

Epidemiology of major disasters in New Zealand as revealed by disaster memorials

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Disasters are important causes of mortality internationally, with one global study reporting over the past 20 years the occurrence of 749,000 earthquake deaths, 160,000 heatwave deaths and 130,000 deaths from a single storm.¹ Furthermore, the recorded number of weather- and climate-related disasters has more than doubled over the past four decades, accounting for 6,392 events in 1996–2015, up from 3,017 in 1976–1995.¹ Climate change is a likely factor in some of these disasters, as is population growth and more people living in vulnerable locations such as flood plains.

In the majority of decades since the year 1900, New Zealand has experienced at least one large sudden mass fatality event, with these having collectively killed over 1,800 people² (albeit not including non-sudden disasters such as disease epidemics lasting weeks to months, eg, the 1918 influenza pandemic^{3,4} and various measles epidemics etc⁵). Furthermore, there have been 21 sudden disaster events with at least 20 deaths each, the worst involving 257 deaths from the aircraft crash into Mt Erebus.⁶

After these disasters, memorials have often been built with public funds—typically with a goal of remembrance of the victims (Figure 1) and possibly to remind the public about the risks posed by disasters (at least this is an implication on some international memorials, eg, in Japan⁷). Given this background, we aimed to examine New Zealand's sudden disaster memorials to determine how well they represented the key aspects of disaster epidemiology and subsequent actions for disaster prevention.

Methods

We reviewed published inventories that recorded the most substantial sudden mass fatality disasters (ie, those with 20+ fatalities) in New Zealand since 1900,^{2,6} and identified any corresponding memorials.^{2,6} Where there were multiple memorials to the same disaster, the largest one was selected. During January 2017 to August 2019, we conducted field visits to the identified disaster memorials, and photographed the memorials and associated information boards for subsequent analysis.

Figure 1: A memorial wall with associated area to the victims of the Canterbury earthquake of 2011. (Photograph by the third author, 2018).



Table 1: Epidemiological data detailed on the 17 disaster memorials and any associated information boards in New Zealand for the 21 sudden mass fatality disasters with 20+ deaths each, for the period 1900 to mid-2019.⁶

Characteristic	N/N	%	Further details
Memorials with an information board present	6/17	35%	All 17 memorials had some form of plaque or other engraved wording. No memorials had URLs that linked to further online resources about the disaster.
Basic epidemiology			
Memorials reporting the number of deaths	13/17	76%	Of the four memorials with no number of deaths reported, three memorials listed the names of all the dead.
Memorials reporting on the number of non-fatal injuries	3/8	38%	This was out of the eight disasters where at least one survivor was known to be injured. Of the five memorials that did not number non-fatal injuries, the Canterbury earthquake memorial mentioned that many were “seriously injured” (Figure 1). Also, for the <i>SS Penguin</i> sinking memorial, an injured person was described in the information board text—but among the 30 survivors there were likely other injuries, and these were not enumerated.
Mention of the cause of the disaster			
No mention of any cause	5/17	29%	Eg, the memorial to the Seacliff fire, erected in 2017, had no information on the cause and did not even mention the word “fire”.
Brief (eg, 1–2 words)	9/17	53%	These were typically just one or two words on the memorial, eg, “overwhelmed” (at sea); “appalling conditions” (at sea); “heavy seas”; “storm”; “flood”; “earthquake”; “7.8 earthquake”; “fire”; and “explosion”.
Detailed	3/17	18%	These were for the Erebus memorial (Waikumete Cemetery), the memorial for the prisoner-of-war shooting disaster at Featherston, and the Tangiwai disaster memorial (at Tangiwai).
Other			
Memorials reporting multiple interpretations of the cause	2/17	12%	These were for the Erebus memorial (Waikumete Cemetery) and the memorial for the prisoner-of-war shooting disaster at Featherston. For simplicity we used the denominator of all the memorials. Potentially an analysis could classify disasters according to whether or not the cause was disputed and exclude disasters where there is very little known of the cause, eg, sinking of the <i>Loch Long</i> .
Memorials referring to the role of rescuers	2/14	14%	These were for the Canterbury earthquake memorial (Figure 1) and the Tangiwai disaster memorial (at Tangiwai). In three disasters (excluded from the denominator) it seems likely that there was no scope for rescue or provision of aid to any survivors (eg, some ship sinkings).
Memorials mentioning any preventive actions arising from the disaster	2/17	12%	These were for the memorials to the prisoner-of-war shooting disaster at Featherston and the Tangiwai disaster (at Tangiwai). As above, we used the n=17 denominator for simplicity, even though historical records for some disasters are unclear on whether preventive responses arising from the disaster were actually taken.

Results

Out of a total of 21 disasters that met the inclusion criteria, 17 (81%) were identified as having at least one memorial (six had a single one and 11 had multiple ones). We could not directly visit two memorials: the Kopuawhara flash flood memorial is located on private land and had no public access; and one was extremely remote in the Chatham Islands (the sinking of the *Loch Long* memorial). However, photographs of these two memorials' plaques were identified online and data were extracted for analysis.

Of the 17 memorials, most (76%) gave the number killed, but only 38% reported non-fatal injuries when these were known to have occurred (Table 1). A description of the disaster's cause was typically very brief (53%), occasionally detailed (18%) and sometimes missing entirely (29%). Any subsequent actions that were taken to prevent the reoccurrence of the disaster were mentioned on only two memorial sites (12%), with this being on information boards for both. Further results details are available on request from the corresponding author.

Discussion

From this survey data it appears that memorials to New Zealand's largest sudden mass fatality events are frequently lacking key information on epidemiological and subsequent preventive actions. Indeed, subsequent preventive actions were only detailed for two of the 17 memorials. We suggest that this lack of information may be a lost educational opportunity for the public given that disasters can sometimes result in a society adopting new safety laws and other system changes. Such safety improvements have almost certainly contributed to the massive decline in transport-related disasters in New Zealand: at sea, on rail

and in air transport.² In particular, other researchers⁸ have detailed progressive legislative responses to numerous major disasters in New Zealand, eg, the Seacliff fire, the Ballantyne's fire, the Pike River Mine explosion and both the Hawke's Bay and Canterbury earthquakes.

Specifically linking memorials with attempts at disaster prevention education has been done with some international disaster memorials. For example, in Japan, the Mt Unzen Disaster Memorial Hall is a museum "dedicated to preserving for posterity the lessons from the Mt Unzen Heisei eruption".⁹ Its facilities are designed "to raise people's consciousness in regard to disaster prevention...".⁷ There may also be scope for online sites to assist with memorialisation and its potential therapeutic aspects as per a study of two major disasters in the US.¹⁰ There is also an emerging pattern of 'disaster tourism' covering both memorials and online content,¹¹ which may have educational benefits.

Care with memorial design is needed as one author argues that while memorial messages may contribute to resilience, "memorial messages demand delicate handling, they require good coordination and in-depth attention to the complexity of individual situations".¹² The need for extensive community consultation around memorial development has also been articulated.¹³ There is also a critical need to understand and consider the place of memorials within Te Ao Māori, eg, the use of pou maumahara (memorial carving) as per a recent war memorial example.¹⁴ Such considerations are all relevant if New Zealand: (i) builds a memorial related to the victims of the Christchurch mass shooting in 2019; and (ii) follows through on a proposed NZ\$3 million national Erebus memorial.

Competing interests:

Nil.

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