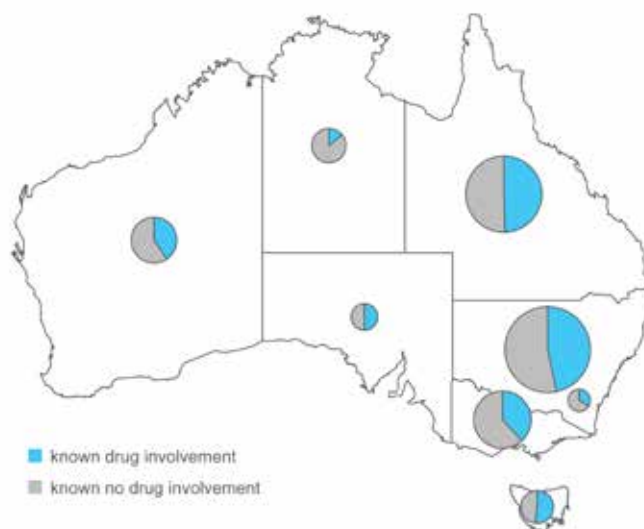
The known presence of drugs accounted for 32% respectively of all drowning deaths in the 25-34 years, 35-44 years and 75+ years age groups. The highest number of river drowning deaths known to involve drugs occurred in the 25-34 years age group, accounting for 17% of all known drug related drowning deaths. This was followed by the 35-44 years age group with 16% of all known drug related drowning deaths in rivers across the 10 year period of this report.

When examining drowning deaths known to involve some kind of drug and age group and sex, males accounted for 100% of known drug related drowning deaths in the 15-17 years age group and 88% of known drug related drowning deaths in the 25-34 years age group. Females accounted for the highest percentage of known drug related drowning deaths in the 45-54 years age group, accounting for 35% of all known drug related drowning deaths in rivers in this age group.

When examining river drowning deaths by known drug involvement and State or Territory, Tasmania had the highest percentage of known drug-related drowning deaths, with 39% of all Tasmanian drowning deaths known to involve some kind of drug. This was followed by Western Australia with 34% and the Australian Capital Territory with 33%.

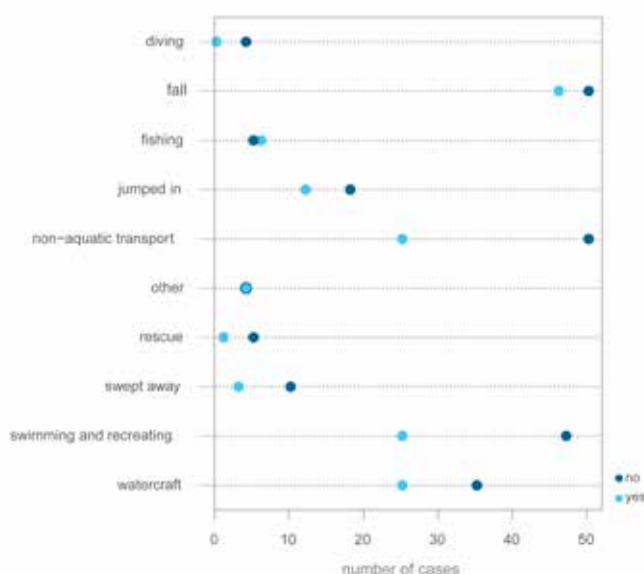
Tasmania was also the only State or Territory with a higher number of known drug related cases than river drowning deaths known to not involve some kind of drug. Queensland and South Australia had an equal number of cases that were both known to involve and not involve drugs (Figure 13). New South Wales had the highest number of cases where drug involvement was unknown, with 111 or 45% of all river drowning deaths in the State across the 10 year period of analysis.

Figure 13: Known drug involvement by State and Territory as a proportion of all river drowning deaths (where drugs were known to be involved or known not to be involved) between 1 July 2002 to 30 June 2012 (n=447)



When examining activity by drug use, half of all activities in the "other" category were known to involve some kind of drugs, followed by 35% of all drowning deaths as a result of an unknown activity. Drugs were known to be involved in 32% of all drowning deaths as a result of fishing or jumping in and 31% of drowning deaths as a result of a fall into a river.

Figure 14: Known activity and known drug involvement (both yes and no) for drowning deaths in rivers between 1 July 2002 and 30 June 2012 (n=376)



Drug related drowning deaths (a comparison between legal and illegal drugs)

By coding the type of drug used (either by name or by reading for drugs present at non-therapeutic levels) it is possible to examine the circumstances of river drowning deaths as a result of legal and illegal drugs.

Of the 195 cases known to involve drugs, 39% were illegal drugs (either illicit drugs or legal drugs at non-therapeutic levels).

Males accounted for 83% of all river drowning deaths known to involve illegal drugs. People aged in the 18-24 and 25-34 years age group accounted for 55% of all drowning deaths known to involve illegal drugs. Males in the same age groups (18-34 years) accounted for almost half of all illegal drug related drowning deaths, male or female (47%).

The gender bias towards males was slightly less prominent when examining drowning deaths involving drugs known to be legal. Females accounted for 26% of legal drug related drowning deaths, compared to 17% of illegal drug drowning deaths. The shift from illegal to legal drugs occurred as people aged with involvement of illegal drugs accounting for 80% of 55-64 years drowning deaths, increasing to 95% legal in the 65-74 years age group and 100% in the 75+ age group

The Northern Territory had the highest percentage of illegal drug related river drowning deaths with 50% of all drug related drowning deaths in that Territory being illegal. This was followed by New South Wales with 46% illegal drugs.

When examining activity immediately prior to drowning, 100% of all drug related 'other' activities involved illegal drugs, as did 60% of drug related swimming and recreating drowning deaths and 50% of drug related drowning deaths as a result of jumping in. 100% of drug-related drowning deaths associated with performing a rescue or being swept away involved legal drugs, and 83% of known drug related fishing drowning deaths involved legal drugs.

The most common type of illegal drug identified in river drowning deaths was Cannabis, found in 68% of river drowning deaths where illegal drugs were present in the victim's bloodstream. This was followed by Amphetamines (21%) and Ecstasy (5%).

There were a wide variety of legal drugs identified in the known drug related drowning deaths in rivers over the last 10 years. Commonly occurring categories of legal drugs included anti-depressant and anti-anxiety medication, anti-convulsants and cardiovascular agents such as anti-hypertensive drugs and anti-arrhythmic agents.

There were 28 cases (4% of all river drowning deaths) known to involve both drugs and alcohol. The most common activities whilst under the influence of both alcohol and any type of drug was swimming and recreating, accounting for 32% all drowning deaths where both alcohol and drugs were known to be involved. The second most common activity being undertaken prior to drowning where the victim had both alcohol and drugs in their bloodstream was falls into water (21% of all drowning deaths known to involve alcohol and drugs).

It is clear that there are a concerning number of river drowning deaths that are known to have been caused, at least in part, by the ingestion of alcohol and/or drugs. Of particular concern is the number of drowning deaths as a result of non-aquatic transport and watercraft accidents whilst under the influence of alcohol.

The high number of cases where alcohol involvement is not known, and the even higher number of cases with unknown involvement of drugs, warrants improvement in data collection processes. Royal Life Saving will continue to work with the National Coronial Information System (NCIS), State and Territory Coronial Offices and the Police to enhance toxicological reporting. Better data will ultimately enhance our understanding of the true contribution of alcohol and drugs in river drowning deaths in Australia.

Key Findings

- Alcohol was known to be involved in 37% of all river drowning deaths
- 82% were male
- Drowning deaths involving alcohol accounted for almost half (49%) of all drowning deaths in the 45-54 years age group
- Alcohol was known to be involved in 40% of watercraft and 36% of non-aquatic transport drowning deaths
- Half of all drowning deaths where alcohol was deemed to be contributory, had a blood alcohol content of 0.2 or higher
- Drugs were known to be present in the bloodstream of 27% of river drowning victims
- Ten percent of all river drowning deaths were known to involve illegal drugs
- 18-34 year old males accounted for almost half of all illegal drug related drowning deaths, male or female (47%).
- The most commonly detected illegal/illicit drug was cannabis, detected in 52 cases (68% of all river drowning deaths known to involve illegal drugs)
- Four percent of all river drowning deaths were known to involve both drugs and alcohol

CASE STUDY: UNDERLYING MEDICAL CONDITIONS AND DROWNING IN RIVERS

Related to the use of legal drugs, is the role of underlying medical conditions in drowning deaths. Data on drowning deaths in rivers across the 10 year period of this study shows that 271 people (37% of all river drowning deaths) were known to have some type of underlying medical condition.

When examining the presence of known underlying medical conditions by sex of drowning victim, 38% of all females who drowned in rivers during the 10 year period of this study were known to have an underlying medical condition. Thirty seven percent of males who drowned in rivers were known to have an underlying medical condition across the same study period.

Logically, underlying medical conditions were more common in middle aged and elderly people, with the highest number of known medical conditions occurring in the 45-54 years age group and the 75+ years age group (accounting for 38% of all drowning victims known to have underlying medical conditions respectively).

Eighty seven percent of all drowning deaths in females with a known underlying medical condition occurred in females aged 65 years or older, compared to 72% of males in the same age groups registering a known underlying medical condition.

Underlying medical conditions were more likely to occur in the Australian Capital Territory where 67% of all drowning deaths were known to have underlying medical conditions, followed by Tasmania (52%) and Western Australia (48%).

When examining river drowning deaths by activity immediately prior, Fishing is the activity category with the highest proportion of known underlying medical conditions, accounting for 58% of all fishing drowning deaths. Just over half (51%) of all victims who drowned as a result of a fall into a river were known to have an underlying medical condition.

Commonly occurring types of underlying medical conditions among victims of river drowning deaths include: cardiac conditions such as coronary artery atherosclerosis and ischaemic heart disease; epilepsy, dementia and the consequences of alcoholism (such as seizures, frailty and alcohol dependence).

Some medical conditions such as frailty and cardiac conditions are likely to increase a person's risk of drowning when they are undertaking aquatic activity or recreating in close proximity to water. The role of underlying medical conditions in drowning deaths is worthy of further research to examine the type and quantity of medical conditions involved in river drowning deaths and attempt to quantify their contribution to the circumstances of the drowning.



Key Findings

- 271 people (37%) were known to have some type of underlying medical condition
- 38% of all drowning victims with known underlying medical conditions were aged between 45-54 and 75 years or older
- ACT (67%), Tasmania (52%) and Western Australia (48%) had the highest proportions of drowning victims with known underlying medical conditions
- 87% of all drowning deaths in females with a known underlying medical condition took place in females aged 65 years or older
- Commonly occurring medical conditions included: cardiac conditions, epilepsy, dementia and the consequences of alcoholism

DISCUSSION

Rivers continue to be the aquatic location with the highest number of drowning deaths with 735 drowning deaths or 25% of all drowning deaths experienced in Australia over the 10 year period of this study. Analysis of data collected on the scale and nature of drowning deaths in rivers during this period in Australia provides the opportunity to identify risk factors and contribute to evidence based drowning prevention strategies. This report highlighted themes worthy of focus and further research.

The significant burden of males in overall drowning statistics is mirrored in river drowning statistics. Males accounted for 80% of all drowning deaths experienced in Australian rivers over the past 10 financial years. That burden is even more pronounced in the 25-34 years age group, where males account for 92% of all drowning deaths in rivers. Males were more likely to drown in rivers as a result of intentionally entering the water as a result of a rescue attempt or jumping in. Males were also significantly more likely than women to drown whilst undertaking activities such as fishing and using watercraft.

The role of alcohol in drowning deaths is also a concerning issue in river environments, and highly relevant to male drowning deaths, with 82% of all known alcohol related drowning deaths to be males, most commonly in the 45-54 years age group.

Alcohol was also commonly associated with risk taking activities in rivers, such as diving and jumping into water, known to be detected in three quarters of drowning deaths as a result of these activities. The involvement of alcohol in drowning deaths, as a result of watercraft and non-aquatic transport accidents, is also of extreme concern. For drowning deaths involving alcohol and watercraft, the victims were 95% male.

Where alcohol was detected, 50% of victims, known to have alcohol in their bloodstream when they died, had a blood alcohol content of 0.2 or higher. This level represents a blood alcohol content 4 times higher than the legal driving limit. Alcohol consumption is known to increase the risk of drowning and decrease the effectiveness of CPR. Therefore river drowning prevention strategies must communicate the risks of undertaking aquatic activity whilst under the influence of alcohol and highlight the extreme dangers associated with excessive consumption.

The enforcement of, and public awareness of State and Territory legislation around the operation of watercraft whilst under the influence of alcohol should be explored. There needs to be greater awareness of the risks of consuming alcohol when using watercraft and greater enforcement of drink driving legislation for people both operating motor vehicles and watercraft.

Activity prior to drowning was unknown in almost one fifth (18%) of all river drowning deaths, indicating there are a number of people undertaking aquatic activities in river environments alone which can increase their risk of drowning. The relatively high proportion of river drowning deaths occurring in areas considered Very Remote (10%) also highlights the importance of ensuring aquatic activities are never undertaken alone and that people both living and recreating in Very Remote areas are equipped with CPR and first aid skills to ensure they can act as first responders. A remoteness classification of Very Remote is based in part on distance to services including medical services, further highlighting the need for community wide resuscitation skills in case of drowning incidents.

Drowning rates of Indigenous people in rivers are 4.5 times higher than drowning rates among the general Australian population. With many Indigenous people living in isolated communities, and the identification of key contributing factors of alcohol and flooding, there is a need for culturally appropriate strategies to be developed to prevent drowning deaths among Indigenous Australians.

Seventeen percent of all drowning deaths in rivers were known to be flood related. Of these, non-aquatic transport accidents and intentionally entering floodwaters by jumping in or for the purposes of swimming and recreating were the most common activities being undertaken. Flooding and natural disaster related drowning deaths will continue to be an issue in Australia. Prevention strategies should focus on education of the community around the power of floodwaters and the risks of engaging with them when using motor vehicles.

Public education around risk reduction and drowning prevention for river environments should cover a number of key issues including the risks of undertaking aquatic activity alone, the dangers of interacting with floodwaters and the dangers posed recreating in, on or near rivers after having consumed alcohol. Data analysis shows that drowning in rivers is largely a local issue, with almost three quarters (74%) of people drowning in a postcode within 100kms of where they lived.

A subsequent phase of this research is to gather data to quantify the rates of exposure to the hazard (rivers). This includes gathering visitation data at rivers and also determining a recreation profile of river users to enhance understanding of the types of activities being undertaken in, on and around rivers and also river user's attitudes to the risks they may encounter.

Royal Life Saving will continue to work with the National Coronial Information System (NCIS), State and Territory Coronial Offices and the Police to enhance reporting around toxicological findings and documentation of underlying medical conditions in drowning victims. This will further enhance our understanding of the contribution of alcohol and drugs and the role of underlying medical conditions in drowning deaths in rivers and drowning deaths more broadly.

RECOMMENDATIONS

- Conduct situational and geographical analysis of river drowning black spot environments nationally. This analysis would collect data on hazards and risk treatments and enhance understanding of usage and recreational patterns at known drowning black spots. This model for environmental audits should be piloted at a State level before utilising the findings to expand nationally.
- Utilise the findings on geographical location of river drowning deaths to partner with catchment authorities to design, implement and evaluate effective, locally targeted drowning prevention strategies.
- Develop, implement and evaluate public education strategies to enhance understanding of the legislative requirements and risks associated with operating watercraft whilst under the influence of alcohol. Consider a collaborative approach with State and Territory police and maritime agencies to enhance awareness of the rules around operating watercraft, the risks associated with consuming alcohol when operating or travelling on watercraft and encourage increased enforcement through breath testing in river environments.
- Develop public education strategies that highlight the risks of consuming alcohol and undertaking aquatic activity in or recreating alongside rivers, creeks and streams. These strategies should primarily be aimed at men and particularly target those aged 25-64 years.
- Partner with Indigenous groups to develop culturally appropriate strategies to prevent drowning among Indigenous Australians. Messages should target Indigenous people living in Remote and Very Remote areas and address the risks associated with undertaking aquatic activity when under the influence of alcohol and/or drugs and the risks of entering floodwaters.
- Integrate river safety knowledge and skills into school based water safety programs to boost awareness of common hazards and risks present in river environments.
- Explore strategies to strengthen first responder skills in cardio-pulmonary resuscitation (CPR) and first aid, particularly in areas deemed Remote and Very Remote.
- Conduct awareness raising activities around the risks associated with recreating in and driving through floodwaters.
- Work with the National Coronial Information System (NCIS), State and Territorial Coronial Offices and the police to enhance reporting around the toxicological profile and underlying medical conditions of river drowning deaths in Australia.
- Review the 41 cases of drowning deaths in rivers with associated coronial recommendations to look at common themes and potential additional strategies for reduction.
- Explore the benefits of conducting qualitative research with men aged 15-34 years regarding recreational activities undertaken in rivers and attitudes towards risky behaviours such as consuming alcohol and drugs.

CONCLUSION

With the sustained high numbers of drowning deaths that have been experienced in rivers across Australia over the past 10 years, it is clear that more work must be done to reduce these statistics and enhance understanding within the community of the risks of drowning in these locations.

While an analysis of the scale and nature of river drowning deaths is an important first step in determining trends and informing prevention strategies, we need to increase our understanding of river users and our understanding of and attitudes towards the unique hazards and risks that river environments present.

Further work is also needed to understand the recreational and usage patterns of river users.

This research highlights that drowning prevention strategies for rivers are desperately needed for the male population, in rural and remote areas and aimed at Indigenous Australians.

Royal Life Saving is well placed to expand upon the findings of this report and implement its recommendations. As a water safety and drowning prevention organisation, we are committed to developing and implementing evidence based strategies to achieve a significant reduction in river drowning deaths in Australia.



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