

Analysis of fatalities attributed to Hurricane Florence in the US.

Jonathan van Leeuwen

Hurricane Florence impacted the US East Coast in September 2018 resulting in dangerous surf conditions, strong winds, storm surge and heavy rain producing significant flooding. The system made landfall over North Carolina as a Category 1 hurricane. While 1.7 million people received evacuation orders (The Independent, 2018), estimates of evacuees in shelters were around 30 thousand people (VOA, 2018), and total flood loss for residential and commercial properties in North Carolina, South Carolina and Virginia were estimated to be between \$19 billion and \$28.5 billion. Around 85 percent of residential loss is estimated to be uninsured (CoreLogic, 2018). This article aims to identify key circumstances and demographic factors common in those who lost their lives as a result of Hurricane Florence.

We define a hurricane death as one which would not have occurred if the hurricane had not impacted, i.e. any death directly or indirectly caused by that hurricane. This includes deaths from the potential mechanisms of rain (e.g., filling a depression into which an individual may fall and drown) and its associated flooding (riverine, flash), storm surge, strong winds and high seas. It also includes deaths of persons carrying out activities specifically associated with the hurricane - e.g., taking measurements, preparing people, goods or buildings to evacuate or endure the event, and cleaning up after the event (e.g., an accident whilst running a generator that was required because strong winds from the hurricane have taken out the electricity supplies). Care needs to be taken with timing - for example, how long after a hurricane has passed should one attribute flood deaths to that hurricane? This will vary from one event to another and is best defined by the weather authorities as (e.g., for Australia) in the case of a tropical cyclone decaying to a tropical low which can produce rain long after the initial impact of the tropical cyclone.

By searching through articles from numerous media outlets, we have identified 53 hurricane deaths. Where possible, records were verified against multiple news sources. We also classified each record by the state and county in which the death occurred, 10 year age bracket, and by category of cause of death (e.g., deaths occurred while in a vehicle, deaths caused by falling debris). The results are also compared with previous research on fatalities associated with Australian Tropical Cyclones by Coates, et al. (2017).

Results and analysis

The most common circumstances that caused fatalities were related to vehicles (n=26, 49%) and flooding (n=23, 43%). Only one vehicle incident causing multiple deaths was identified. Fourteen (26%) fatalities resulted from vehicles being washed off roads and nine (17%) from vehicles colliding with obstacles due to water on the road causing aquaplaning or heavy rain causing low visibility. Most incidents involved only private vehicles, but two people died when a prison transport van was driven into floodwater and one person died driving a semi-trailer truck which aquaplaned, left the road and struck an undescribed obstacle. Only two

flooding related fatalities were not also related to vehicles: a child playing in water which was deeper than normal due to preparatory release from a dam and a man who refused mandatory evacuation and was subsequently trapped in a caravan trailer.

Four people died as a result of a tree falling on their residence or vehicle during the hurricane, while other debris related circumstances included vehicle striking fallen tree, tree falling during clean-up operations and a woman who died after suffering a heart attack as emergency services could not get to her due to debris on roads. Two people died from carbon monoxide poisoning while running a generator indoors due to power outages, while other circumstances relating to death included loss of power for an oxygen concentrator and electrocution while attempting to connect extension cords to a generator in heavy rain. Two people died in a house fire which was caused by candles used after a loss of power. Two people fell from ladders and another person suffered unspecified injuries while cleaning debris from the storm or making repairs. Three people died in circumstances relating to evacuation, one of whom fell while packing for evacuation, one on a moped while evacuating and one who fell and struck his head in a hotel to which he had evacuated.

Circumstance leading to death	Fatalities (n, %)
Flood related (total)	23, (43%)
Vehicle related (total)	26, (49%)
Vehicle (washed off road)	14, (26%)
Vehicle (lost control)	9, (17%)
Falling/fallen debris	7, (13%)
Loss of electricity	7, (13%)
Clean-up	3, (6%)
Evacuation	3, (6%)
Fire	2, (4%)
Other	8, (15%)

Victims were most commonly 70 years old and above. No deaths were recorded for people between 10 and 19 years old, but there were a few fatalities under 10 years old. The deaths of those under 10 years old were caused primarily by trees falling on homes, and being in cars that were driven into floodwater by an accompanying adult. Figure 1 shows fatalities in 10-year age categories as a percentage of all fatalities where age was reported.

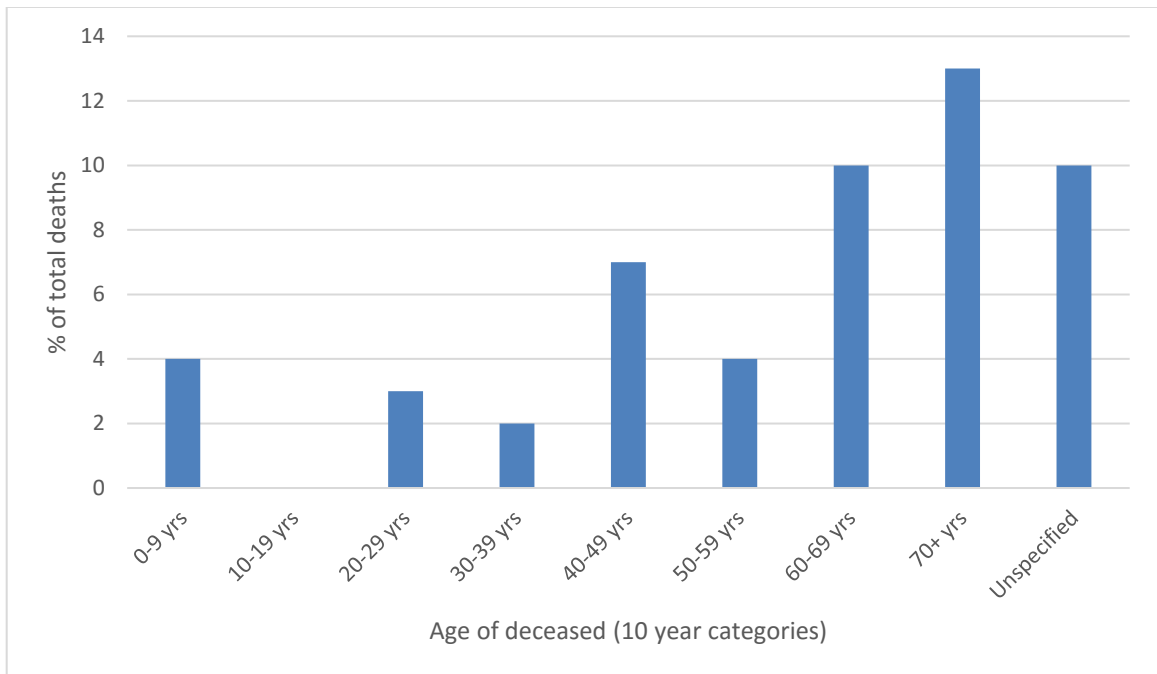


Figure 1: % of fatalities by 10-year age category

Males represented 74% of the deaths where the gender of the deceased was specified; however, a higher proportion of females died in circumstances relating to vehicles (58%) compared to males at 35%. More males died in circumstances relating to preparing for, activities during, and clean-up after the event such as checking on possessions, setting up generators, swimming in dangerous conditions or clearing debris.

Discussion and conclusion

The consequences of Hurricane Florence provide a clear reminder of the dangers associated with driving vehicles during and after severe weather, and the importance of avoiding driving through floodwater. Severe weather is shown to increase risks associated with evacuating by vehicle.

Figures 2 and 3 compare key demographics between fatalities from Hurricane Florence and a historical analysis of fatalities due to tropical cyclones in Australia from 1970 to 2015 by Coates, et al. (2017). Our analysis of deaths resulting from Hurricane Florence demonstrates a consistent gender distribution with Australian historical data. This supports the conclusion that males are more likely to be in hazardous situations or undertake risky behaviours than females in these types of events. However, the two data sets differ markedly in age demographics, with much younger victims in Australia than Hurricane Florence.

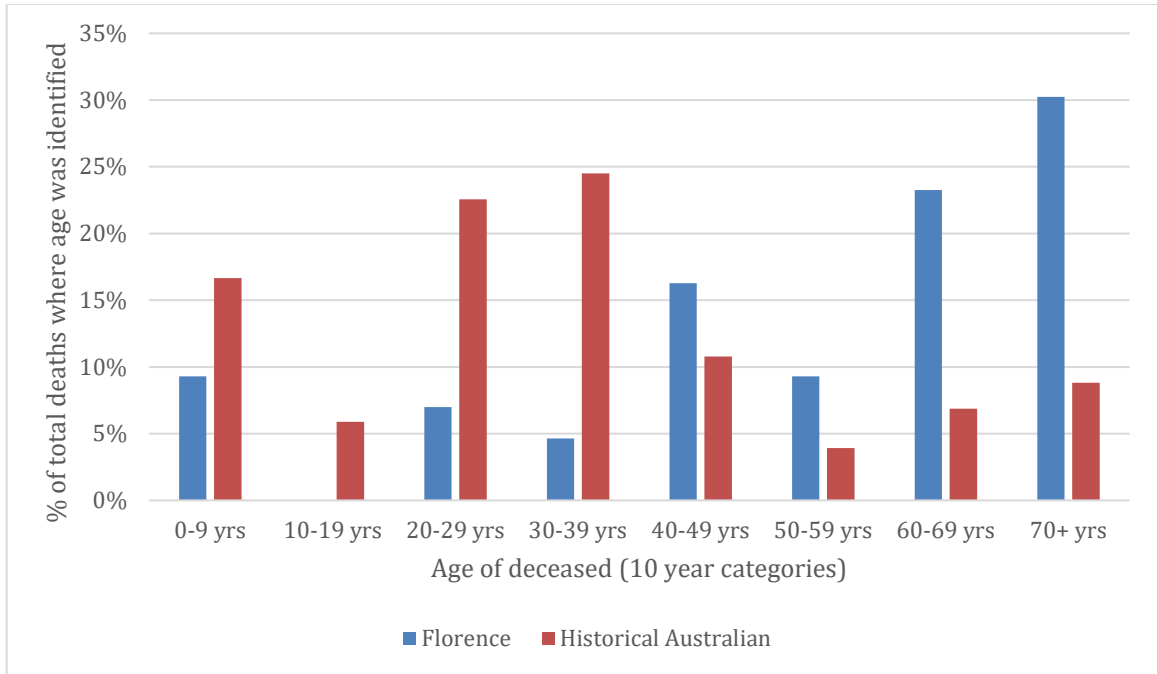


Figure 2: Comparison of Hurricane Florence fatalities by age with historical Australia cyclone fatalities (Coates, 2018)

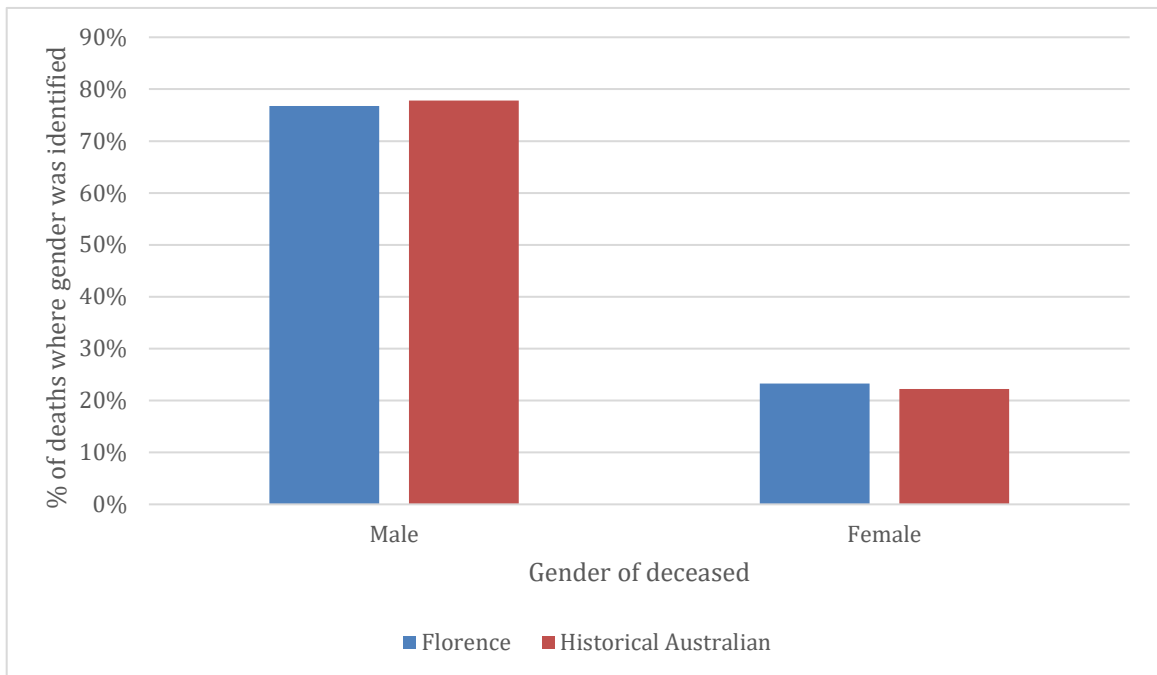


Figure 3: Comparison of Hurricane Florence fatalities by gender with historical Australia cyclone fatalities (Coates, 2018)

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