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Accident and fatality characteristics in a population of mountain climbers in New Zealand

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Abstract

Aim To examine demographic, morbidity, and mortality findings in a population of mountain climbers in New Zealand.

Methods A baseline survey and a 4-year follow-up took place among a population of mountain climbers. The purpose of this survey was to determine the frequency and characteristics of mountain-climbing accidents and to estimate the climbing-related death rate.

Results Forty-nine climbers enrolled in the study. Baseline findings revealed that 44 (90%) climbers had been involved in the sport for more than 5 years and 23 (47%) climbers had been involved in a total of 33 accidents. At 4-year follow-up, results were available on 46 (94%) climbers. There were nine further accidents and four deaths from climbing misadventure.

Conclusion Mountain climbing is associated with a high risk of serious injury and mortality.

Mountaineering and alpine rock climbing activities are considered by the general public to be high-risk endeavours. Historically climbing attitudes have tended to be strongly influenced by 19th Century values of discipline, self-denial, cooperation, and romanticism.[1] However, over the past 15 to 20 years, attitudes have shifted as commercial and market pressures have become more pronounced. Guided ascents to most major climbing areas in the World are now available to fee-paying clients.

Several adventure climbing companies offer novices guided ascents of the World's highest peaks, such as Mount Everest, for a fee of NZ$50,000 to NZ$65,000. Despite well-publicised disasters such as the 1996 Everest tragedy where five climbers (from two commercial expeditions) died, the number of clients continues to increase.[1]

Recently, significant media attention has focused on 13 reported climbing fatalities in Mount Cook National Park (MCNP) and on Mount Aspiring in the South Island of New Zealand.[2] Many of the fatal accidents have involved experienced, senior guides and their clients—as well as experienced mountaineers.[3] Four guides (constituting 10% of qualified New Zealand mountain guides) died from climbing misadventure during 2004.

A search of the medical and climbing literature revealed several studies that have estimated death rates associated with mountaineering in different settings. Malcolm examined fatality data from the New Zealand Mountain Safety Council and the Mount Cook Field Office of the Department of Conservation between July 1981 and June 1995.[4] There were a total of

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46 deaths due to mountaineering misadventure and Malcolm estimated the fatality rate to be 1.87/1000 climbing days in MCNP.

Malcolm concluded that the risk of death from climbing in MCNP was 5000 times greater than from work-related injuries in New Zealand. Pollard et al examined data from an international mountaineering journal between December1968 and December 1987 and estimated that the death rate of British climbers on peaks over 7000 metres high was 4.3 per 100 mountaineers.[5] These results support the view that mountain climbing is associated with a high risk of death. However, the data is limited and open to bias as it estimated death rates by examining fatality statistics of climbers in specific, particularly dangerous mountain regions. Furthermore, the research did not prospectively examine a population of climbers and therefore caution must be exercised in generalising from the results.

To our knowledge, there are no past or current studies examining accident and fatality rates in climbing populations. The purpose of this paper is to report the demographic characteristics, morbidity, and mortality findings in a prospective survey of a group of climbers. Baseline and 4-year follow up reports are provided. The results are from a study that examined the psychological characteristics in a population of mountain and alpine rock climbers. The psychological characteristics of the study population have been reported in a climber's journal publication and are available from the author.[6]

Method

Subjects were a diverse group of climbers enrolled into the survey on a voluntary basis. They were recruited from local Alpine Club meetings, adventure magazine advertisements, and from personal communication among the climbing community. Subjects in the study were involved in mountaineering and alpine rock climbing sports.

Subjects agreed in writing to participate in the study and responded to several pen-and-paper questionnaires providing information on age, gender, marital status, number of children, and number of years involved in climbing.

The Hospital Anxiety and Depression Scale and the Cloninger Temperament and Character Inventory were also completed.[7]

Subjects were asked whether they had suffered serious climbing accidents. Severity of accidents were rated as either:

- Mild—if injury required medical help, but did not lead to hospital admission and convalescence was less than 1 week,
- Moderate—if injury required hospital admission and/or convalescence was more than 1 week, but less than 3 months, or
- Severe—if injury led to risk of death, protracted convalescence (more than 3 months) and/or long-term health problems.

Rock climbing grades were rated according to the Australasian Ewbank system (5 to 34), where grade '5' indicates trekking through rough terrain. Above grade '10', ropes and security devices are recommended. Grades above '18' require a significant degree of technical skill. (Generally the higher the grade, the greater the technical challenges and risks assumed.)

Mountaineering climbing grades were rated according to the New Zealand and Australian system (1 to 7). For grade '3', technical climbing equipment (such as ice axes, crampons, security equipment, and a rope) are required. Grade '5' involves sustained technical climbing, which may include vertical sections of ice climbing. Grade '6' involves climbing vertical sections of ice with poor protection for the climber. Grade '7' is possible but is as yet unaccomplished. Subjects were followed up 4 years after baseline data

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was obtained. Subjects were interviewed in person, over the telephone, or via email and data collected on accident and death statistics.

A serious omission of the study was the failure to collect specific data on risk exposure, beyond a baseline estimation of climbers who had previously climbed in "high-risk" situations (defined in the discussion section).

Results

Baseline demographic findings are summarised in Table 1.

There was a good response rate—49 out of a total of 60 questionnaires handed out were returned completed. 44 subjects (90%) were male. The median age at the start of the study was 33 years and generally participants were involved in the sport more than 5 years. The median rock-climbing grade was '23' and the median alpine grade was '5'.

Results at baseline revealed that 23 (47%) climbers had been involved in a total of 33 accidents (Table 2). There were 10 severe, 16 moderate, and 7 mild accidents. Of those who had more than one accident, four participants were involved in three separate accidents and two were involved in two separate accidents.

At 4-year follow-up, results were available on 46 (94%) participants. There were five deaths—four related to climbing misadventure and one from a medical condition. Two deaths were caused by avalanche, and one from multiple trauma following a climber slipping and falling several hundred meters. The cause of the accident in the fourth climber is unknown. He was on his own and died from multiple-trauma after a fall.

Of the 44-surviving climbers seven (15%) had retired from the sport. There were nine further accidents (seven mild and two moderate) involving seven (15%) climbers.

Several attempts were made to contact the three study participants lost to follow-up. All these were non-New Zealanders who had left the country without providing a contact address. Their names were not recorded in the fatality reports of the New Zealand Mountain Safety Council and the Mount Cook Field Office of the Dept. of Conservation. Review of Internet data located one of the three participants, but unfortunately he did not reply to an email interview.

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Table 1 Baseline and demographic characteristics of study participants (N=49)

Age		Gender		Marital status		Years climbing				Climbing grade				Number of own children	
										Rock		Alpine			
Med	*Range*	*M*	*F*	*Si*	*Ma/ DF*	*1*	*1-3*	*3-5*	*5-7*	*Med*	*Range*	*Med*	*Range*	*Med*	*Range.*
33	(21-56)	44	5	25	24	0	2	3	44	23	(12-29)	5	(2-6$^+$)	0	(0-5)

Professional climbers/ guides	Amateur	Nationality		Climbing style		
		New Zealand	*Other*	*Rock*	*Mountaineer*	*Rock and mountaineer*
8	41	28	21	2	1	46

Med=Median; M=Male, F=Female; Si=Single, Ma=Married, DF=De facto.

Table 2. Accident characteristics of study participants

	MILD – N = (7)	MODERATE – N = (16)	SEVERE – N = (10)
Baseline	1. Frostbite to thumb 2. Frostbite to 3 fingers x2 3. Contusion/soft tissue injury to arm x2 4. Laceration to hand x2	1. Laceration to hand requiring x10 sutures 2. Ruptured anterior cruciate ligament requiring surgical repair 3. Fractured tibia and fibula 4. Fractured radius and ulna x2 5. Fractured ribs (2) 6. Compound wrist fracture x2	1. Compound fracture of femur 2. Skull fracture, rib fracture (3), humerus fracture 3. Spinal injury with fracture of multiple spineous processes 4. Fractured vertebrae 5. Compound fracture of ankle 6. Multiple tibia & fibula fractures

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		7. Concussion x2 8. Laceration to head with x12 sutures and concussion 9. First metatarsal fracture x2 10. Severe laceration to upper limb 11. Soft tissue injury to spine 12. 1st metacarpal, carpal and scaphoid fracture	7. Skull fracture with traumatic brain injury 8. Rib fracture (3), extensive head lacerations 9. Multiple lower limb fractures. Traumatic brain injury with 1 week coma 10. Mandibular and maxillary fracture
	N = 7	**N = 2**	
4-year Follow-up	1. Burn to arm 2. Contusion to hand 3. Contusion to arm 4. Contusion to abdomen and back 5. Tendon strain/soft tissue injury to ankle x2 6. Crevasse fall with contusions to upper and lower back	1. Rib fracture (2) 2. Femur fracture	

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Discussion

To the author's knowledge, this is the first prospective study reporting morbidity and mortality data in a population of mountaineers and alpine rock climbers. The study captured a population of serious, committed and experienced climbers, who had been involved in the sport for many years and had reached high levels of technical proficiency.

Ninety-six percent of participants estimated that (on at least two occasions) they had climbed in situations of high-risk. High-risk was defined as climbing in dangerous terrain (under unstable ice cliffs, over avalanche prone terrain and in crevassed glaciers), in dangerous weather conditions, or in situations were the climber did not feel fully confident in their abilities and where a climbing mistake would lead to significant risk of serious injury or death. (Mountaineers practice their sport in glaciated, dangerous environments and so generally this exposure to high risk is an inherent and unavoidable part of the sport.)

At baseline, 47% of climbers had been involved in accidents. Serious accidents involving multiple bone fractures, head, and spinal injuries were not uncommon and interestingly had not dissuaded many climbers from continuing to practice the sport.

A climbing-related death rate of 8.2% over a 4-year period is alarming, and supports other evidence that climbing is a dangerous sport. Mountaineering-related deaths in this study did not appear to be related to inexperience, as all fatal accidents involved participants who had practised the sport more than 5 years, and two who were qualified mountain guides.

All deaths appear to have been a consequence of the hazardous mountain environment. This is similar to Pollard et al’s study, which found that 70% to 80% of fatalities were related to environmental factors.[5] This study did not specifically examine the role that altitude-related problems (cerebral and pulmonary oedema) played on morbidity and mortality. However, given the relatively low altitude of New Zealand mountains (all under 4000 metres), the contribution was likely to be very modest.

There are a several methodological limitations that must be considered in interpreting the results of this survey. The main purpose of the study was to collect information on the psychological characteristics of climbers. As part of the study, demographic and accident data were also collected. The findings were therefore from a survey rather than a cohort study.

Data on climbing frequency over the study period was not obtained and so there was no measure of risk exposure to index to the rate of morbidity and mortality. The findings are therefore quite crude. Follow-up of participants was via a single telephone or email interview (4 years after baseline data was collected). This time length may have led to recall bias, as respondents were more likely to forget minor injuries and ‘near misses’ than major accidents and fatalities. It may account for the high death to injury ratio at follow-up and the high moderate-and-severe injury to mild injury ratio at baseline.

The relatively lower injury rate at follow up (compared to baseline) may be due to the fact that 15% of climbers had retired from the sport and that the participants were older and potentially less inclined to take risks.

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The population was not strictly a random sample. General difficulties in recruiting sufficient volunteers from a relatively uncommon sport (to make up a meaningful sample size) led to the inclusion of all climbers whom volunteered to participate in the study. This sample may represent a population of particularly high-risk-taking climbers, as 47% of the population at baseline had been involved in accidents yet persisted with the sport. It is also possible that more cautious climbers, who had given up the sport following an accident or a fear inducing experience, were no longer involved in climbing and so were not included. However, it is also possible that less experienced, more impulsive, and higher-risk-taking climbers were involved in fatal accidents at earlier stages of their climbing careers and so were excluded from the study.

This study examined the risks associated with mountain climbing—and despite the methodological limitations, the results are sobering. Serious injury and death not only contribute to considerable emotional and physical suffering and loss of productivity, but also to a significant burden on medical services. Urgent priority should be given to replication studies to further explore the relationship between mountaineering, morbidity and mortality.

The reasons that determine an individual's choice to climb mountains are complex. An adventurous spirit appears to be part of human nature and clearly mountain climbing provides participants with many positive experiences and enhanced physical and psychological wellbeing through regular participation in outdoor activities.

Interestingly, many participants in the study made unprompted positive comments about the benefits of climbing and seemed keen to point out that they chose to climb despite the perceived risks of the sport.

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