FLOOD RISK COMMUNICATION RESEARCH INTO PRACTICE BRIEF 2 JULY 2019

Vehicle-related flood deaths

An analysis of vehicle-related flood deaths in Australia, 2001-2017

Mozumdar Arifa Ahmed, Katharine Haynes, Mel Taylor and Matalena Tofa, Department of Psychology, Macquarie University

The Research-into-Practice Brief series provides concise summaries of research findings for end-users and practitioners.

Macquarie University NSW 2109 Australia ABN 90 952 801 237

Mel Taylor: mel.taylor@mq.edu.au
Matalena Tofa: matalena.tofa@mq.edu.au

CRICOS Provider 00002J

@bnhcrc
www.bnhcrc.com.au

BACKGROUND AND AIMS

Globally, vehicle-related incidents account for a significant proportion of flood fatalities. For example, in the United States, Ashley and Ashley (2008) reported 63% of all flood deaths were vehicle-related. In Australia, FitzGerald et al. (2010) reported that between 1997 and 2008 49% of flood fatalities were vehicle-related, similarly Haynes et al. (2017) identified 49% between 1900 and 2015. Recent research in Australia (Haynes et al., 2017, Peden et al., 2017) has documented and quantified vehicle-related flood fatalities, however, these studies have done so in the context of an investigation of all flood fatalities over an extended time frame, and gaps remain in our understanding of vehicle-related flood deaths specifically.

This study aims to better understand the situational, demographic, and environmental conditions under which vehicle related flood deaths occur. It also aims to explore age and gender patterns of the vehicle occupants, and the circumstances of those who survived.

METHODS

The Australian National Coroners Information System was accessed to gather information on all vehicle-related flood fatalities that had occurred between 2001 and 2017. A few recent fatality cases that were not yet available within NCIS were identified from archived newspaper reports. Additional information was also accessed from archived newspaper reports and relevant websites such as the Australian Bureau of Statistics (ABS) and the Australian Bureau of Meteorology (BoM).

Data were coded and categorised according to a range of factors previously identified as significant in vehicle-related flood fatalities internationally. These were demographic, spatial (e.g., state, location type), temporal (year, month, time of day), and situational factors (e.g., number of vehicle occupants, weather conditions).

TRENDS IN FATALITY DATA

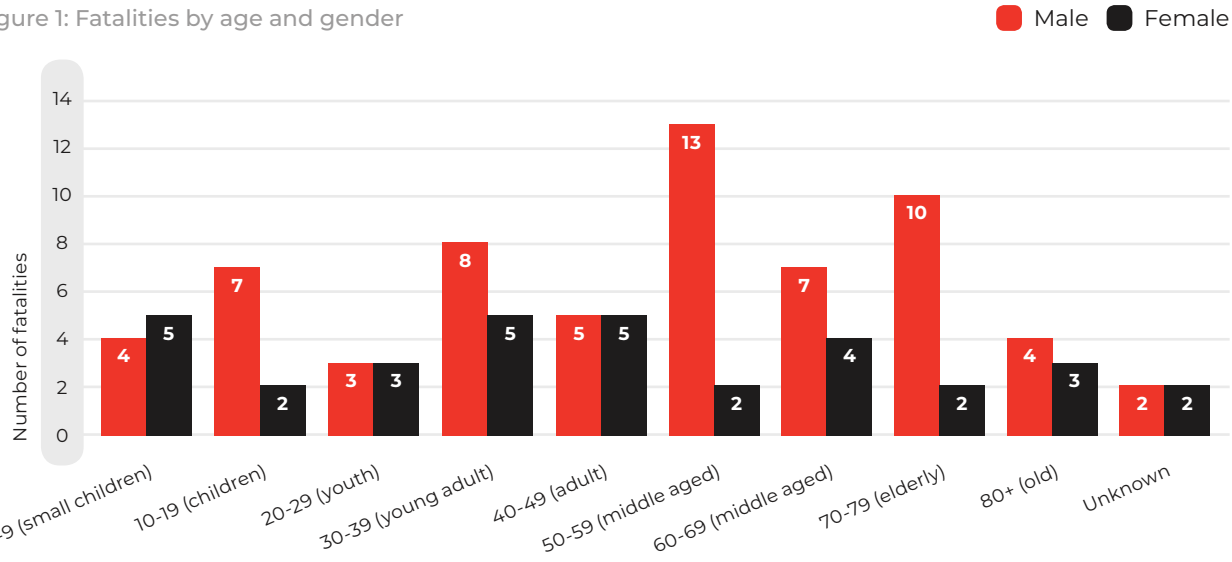
The final dataset contained the details of 96 individual vehicle-related flood fatalities in Australia that occurred between 2001 and 2017. These deaths took place during 74 flood-related vehicle incidents, with a mean of 1.3 fatalities per incident.

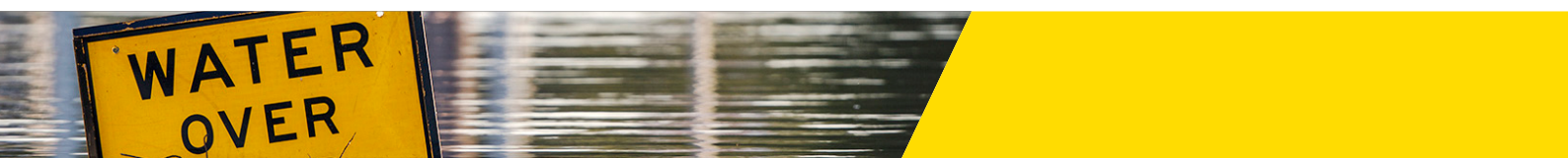
Demographic factors

As shown in Fig. 1., overall, a slightly greater number of fatality cases were noted for those aged 50-79 years (n=15) and 30-39 years (n=13), and fewer for those aged 20-29 year (n=6) and over 80 (n=7). Males accounted for a higher number of deaths overall (66%; n=63) than females (34%; n=33), and the number of male deaths is notably higher in most age groups. This higher proportion of male to female deaths is in accord with male overrepresentation in vehicle-related flood death statistics reported in the literature (e.g., Haynes et al., 2017).

Of the 96 fatalities, 60% were drivers (n=58), 31% were passengers (n=30), and 8% were unknown. Of the 58 drivers, 72% were male (n=42) and 28% female (n=16). Of the 30 passengers, 57% were male (n= 17), 43% female (n=13). The age distribution of the driver fatalities shows that the majority 88% (n=49) are aged over 30 years. As might be expected for passengers, the number of child fatalities (n=14, 46%) is higher than adult fatalities.

Figure 1: Fatalities by age and gender





Spatial and temporal factors

The annual number of fatalities during the period 2001 to 2017 is shown in Figure 2. The annual death toll is highest in 2011 with 17 fatalities (attributable to a widespread severe flooding event in Queensland in January 2011). The mean death toll across the study time period is 5.65 fatalities per year. Data show a moderate rising trend from 2001 to 2011. Since 2006, the annual number of fatalities has continued above the mean almost every year, except 2012 and 2014. No vehicle-related fatalities were recorded in 2014. In recent years, since 2015, the number of fatalities annually appears to have increased again in comparison with the early 2000s.

A higher number of fatalities occurred during the Australian summer months of January (n=24; 25%) and February (n=13; 14%), and the winter month of June (n=17; 18%). Queensland (QLD) and New South Wales (NSW) account for 84% of the overall number of fatalities (n=81). Indeed, the majority of fatalities have occurred along the east coast of QLD and NSW. The coastal strip from mid-NSW (Wollongong) to mid-QLD (Marlborough) has been identified previously as the most hazardous zone in Australia with regard to flood fatalities generally (Coates, 1999).

Further analysis of each of the 74 fatal incidents showed that more fatal incidents occur in summer (49%, n=36) and in the evening/at night (50%, n=37). The majority of incidents occurred when victims were attempting to cross creeks, bridges or causeways (87%; n=64) and the crossings were flooded due to rising water levels. Much smaller proportions occurred at a ford or weir, or on a normal stretch of (flooded) road.

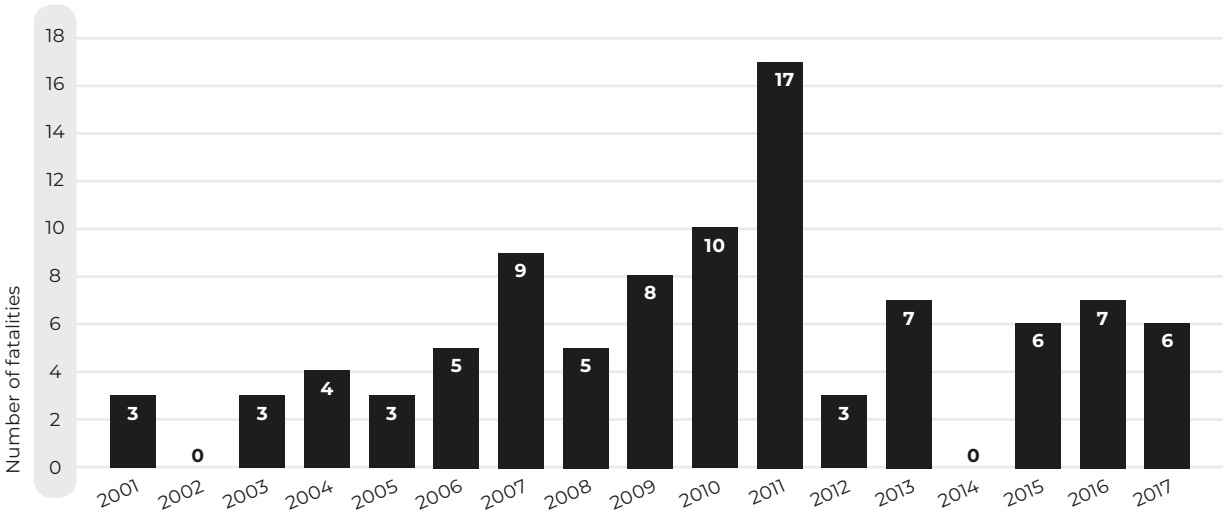
Situational factors

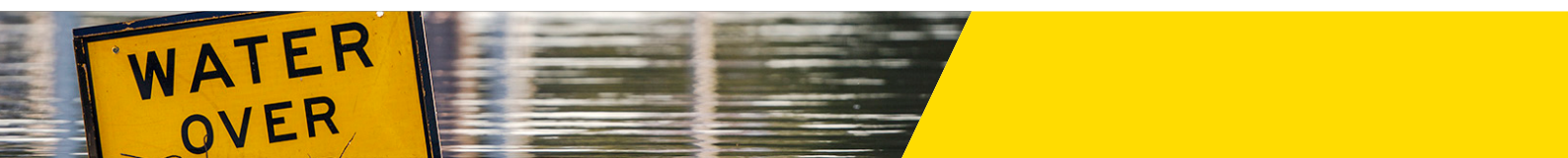
Detailed analysis was undertaken to identify the main situational factors associated with vehicle-related flood fatalities. These include: the presence of alcohol, whether engaged in work duties/on duty, the flow of the water, the weather conditions, proximity to driver's home, and the reasons for entering into floodwater. In addition, other factual information about the incidents, such as the type of vehicle involved, the number of fatalities per event, the number of occupants present in the vehicle, the number of occupants who escaped from the vehicle, and the causes of death has also been extracted and collated. This analysis revealed that:

- Drowning is the leading cause of death (65%)
- Presence of alcohol in deceased body found in 55% (n=21/38) incidents.
- No individual was recovered alive in 60% (n=44) incidents
- 62 (84%) incidents were single fatality incidents; of these 64% (n=40) happened when the driver was alone
- Twelve passengers died in single fatality incidents, where the driver managed to escape
- 43% (n=33) occurred within 20 km of driver's home address
- The shallowest water depth was only 20 cm;
- 63% reported fast flowing water

The characteristics of the motor vehicle were regarded as an important feature to capture in our analysis; however, vehicles were difficult to classify as their characteristics were reported in various ways in coronial data; for example: by size, i.e. small, medium, large; by manufacturer, etc. Just under a quarter of incidents (22%) occurred in sedans, a fifth (20%) in sports utility vehicles (SUVs) and 15% in utility vehicles (utes). At least 29% of all vehicles trapped in floodwater were officially reported as four-wheel drive vehicles (4WD). This finding represents a well-established trend noted in Australia (Haynes et al., 2017, Peden et al., 2017) in which 4WD vehicles account for an increasing number of vehicle-related flood fatality incidents.

Figure 2. Annual number of vehicle-related flood fatalities from 2001 to 2017





IMPLICATIONS AND RECOMMENDATIONS

These trends in the fatality data have implications for the development of intervention strategies targeting those at risk of vehicle-related flood fatality. The data shows that men are at the greatest risk across most age groups, and that campaigns and interventions could usefully target male drivers. In addition, more needs to be done to communicate the risks of entering floodwater in a vehicle from the passenger's perspective, e.g. messaging that persuades drivers to prioritise their responsibility for passengers' safety, and that assists passengers to understand their risks and advocate for their safety - especially children/females. Further, floodwater with high flow and the presence of alcohol and drugs are common contributing factors identified, with drugs and alcohol leading to impaired responses, or impacting mobility - reducing the chance of survival.

The spatial and temporal patterns of fatalities by annual and monthly distribution have implications in terms of developing, maintaining and prioritising engagement in risk messaging and interventions in relation to time (season) and location (state).

FURTHER READING

Ahmed, M. A., Haynes, K., and Taylor, M. (2018). Driving into floodwater: A systematic review of risks, behaviour and mitigation. International Journal of Disaster Risk Reduction, 31, 953-963. doi:https://doi.org/10.1016/j.ijdrr.2018.07.007

Ashley, S. T., and Ashley, W. S. (2008). Flood Fatalities in the United States. Journal of Applied Meteorology and Climatology, 47(3), 805-818. doi:10.1175/2007jamc1611.1

Coates, L. (1999). Flood Fatalities in Australia, 1788-1996. Australian Geographer, 30(3), 391-408. doi:10.1080/00049189993657

Fitzgerald, G., Du, W., Jamal, A., Clark, M., and Hou, X. Y. (2010). Flood fatalities in contemporary Australia (1997–2008. Emergency Medicine Australasia, 22(2), 180-186. doi:10.1111/j.1742-6723.2010.01284.x

Hamilton et al (2018) Changing people's attitudes and beliefs toward driving through floodwaters- Evaluation of a video infographic- Transportation Research Part F: Traffic Psychology and Behaviour, 53, Feb 2018: 50-60. https://www.sciencedirect.com/science/journal/13698478/53/supp/C

Hamilton et al (2017) Drivers' experiences during floods- Investigating the psychological influences underpinning decisions to avoid driving through floodwater. International Journal of Disaster Risk Reduction. Dec 2017: https://www.sciencedirect.com/science/journal/22124209

Hamilton, K., Peden, A. E., Pearson, M., and Hagger, M. S. (2016). Stop there's water on the road! Identifying key beliefs guiding people's willingness to drive through flooded waterways. Safety Science, 89, 308-314. doi:http://dx.doi.org/10.1016/j.ssci.2016.07.004

Haynes, K., Coates, L., van den Honert, R., Gissing, A., Bird, D., Dimer de Oliveira, F., D'Arcy, R., Smith, C., Radford, D. (2017). Exploring the circumstances surrounding flood fatalities in Australia—1900–2015 and the implications for policy and practice. Environmental Science and Policy, 76, 165-176. https://doi.org/10.1016/j.envsci.2017.07.003

Kellar, D. M. M., and Schmidlin, T. W. (2012). Vehicle-related flood deaths in the United States, 1995-2005. Journal of Flood Risk Management, 5(2), 153-163. doi:10.1111/j.1753-318X.2012.01136.x

Pearson, M., and Hamilton, K. (2014). Investigating driver willingness to drive through flooded waterways. Accident Analysis and Prevention, 72, 382-390. doi:http://dx.doi.org/10.1016/j.aap.2014.07.018

Peden AE, Franklin RC, Leggat P, Aitken P. Causal Pathways of Flood Related River Drowning Deaths in Australia. PLOS Currents Disasters. 2017 May 18 . Edition 1. doi: 10.1371/currents.dis.001072490b201118f0f689c0fbe7d437

Ruin, I., Gaillard, J.-C., and Lutoff, C. (2007). How to get there? Assessing motorists' flash flood risk perception on daily itineraries. Environmental Hazards, 7(3), 235-244.

FLOOD RISK COMMUNICATION

This research is funded by the Bushfire and Natural Hazards CRC and is led by Dr. Mel Taylor. This project will develop an understanding of the motivations, beliefs, decision-making processes and information needs of at-risk groups for flood fatalities, specifically those who drive or recreate in floodwater.

For more information, please see:
www.bnhcrc.com.au/research/floodriskcomms