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New Zealand Search and Rescue fatality data: Creating targeted prevention messaging.

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Abstract

Introduction: Whitireia New Zealand were commissioned by New Zealand Search and Rescue (NZSAR) to undertake a thorough analysis of all NZSAR related fatalities between April 2010 and July 2017. The purpose was to provide a high level overview of all fatalities, in-depth analysis of recreational fatalities and provide recommendations for prevention messaging where appropriate.

Method: The NZSAR data was comprised of 1542 cases with 42 fields. Missing data were evident in the majority of cases. Cases were coded into one of six prescribed categories: Land, Water, Wanderer, No incident/false alarm, Out-of-scope (suicide, criminal, disaster victim identification (DVI), aviation and outside SAR region), Uncertain. Land, Water and Wanderer fatalities underwent full demographic and thematic analyses, while Out-of-scope, No Incident/false alarm data received full demographic analysis and partial thematic analysis, where the data allowed.

Results: Annual fatality numbers remained constant. Gender disparity was evident (66% male). Land-based activities resulted in 194 fatalities. Five activities were most frequently associated with fatal events and accounted for 75% of the land-based fatalities: tramping (29%), hunting (15%), walking (12%), mountaineering (11%) and commercial (8%). Falls (31%), drownings (26%) and medical events (24%) accounted for 81% of fatalities. Water-based activities resulted in 320 fatalities, with boating (30%), commercial (27%) and swimming (22%) resulting in 79% of deaths. Eleven fatal wanderings fell into two distinct cohorts; children (45%) and the elderly (55%). Drowning was indicated in the majority of child wanderers (80%). Out-of-Scope activities resulted in 452 deaths, with suicides (41%) and DVI cases (40%) the most common.

Conclusions: Recommendations include the use of buoyancy devices when engaged in any activity close to water, education around falls prevention targeting tramping and mountaineering clubs,

providing an emergency position indicating radio beacon (EPIRB) to each person on board a vessel, and education to specifically target Māori and Pacific communities in relation to water safety.

Keywords: Search and Rescue; Fatality; Prevention; Land; Water.

Introduction

Outdoor recreation is popular in New Zealand, and is promoted as an accessible and relatively low-cost activity to encourage 42% of New Zealanders who are insufficiently physically active (World Health Organisation, 2018). However, in a country as geographically diverse as New Zealand, outdoor recreation does present risk of injury and death. In the event of remote accidents, injury or missing persons, New Zealand Search and Rescue (NZSAR) teams are at the forefront of survivor recovery.

New Zealand presents unique and challenging terrain for both recreational activities and provision of search and rescue services. The number of rescue helicopters in New Zealand per km is approximately ten times that of Australia demonstrating New Zealand's diverse and difficult terrain (Ministry of Health, 2018). The Search and Rescue (SAR) sector is led by the New Zealand Search and Rescue (NZSAR) Secretariat who provide a link between the operational and strategic roles of New Zealand SAR. They support and advise the NZSAR Council who in turn provide high level oversight. They also provide leadership to the NZSAR Consultative Committee, comprised of a wide range of NZSR stakeholders including the Rescue Coordination Centre (RCC) and NZ Police.

The RCC and NZ Police provide operational coordination for the more than 11,384 people who assisted in search and rescue responses in 2016-17. The responders, 94% of which are volunteers, attended 2,643 incidents in 2016 –17 (NZ Search and Rescue Council, 2017).

SAR responses are led by one of two coordinating authorities. Category One incidents are coordinated by NZ Police, usually at a local level and involve land and close-to-shore marine SAR operations. Category two incidents are coordinated centrally by the RCC for incidents typically involving missing aircraft or vessels, tracking distress beacons and international search and rescue operations. RCC monitors a 30 million km² search rescue area around New Zealand, from the South Pole to Tokelau and half way to Chile (Rescue Coordination Centre New Zealand, 2017).

Whitireia NZ were commissioned by NZSAR to undertake an analysis of all NZSAR related fatalities between April 2010 and Jul 2017. The aim of the study was to provide a high-level overview of all fatalities, in-depth analysis of recreational fatalities and provide recommendations for prevention messaging where appropriate.

Literature Review

Accident reports and safety messaging

International

There are few if any published studies which present backcountry fatality data for an entire country. Most focus on a specific range of activities or geographical region, with the result that only a portion of total deaths are reported.

A study in the United States (US) presented data from a five-year period (1989 to 1993 inclusive) for victims attended by the Reach and Treat team servicing Mount Hood wilderness area (Schmidt et al., 1996). Fatality statistics were not given, but it was reported that six missions were for body retrievals. In Austria, changes in injury patterns of victims attended by the helicopter-based emergency medical system (HEMS) were compared over two three-year periods from 1998 to 2003 (Kaufmann et al., 2006). However, the fatality data was coupled with those who were categorized as 'critical, survival uncertain', meaning that the specific number of deaths was not stated. An analysis of sixteen years' worth of Search and Rescue (SAR) data (1992 to 2007 inclusive) from missions in National Parks in the US included fatality data (Heggie & Amundson, 2009). In the United Kingdom (UK) a study analysed mountain rescue casualties for the period from 2002 to 2006 and presented a breakdown of injury types, but excluded fatality data (Mort & Godden, 2010). In an Italian study, SAR records were used to identify injury and fatality trends in a particular sub-alpine region over the twenty year period from 1992 to 2012 (Ciesa et al., 2015).

New Zealand

Outdoor safety messaging in New Zealand has historically been undertaken by a variety of organisations. In 2009, a number of these organisations collaborated to create AdventureSmartNZ (AdventureSmart New Zealand, 2020), the purpose of which was to provide consistent safety messaging for land, snow, water, boating and air activities. The AdventureSmart website also provides a central repository where links to the foundation organisations can be accessed.

In 2016, the New Zealand Mountain Safety Council (NZMSC) published 'There and Back: An exploration of outdoor recreation incidents in New Zealand'. This was the first major publication which presented comprehensive injury and fatality statistics relating to outdoor activities, with the fatality data covering the seven-year period from 2007 until 2014. The data was split into five main categories: tramping; hunting; mountaineering; mountain biking; and trail running. Fatality statistics in the report were taken from coronial data. This is to date the only wide-ranging publication analysing land-based activities in New Zealand.

Previous studies looking at New Zealand fatality or injury data have focused on a much narrower range of activities, such as the relative mortality risk for alpine climbers in Aoraki/Mount Cook National Park (Malcolm, 2001). Malcolm's fatality data came from the Mountain Safety Council (MSC), the Department of Conservation and records from the NZ Coroner's office. Similarly, Monasterio, (2005) described the patterns and severity of injuries to alpine climbers, including fatalities. Visser & Campbell (2014) looked at records from Police SAR databases to determine which injuries were most prevalent in victims tended

by SAR responders. Another study analysed causative factors leading to accidents and fatalities in 'led outdoor activities', that is activities typically facilitated by a professional organization for education purposes (Salmon et al., 2014). The data, which spanned the five-year period from 2007 to 2011 (inclusive) included six fatalities.

With regards water-based activities, Water Safety New Zealand publish an annual 'Drowning Report'. In a similar manner to AdventureSmartNZ, Water Safety NZ was formed by an association of organisations within the water safety sector to provide a central and consistent safety messaging voice. Members of the public can access consensus statement safety messages from, and web links to member organisations.

Maritime New Zealand produced the Safer Boating Guide, which provides clear, evidence-based messaging for members of the public (Maritime New Zealand, 2017). The guide advises that lifejackets should be worn at all times, and that two forms of waterproof communication devices should be carried, preferably tethered to the skipper. Water Safety NZ works closely with Māori groups and communities to promote meaningful and applicable messaging to people of Māori ethnicity who engage in water-based activities (Water Safety NZ, 2019). Additionally, AdventureSmartNZ provide a Te Reo (Māori language) version of the Boating Safety Code.

A small number of studies have investigated specific water-based activities. Bailey (2010) compiled a list of 50 sea kayaking incidents which occurred between 1992 and 2005, which included 14 fatalities. O'Hare et al. (2002) published a paper on mortality and morbidity in white water rafting in NZ. And Bentley and Page (2008) presented a decade's worth of injury data from the NZ Adventure Tourism sector. None of these studies had an overlapping data collection timeframe as our study, nor did they use the same databases, although they were reporting on some of the same types of fatalities.

To the best of our knowledge, our study is the first to analyse fatality trends from Police and SAR databases for all land-based activities which generated a SAR activation. It also appears to be the first to present NZ data for virtually all water-based deaths (excluding those occurring in swimming pools), as it would be very unusual for a water-based incident resulting in a fatality not to trigger a SAR activation.

Method

The initial data was comprised of 1542 events between April 2010 and July 2017 where NZSAR were activated and one or more fatalities were reported. NZSAR merged the Category One and Two databases, which provided the raw data for this study. The database contained approximately 43 fields, many of which were incomplete. Two fields provided a narrative description of the event. Narratives lacked uniformity, ranging from 2000-word descriptions to no given narrative. The database was cleaned to allow meaningful analysis, and cases were initially divided into six prescribed categories:

1. Land
2. Water
3. Wanderer
4. No incident/false alarm
5. Out-of-scope (suicide, criminal, disaster victim identification (DVI), aviation, outside SAR region)
6. Uncertain – for cases that did not clearly fit into one of the above.

Land, Water and Wanderer fatalities were considered to be within scope and were the subject of full analysis. Suicide, criminal, DVI, aviation, out-of-region and no incident NZSAR activations were considered out-of-scope but were still the subject of full descriptive demographic analysis and partial thematic analysis, where the data allowed. Events categorised as 'uncertain', were discussed in order to establish categorisation by consensus. The 72 cases that could not be categorised due to a lack of information were then referred back NZSAR. NZSAR made the decision to exclude these cases from the analysis due to a lack of accurate information.

Land-based classification

Fatalities were coded as land-based when death occurred while the victims were intentionally engaged in land-based activity. For example, a person who intended to walk along a riverbank, slipped into the water and drowned would be included in this category, because their primary intention was walking. Similarly, a person who was walking, but then entered the water while attempting to rescue someone else and drowned would also be included in this category, as the primary intention of the victim had been recreational walking.

Water-based classification

Fatalities were coded as water-based when death occurred while the victims were intentionally engaged in water-based activity. This category included: boating, swimming, snorkelling, kayaking, self-contained underwater breathing apparatus (SCUBA), fishing and net setting. 'Boating' included vessels of all sizes that were engaged in a recreational activity, from large fishing vessels to the smallest dingy. Jet skis were also in this category. 'Swimming' related to fatalities where the intention was swimming for recreation, while any activity that involved breath-holding, and use of a mask and flippers (with or without a snorkel) was categorised as 'snorkelling'. SCUBA was the term chosen for those engaged in underwater diving activities that involved compressed air tanks (or other gas mixtures). 'Net setting'

was a category that emerged from the data, and involved checking or retrieving nets in tidal waters or river mouths, while 'Fishing' was for those who were engaged in fishing with a rod and line (fly-fishing or surf-casting), but were not involved in any other category.

Wanderers

Wanderers were defined as people of impaired cognitive capacity, associated with age, special needs or dementia and who left their last location without permission of their carer. All wanderer events involved a multi-agency activation, with many personnel engaged in the NZSAR response.

Categorisation

The located fatalities (883 cases) were then categorised by activity using a coding system, which indicated whether they were in-scope or out-of-scope. In-scope fatalities (431 cases) were assessed for sub-activities, cause of death and associated trends. Out-of-scope fatalities (452 cases) were sub-categorised by cause with a high-level overview provided. Following categorisation, demographic and thematic analyses were completed on each category, creating a demographic profile of victims while identifying trends and patterns from the narrative descriptions.

Terminology and missing data

The terminology used throughout the analysis, particularly in relation to ethnicity and behaviour, reflects the data labels used within the database. Demographic data was often empty, unclear or inconsistent and frequently unable to inform analysis. The database narratives and publicly available sources were used in an attempt to consolidate the data, although confirming data definitively using coronial reports was beyond the scope of the analysis.

Authors	Year	Years covered	Theme	Fatality data	Region	Notes
Schmidt et al.	1996	1989-1993	Various wilderness activities	Reach and Treat team mission records	US	
Malcolm	2001	1981-1998	Mountaineering	Department of Conservation (DoC), Mountain Safety Council (MSC) and Coronial files	NZ	
O'Hare, Chalmers, Arnold & Williams	2002	1983-1996	White water rafting	NZ Health Information Service (NZHIS)	NZ	
Monasterio	2005	Not specified	Mountaineering and rock climbing	MSC, DoC and self-reports from participants	NZ	Survey of participants with a follow-up survey four years later
Kaufmann, Moser and Lederer	2006	1998-2003	Various mountain-based activities	Helicopter-based emergency medical system (HEMS)	Austria	Fatality and 'critical, survival uncertain' data coupled together
Bentley & Page	2008	1996-2006	Adventure tourism	NZHIS and the Accident Compensation Corporation (ACC)	NZ	
Heggie and Amundson	2009	1992-2007	Various National Park-based activities	SAR database	US	
Mort & Godden	2010	2002-2006	Various hill country-based activities	Not included	UK	
Bailey	2010	1992-2005	Water; sea-kayaking	Various sources	NZ	
Visser & Campbell	2014	2010-2011	NZSAR operations	NZ Police SAR database	NZ	
Salmon et al.	2014	2007-2012	Various 'led' outdoor activities	New Zealand Outdoor education/Recreation National Incident Database (OER NID)	NZ	
Ciesa, Grigolata and Cavalli	2015	1992-2012	Various pre-alpine region activities	SAR database	Italy	

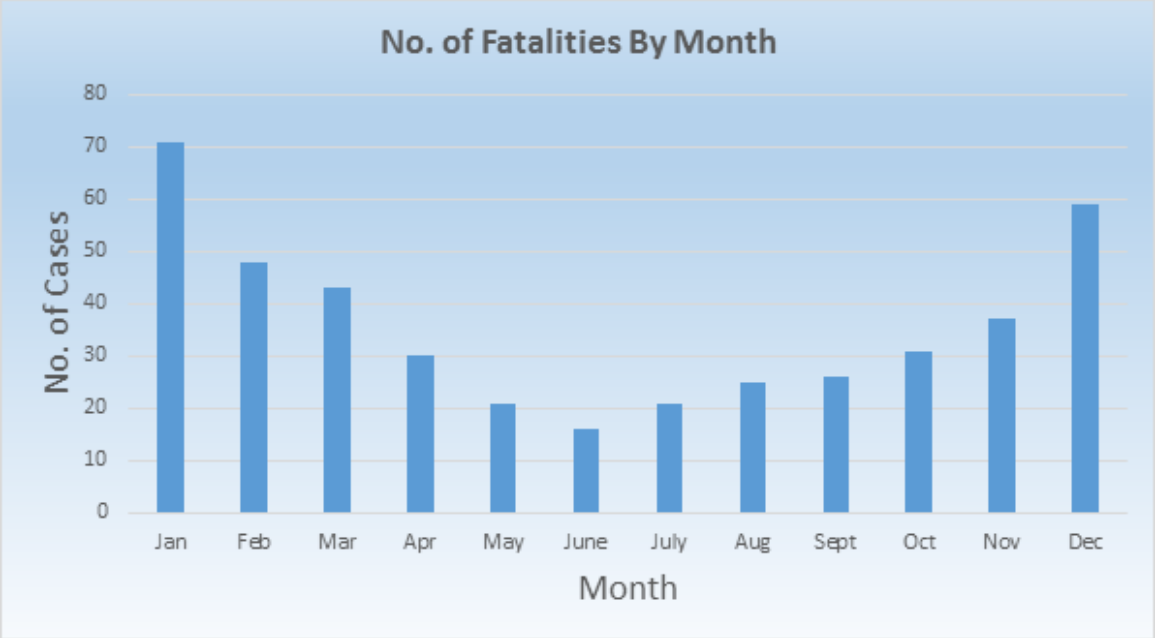
Table 1: *Studies involving injury and fatality data for outdoor activities*

Results

Of the 1542 NZSAR activations resulting in either no person located or a recorded fatality between April 2010 and July 2017, 883 involved at least one located fatality. Of these, 431 were categorised as 'In-Scope' (land, marine or wanderer), with 452 'Out of Scope' (suicide, criminal, disaster victim identification (DVI), aviation and outside SAR region). The remaining 659 cases were either not located, had no available information or were duplicates. Males accounted for 66% of all located fatalities. There was no significant difference in the number of fatalities by year. There was a clear increase in all fatalities during the warmer months of the year, due to an increase in outdoor recreation during this time (see Figure One)

Land-based activities

Figure 1: Total located NZSAR fatalities between April 2010 and July 2017 by month



Land-based activities resulted in 194 fatalities with a mean age of 45.2 ± 18.6 years. Males represent 75% of all fully documented land-based deaths. The majority of the deceased were engaged in walking activities such as: a multi-day tramping; day walks; dog walking; exploring coastal rocks (or similar) or fishing from land. In the case of those walking across rocks, the main cause of death was drowning after the victims were swept off the rocks by a large wave or slipped and fell into the water. Activities were initially assigned to one of twelve overall categories (see table 2), using the definitions as listed below.

Activity	*No. of Deaths*	*Percentage of Deaths*
tramping	**56**	**29%**
hunting	**29**	**15%**
walking	**23**	**12%**
mountaineering	**21**	**11%**
commercial	**15**	**8%**
other	**14**	**7%**
fishing	**10**	**5%**
riding	**7**	**4%**
intoxication	**7**	**4%**
skiing	**5**	**2%**
vehicle	**5**	**2%**
running	**2**	**1%**
TOTAL	**194**	

Table 2: *Land based activity resulting in death*

Land based fatalities were then analysed to determine how the activity ultimately resulted in death. The majority of land-based fatalities resulted from falls (30%), including many backcountry falls, where trampers, hunters and mountaineers fell to their deaths, and also falls from cliffs in urban areas. Only 2% of all land-based activities were recorded as a result of hypothermia. Fifty one land-based deaths occurred due to drowning (26%), further broken down into sub-categories (table 3).

Specifics of Drowning Deaths	*No. of Deaths*	*Percentage of all Land-based Deaths*
crossing river	**15**	**29%**
swept off rocks	**11**	**22%**
fell into water	**8**	**15%**
swept out to sea	**7**	**14%**
other	**10**	**20%**
TOTAL	**51**	

Table 3: *Breakdown of land-based drowning fatalities*

Medical events were the third highest cause and accounted for 46 deaths (24%). It is impossible to determine with certainty the exact medical cause from the database, but from the narrative it is clear that few were survivable unless they had occurred within a few minutes of a Tertiary Hospital.

Water-based activities

Water-based activities resulted in 320 fatalities with a mean age of 38.1 ± 17.9 years. Sixty-six percent of water-based fatalities were male. It is difficult to draw meaningful conclusion regarding ethnicity, as 36% of the data was either missing or inaccurate. However, Polynesian and Māori were over-represented accounting for 24% of the known deaths compared with 22% of the population (Statistics New Zealand, 2018). Table 4 shows the number of fatalities by water-based activity.

Activity	*No. of Deaths*	*Percentage of Deaths*
recreational boating	**96**	**30%**
commercial	**85**	**26%**
swimming	**71**	**22%**
snorkelling	**16**	**5%**
kayaking	**15**	**4%**
SCUBA	**14**	**4%**
net setting	**13**	**3%**
unknown	**4**	**1%**
fishing	**3**	**<1%**
other	**3**	**<1%**
TOTAL	**320**	

Table 4: *Fatalities by water-based activity.*

Of the recreational boating fatalities, 62% occurred in a coastal environment (less than five kilometres from the coast of mainland New Zealand), 28% in blue water (more than 5 kilometres off the coast) and 10% in fresh water lakes or rivers. A breakdown of factors contributing to all water-based fatalities was limited due to missing data. Nevertheless, data from 116 fatalities (36%) are detailed in table 5.

Contributing factors	*Number of Deaths*	*Percentage of Deaths*
swept out to sea	**35**	**30%**
no life jacket	**18**	**15%**
alcohol or drugs	**13**	**11%**
medical	**12**	**10%**
jumping	**9**	**8%**
inexperienced	**6**	**5%**
bad weather	**5**	**4%**
other	**18**	**15%**
TOTAL	**116**	

Table 5: *Factors contributing to water-based deaths.*

Wanderers

Eleven fatalities were as a result of wandering incidents. Wanderers fell into two distinct age categories, children (45%) and the elderly (55%). Following thematic analysis, it was identified that both age categories were associated with distinct behaviour and terminology. Therefore each age group was analysed independently.

Children

The children involved in fatal wanderer events were aged between three and 11 years of age, predominantly male, with 80% of Māori or Polynesian decent. Of the five child wanderers, three were known to be autistic. Three were reported missing from their homes, while two absconded during recreational activities with their families. All were under the care of at least one family member at the time of their disappearance. All child wanderers were located in close proximity to their last known location. Eighty percent drowned in water hazards known to the child.

Adults

The adults involved in fatal wanderer events were aged between 64 and 87 years of age, male and were either of Māori, Asian or Caucasian decent. Of the six adult wanderers, all were known to suffer from dementia. All were reported missing from their family home or an aged care facility.

Adult wanderers were located in a variety of locations, some within the immediate vicinity of their last known location, and others up to 22 kilometres away. Fifty percent drowned after falling into water hazards. The remainder died as the result of accidental trauma or were not found.

Out-of-scope activities

Deaths attended by NZSAR that fell outside the remit of the study were defined as 'Out-of-scope'. There were 452 out-of-scope events, which represented 29% of deaths within the database. These fatalities were the subject of demographic analysis to provide frequency data and context. The fatality events fell into seven broad categories: Disaster Victim Identification (DVI); Suicide; Outside the NZSAR geographic region; Aviation; Criminal; Commercial; and Unknown (table 6). Fatalities were assigned to each category primarily on the basis of the person's activity at the time of death, or where this was unknown, on the basis of NZSAR involvement.

Activity	*No. of events*	*Percentage of Out-of-Scope events*
Suicide	**187**	**41%**
DVI	**183**	**40%**
Aviation	**44**	**10%**
Outside Region	**25**	**5%**
Criminal	**8**	**2%**
Commercial	**3**	**1%**
Unknown	**2**	**1%**
TOTAL	**452**	

Table 6: *Out-of-scope fatalities*

Discussion

Land-based activities

In many instances, the distinction between tramping and walking is problematic. Tramping was defined as a walking excursion that involved any of the following: remote or sub-alpine terrain; a multi-day outing; or terrain that was otherwise challenging enough to resemble the rugged terrain typically associated with the backcountry. The 56 tramping deaths in this study is comparable with the 45 fatalities over 7.5 years recorded in the MSC report (Mountain Safety Council, 2016).

"Lost footing. Couldn't self-arrest. Fell to death." In North America this sequence results in death so frequently that it has become an official phrase (Gonzales, 2003). The highest proportion (31%) of the Land-based deaths were secondary to falls, and it is reasonable to assume that many of the accidents occurred due of the mechanism described above. New Zealand's sub-alpine zone, typically occurring between 1200 and 1500 metres, consists of challenging terrain that can be as dangerous as the high mountains, while not appearing to be so (Mulheron, 2015). Sub-alpine terrain lends itself to slips and falls, which are then more likely to have fatal consequences. This may be because it is accessible to those who are less experienced, and partly because of the rugged and uneven terrain.

McCammon (2001) describes two types of backcountry learning environments: the first is where feedback from decisions is *progressive*; and the second is where it is *catastrophic*. In the latter setting the decision to cross a marginal river, for example, is an 'all-or-nothing' venture; either the party are capable of the crossing or they are not. McCammon emphasises that "…catastrophic environments are poor places to learn through trial-and-error" (p. 8). A marginal rise in river level can create a catastrophic learning environment due to an unexpectedly large increase in water force: this acts both directly by applying force to the person crossing, and indirectly by decreasing foot traction on the river bed secondary to increased buoyancy (Federated Mountain Clubs, 2012).

Hypothermia was a leading cause of death in remote New Zealand prior to the 1960s (Tararua Tramping Club, 1991), but has become proportionally less common (2% of NZSAR land-based fatalities). The reasons for this decrease are multifactorial, but include: improvements in outdoor clothing; decreased rescue times; increased performance abilities of rescue helicopters; improvements in weather forecasting; and the advent of specialised rescue teams which are able to operate on narrower safety margins, according to a conversation with an expert in outdoor recreation (Barnett S 2017, personal communication). The 'Trauma Triad of Death' is a term coined to describe the lethal combination of hypothermia, acidosis and coagulopathy which can lead to a vicious downward spiral for trauma patients with significant bleeding (Mitra et al., 2012). However, in the last 20 years substantially more of these patients have been surviving, largely due to early access to advanced medical care at tertiary trauma hospitals (Mitra et al., 2012).

Water-based activities

Kalafatelis et al. (2014) suggest that females are more likely to place importance on checking marine weather forecasts, avoiding alcohol and have a higher regard for lifejacket use than male recreational boaters. Their data also show that participation rates for recreational boating are higher for males (35%)

than females (22%). It was therefore expected that NZSAR recorded deaths for males would be higher than females, however a death rate of 5% for females is significantly lower than anticipated. The Watersafe organisation presents similar numbers, consistently reporting that over the past seven years, approximately 80% of drowning victims are male (Water Safety NZ, 2017). Males exhibit more risky behaviour than females (Harris et al., 2006), and among those who participate recreational boating, men have been identified as more likely to boat alone (Kalafatelis et al., 2014)

The majority of boating deaths were as a result of the vessel capsizing. In a number of cases those involved had floatation devices and/or emergency position indicating radio beacons (EPIRBs), but were unable to use them because of the speed of the event (EPIRB underneath capsized hull or swept away). Carrying an avalanche transceiver in a pack, rather than on your person, can result in failure due to the device not being accessible, or not in proximity to the victim if their pack is torn off. This is a similar issue to the EPIRBs being available, but not accessible after a capsize event. Avalanche transceiver manufacturers therefore recommendation having them attached to your person, not stowed in your pack. A similar recommendation might be prudent for recreational sailors.

Wanderer fatalities

Wanderer fatalities represented a small proportion of those contained within the NZSAR database but resulted in a substantial investment in terms of time and resources. All wanderer events, and especially those involving missing children, triggered a multi-agency response coupled with a substantial community involvement. The time between the wanderer being identified as missing and the emergency services being informed varied widely, from almost immediately to five hours after the disappearance. This was not associated with the age of the wanderer or whether the wandering originated from a home location or elsewhere. Social media was often also used to alert the community and distribute information. All adult wanderers had impaired cognitive capacity, but there was no indication of negligence on behalf of those responsible for their immediate care.

While the narratives contained within the database are written with appropriate objectivity and detachment, there is a tangible sense of distress and disappointment at the death of a missing child. Although an occupational hazard, attending such events has significant mental health implications for attending personnel (Collopy et al., 2012). Appropriate resources should be made available to NZSAR and emergency services personal in order to manage the personal impact of being involved in such traumatic events.

Out of Scope

The out-of-scope fatalities represented a large proportion of the total number of fatality events involving NZSAR. Of the seven broad categories that comprise the OS data, fatalities identified as suicides were the most prevalent, resource intensive and time consuming. Many involved extensive land searches involving NZSAR and community volunteers, body recovery from remote or inaccessible locations, or unpleasant and traumatising recovery of remains following impact suicides. NZSAR involvement was often triggered by reports of a missing person, eventuating in a suicide recovery. Demographic analysis has identified an over representation of New Zealand Caucasian males in all out-of-scope

subcategories where the data is available. Previous research has identified that men are at far higher risk of suicide than women (Freeman et al., 2017), which supports the NZSAR data, whereas little information exists on gender disparities among the natural deaths requiring DVI.

Limitations

The database was comprised of routinely collected data, which was often incomplete. It was beyond the scope of the study to corroborate information with other databases such as coronial data or hospital records. The database only includes deaths involving a NZSAR response and does not capture all outdoor recreation related deaths. Activity categorisation was based on expert opinion and understanding of the literature, as there is no standardised definition of tramping and walking, or different types of boating. This study represents deaths in the unique terrain and population of New Zealand and results are not necessarily generalizable internationally.

Recommendations

Public messaging

1. Specifically target the Māori and Pacific communities in relation to water safety.
2. When boating, always wear a floatation device; put it on prior to getting onto the boat and only remove it once back on land.
3. The skipper of any boat to carry an EPIRB on their person at all times.
4. An EPIRB or personal locator beacon (PLB) be carried by each boat crew member, especially those engaged in blue water travel (more than 5 km off the coast).
5. Use buoyancy devices when planning to engage in an activity on the rocks or on a riverbank, such as fishing, surfcasting or exploring cliffs.
6. Use buoyancy devices when net setting or fishing on estuaries or at river mouths regardless of the perceived water depth
7. Create an education programme around fall prevention for trampers, day walkers and mountaineers.

NZSAR messaging

1. When searching for wanderers, immediate water hazards such as swimming pools, rivers or coastlines should be an urgent priority.
2. When searching for child wanderers, inaccessible locations (such as well secured private swimming pools) should not be discounted.
3. Ensure NZSAR staff have appropriate resources for managing the psychological impact of trauma.

Conclusions

The data highlights the importance of buoyancy devices whilst undertaking both water and land-based activities, including net-setting and fishing from rocks. Immediate water hazards are associated with wanderer fatalities, while falls and slips are associated with land-based fatalities. While the database was incomplete, with missing data skewing all analyses, the data suggests that significant fatality rates are present for Māori and Pacific peoples in water recreation, and that water safety advice should be targeted towards these specific populations.

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Abbreviations

DVI	Disaster Victim Identification
EPIRB	Emergency Position Indicating Radio Beacon
NZ	New Zealand
NZSAR	New Zealand Search and Rescue
PLB	Personal Locator Beacon
RCC	Rescue Co-ordination Centre
SAR	Search and Rescue
SCUBA	Self Contained Underwater Breathing Apparatus

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