

**RETROSPECTIVE ANALYSIS OF DEATHS IN THE TABLE
MOUNTAIN NATIONAL PARK 2000-2011.**

By

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Declaration

I, SAIRITA MAISTRY, hereby declare that the work on which this dissertation/thesis is based in my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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List of abbreviations:

BMI:	Body mass index.
CO:	Carbon monoxide.
CPPNE:	Cape Peninsula Protected Natural Environment.
SANParks:	South African National Parks.
SAPS:	South African Police Service.
SRFPL:	Salt River Forensic Pathology Laboratory.
TMNP:	Table Mountain National Park.

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Part one: Literature review

Introduction:

National Parks: conservation and tourism locations

National Parks are found in a 100 countries worldwide and are primarily conservation sanctuaries.

National Parks contain natural, semi-natural or developed land with indigenous flora and fauna. Most are open to the public and provide opportunities for sightseeing and participation in recreational and sporting activities (en.wikipedia.org/wiki/National_park).

The popularity of a National Park depends on its geographic, botanic, scenic and cultural value, as well as the presence of a natural iconic landmark. These can include mountain ranges, active volcanoes, waterfalls, lakes, natural geysers, glaciers and forests. Some of the most famous National Parks are Yellowstone, Grand Canyon, Yosemite, Blue Mountain and our own TMNP (simple.wikipedia.org/wiki/National_park).

National Parks are preserves of nature and continue to attract large numbers of local and international visitors. A fitting example is the TMNP with an estimated 4.2 million visitors annually (George, 2003). While there are numerous safety measures in place, there have been sporadic media reports of incidents and fatalities in the TMNP (www.iol.co.za.../us-diplomat-falls-to-his-death-during-hike-1.162230; www.iol.co.za toll-rises-as-mountain-dangers-are-ignored-1.365853; www.news24.com News/Man-dies-in-Table-Mountain-fall-20110322).

This review will provide a description of the origin, geography and activities within the TMNP with the ultimate aim of investigating the causes and types of Park mortality. It is anticipated that the information obtained, will contribute to increased public health awareness and the prevention of adverse events.

The Table Mountain National Park:

The Table Mountain National Park (TMNP) was formally established in 1998. Prior to this, it existed as 30 000 hectares of land on the Cape Peninsula and was known as the Cape Peninsula Protected Natural Environment (CPPNE). But since then, larger parts of the Peninsula and the Table Mountain range were included within its infrastructure (www.sanparks.co.za; www.sanparks.co.za/parks/table_mountain/).

Unlike other National Parks, the TMNP does not occupy a single area; instead it stretches over approximately 25 000 hectares of urban, private and protected land and borders 1000km² of seas and coastlines. This large open access Park (Figure A) has over 100 entry points but only four managed pay points (www.sanparks.co.za/parks/table_mountain/).

For operational purposes, the Park is divided into the following sections:

- The Table Mountain section: includes Signal Hill, Table Mountain and Devil's Peak.
- Silvermine Tokai section: includes Constantia, Noordhoek and Fish Hoek.
- Cape of Good Hope and Cape Point.

The TMNP is controlled by the South African National Parks (SANParks) which was established in 1926 and is one of South Africa's leading conservation authorities. SANParks manages 3.7million hectares of protected land in 21 parks across the country; the oldest and largest being the Kruger National Park. In 2014, SANParks reported a 2.4% increase in visitor numbers, with a total of 700 000 visitors passing through the gates of the 21 Parks (www.sanparks.co.za).

The TMNP is a major conservation site in the Western Cape. The property has been included in the UNESCO Cape Floral Region World Heritage Site as it contains rare indigenous flora and bird species and a variety of endangered wildlife (www.southafrica.net/...article-busicness-tourism-unesco-world-heritage; www.sanparks.co.za/parks/table-mountain/conservation.heritage.php).

The Park is home to scenic forests (Cecilia Plantation, Silvermine, Newlands and Tokai forests) which are popular hiking and nature walk locations. Dams located at the Silvermine Nature Reserve, Karbonkelberg, Kirstenbosch National Botanical Gardens, Van Riebeck Park, Devil's Peak Quarry and Hely-Hutchinson's are popular swimming sites (www.sanparks.co.za/parks/table_mountain/).

The TMNP has a large number of beaches on its borders namely Llandudno, Noordhoek, Kommetjie and Scarborough, where scuba diving, swimming, fishing, wind and kite surfing are popular.

Boulders one of the more famous beaches, is located towards the south of the Park and is home to large colonies of African Jackass penguins (www.sanparks.co.za/parks/table_mountain/).



Figure A: Map showing the TMNP which extends from Signal Hill in the North to Cape Point in the South. The location of Table Mountain within the Park is indicated in red.

Table Mountain:

Table Mountain is one of the more popular of the National Park's attractions. In 2011, the Mountain Range was inaugurated as the new 7th wonder of nature along with Halong Bay (Vietnam), Iguazu Falls (Argentine/ Brazilian border), Jeju Island (South Korea) and the Underground River in the Philippines (www.new7wonders.com). In December 2013, a record number of 120 000 people visited the mountain (www.tablemountain.net/blog/.../december_was_our_busiest_month_ever).

History of Table Mountain

Table Mountain originated from the Cape Super group of Fold Mountains. It is approximately 260 million years old and is composed of sandstone, shale, quartz and mica. By comparison, the Himalayas are 40 million and the Alps 32 million years old. Originally Table Mountain lay at the bottom of a valley but the ice sheets generated by the ice age flattened the layers of sandstone. Throughout the years, the effects of erosion, wind, fire, ice and water on Table Mountain resulted in the uniquely shaped rocks, cliffs and deep ravines (www.sanparks.co.za/parks/table-mountain/conservation/geology.php; en.wikipedia.org/Table-Mountain-Sandstone... (Geological-Formation)).

The earliest inhabitants of the Cape Peninsula were the Khoisan people, and they called Table Mountain Hoerikwaggo which means 'Sea Mountain'. The first documented ascent of Table Mountain was in 1503 by the Portuguese navigator Admiral Antonio de Saldanha, who christened the mountain Taboa de Cabo (Table of the Cape). A cross was carved into the rocks at Lion's Head to commemorate the event. Remnants of this historic artefact can still be seen today (www.capetown.at/heritage/history/prehistory-geo.htm).

Geography of Table Mountain

Table Mountain is uniquely flat topped with a level plateau of 3 kilometers. The mountain stands at 1.084 meters above sea level and ranks as the 57th tallest mountain in Southern Africa. The plateau has two rock formations on either side: Devil's Peak to the east and Lion's Head to the west (Figure B). The lower part of the mountain, which lies in a southerly direction from the main plateau, is called the Back Table. The eastern slope of the mountain is flanked by the famous Kirstenbosch National Botanical Gardens and rounding off the northern mountain border is the city of Cape Town and Signal Hill ([en.wikipedia.org/wiki/Table Mountain](http://en.wikipedia.org/wiki/Table_Mountain); [en.wiki.org/wiki/List-of mountains-in-South-Africa](http://en.wiki.org/wiki/List-of_mountains-in-South-Africa)).

Devil's Peak is a three pronged spear shaped land formation that is 1,000 meters high. The Peak has important landmarks adjacent to it including Rhodes Memorial (erected in memory of Cecil John Rhodes), the University of Cape Town and the Groote Schuur Hospital where Dr Christiaan Barnard performed the first heart transplant ([en.wiki.org/Devil's-Peak_\(Cape-Town\)](http://en.wiki.org/Devil's-Peak_(Cape-Town))).

Lion's Head is a mountain peak that is 669 meters high. It was called Leeuwen Staart (Lion's Tail) by the Dutch because of its resemblance to a crouching lion. Lion's Head is renowned for its panoramic views of Cape Town, the Atlantic Seaboard and Robben Island where former president Nelson Mandela was incarcerated for 18 years ([en.wikipedia.org/wiki/Lion's_Head_\(Cape_Town\)](http://en.wikipedia.org/wiki/Lion's_Head_(Cape_Town))).

Signal Hill, known as the lion's flank, forms the lion's body that is adjacent to Lion's Head. Signal Hill has strong cultural Cape influences, evidenced by the presence of tombs or kramats of Muslim missionaries and religious leaders. The most famous is the white square building with a green dome that was erected for Sheikh Mohamed Hassen Ghaibie. These religious buildings are still visited by locals today ([en.wikipedia.org/wiki/Signal_Hill_\(Cape_Town\)](http://en.wikipedia.org/wiki/Signal_Hill_(Cape_Town))).



Figure B: Aerial photograph showing the flat plateau of Table Mountain (red arrow) and the recognizable land formations of Devil's Peak (yellow arrow), Signal Hill (green arrow), Lion's Head (white arrow) and the Twelve Apostles (purple arrow).

On the Atlantic coast, the mountain range continues as the Twelve Apostles (average height 750 meters) which is made up of a series of peaks or buttresses. The name is actually a misnomer as there are more than 17 peaks and only one peak is actually named after an apostle (www.tablemountain.net). The mountain range then continues west and becomes the popular tourist site Chapman's Peak (Figure C) which consists of flat sedimentary rocks. Along the vertical face of the Peak is a long winding 9km road with 114 curves. This is known as the Chapman's Peak Drive (Figure D) which is the route used by thousands of participants in the famous Two Oceans Marathon and Cape Argus cycle race (en.wikipedia.org/wiki/Chapman's_Peak; www.chapmanspeakdrive.co.za).

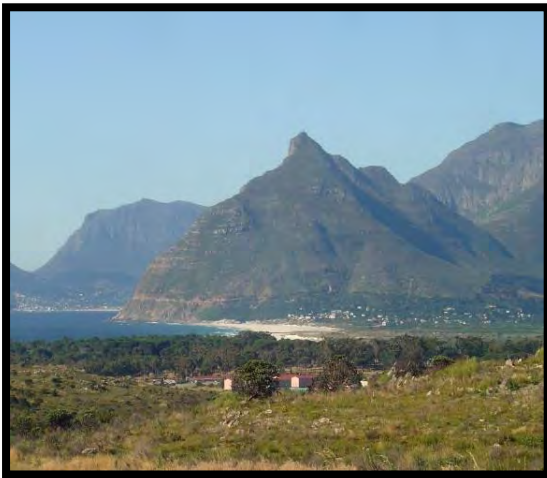


Figure C: Chapman's Peak

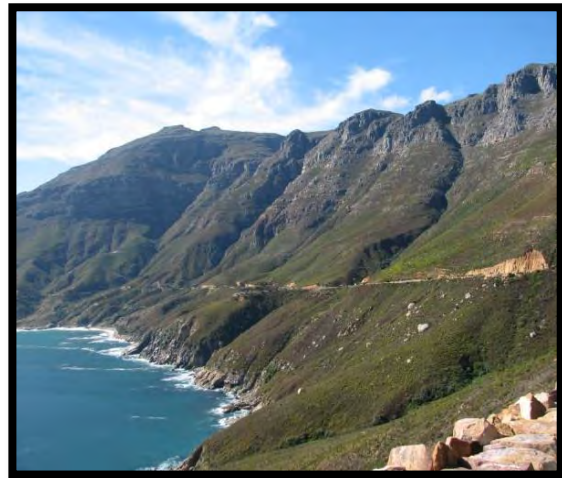


Figure D: Chapman's Peak Drive

Adjacent to Table Mountain are Tafelberg Road and Signal Hill Drive. Tafelberg Road passes along the north face of the mountain and levels out at the Cable Way Station and Devil's Peak. It is known for heavy traffic due to cyclist and pedestrian congestion. Signal Hill Drive is a steep drive from Kloof Nek that passes along the eastern side of Lion's Head and curls around Signal Hill. It is a popular tourist site due to the spectacular views of the city bowl and the main harbor (www.mountainpasssouthafrica.co.za >Find A Pass > Western Cape (170)).

In addition to the panoramic views, Table Mountain is renowned for hiking and walking trails, rock climbing, scrambling and extreme mountain sports. Some of the better known hiking trails are found at Signal Hill, Lion's Head, Devil's Peak, African Ledge, Twelve Apostles and the front face of the mountain. It is a Cape Town tradition to hike to Lion's Head and toast the full moon. Platteklip Gorge, a large gorge up the center of the main table, is one of the more challenging and longer hiking routes (www.sanparks.co.za/table_mountain/tourism/map.ph).

From the southern suburbs side, there are the Skeleton Gorge and Contour Path routes which begin at the Kirstenbosch National Botanical Gardens. The route via Skeleton Gorge to Maclear's Beacon (highest point on the mountain) is known as Smuts Track in memory of former South African Prime Minister Jan Smuts, who was a keen hiker. The India Venster hike starts to the right of the cable car station on Tafelberg Road, and the Pipe Track (named after pipes that used to carry water from the reservoirs) serves as a link to the Twelve Apostles Ridge. The slopes of Table Mountain has many deep tracks that allow for the popular sport of mountain biking. There are also designated hang gliding, micro light, abseiling and paragliding spots at Lion's Head and Africa Ledge (www.sanparks.co.za/table_mountain/tourism/map.ph; www.citysightseeing.co.za; www.downhilladventures.com/abseiling.php; www.tablemountainhikes.co.za; www.capeclimb.co.za/about_us.htm).

Due to the multitude of recreational and sporting activities on offer, the TMNP is extremely proactive in promoting and ensuring visitor safety. At various sites they have visible uniformed policing, roving patrols, surveillance via closed circuit television, night scopes, stake-out units, visitor information centers and visible signage. In addition, relevant emergency numbers and a seven day Cape Town weather forecast are readily displayed, as well as safety precautions that are available in the Park or from the Park website. General safety hints from the TMNP website advise that visitors not walk alone, keep others informed of their whereabouts, wear appropriate clothing, always carry sunscreen and water, be observant, get a reliable map, avoid remote areas and wild animals and always complete activities before dark. Alcohol use is strictly prohibited in the Park (www.sanparks.co.za).

Table Mountain Aerial Cable Way

Table Mountain is one of only three locations in the world accessible by a uniquely rotating cable car (Figure E). The Titlis Rotair in Engelberg Switzerland allows visitors unbelievable views of the Alps, while the cable car system in Palm Springs USA allows access to Mount San Jacinot's Chino Canyon. The Table Mountain's aerial cableway was first conceptualized in 1870 and in 1926 a Norwegian engineer, Trygve Stromsoe, began designing the first aerial cable way. Construction started in 1926 with the official opening in 1929. The first cable car was made of tin and wood and only carried 20 passengers, but today there are two cars which travel at a maximum speed of 10m per second and carry 65 passengers each. The height of the Upper Cableway Station is 1067 meters above sea level and approximately 20 million people have traveled by cable car including royalty, heads of state and celebrities (en.wikipedia.org/wiki/Table_Mountain_Aerial_Cableway; www.tablemountain.net).



Figure E: Photograph of the Table Mountain Aerial Cableway

National Park deaths:

Most National Parks have guidelines and protocols in place to ensure visitor safety yet fatalities still occur. Studies from National Parks across the world seem to indicate that deaths are specific to each Park and are due to the individual terrain, climate, wild life and recreational activities on offer (Arizia et al., 2007; Bauer L., 2002; Heggie et al., 2004; Heggie et al., 2005; Heggie et al., 2006; Heggie et al., 2008; <http://www2.nature.nps.gov/stats>).

To illustrate, American National Park studies found that most visitors died unintentionally during transportation, water based and recreational activities. These included motor vehicle accidents (20%), scenic airplane crashes (9%) boating accidents (5%), motor cycling accidents (4%) and while swimming (11%), hiking (10%) and climbing (6%). Contributing factors to motor vehicle accidents were: visitors distracted by scenery (27%), alcohol (23%), visitors from Asia and Europe driving on the left side of the road (14%), excessive speed (8%) and driving off-road and hitting stationary objects or rolling over (11%). Rip currents and large waves were associated with 54% of the swimming fatalities; falls from cliffs and heights accounted for 49% of the hiking fatalities; mechanical failure attributed to 64% of the airplane crashes; 56% of boating fatalities were attributed to boats capsizing; and 73% of the motorcycle crashes were attributed to excessive speed.

Fatalities were most common during the summer months and on weekends. Males accounted for 75% of the reported deaths, and visitors aged 20 to 29 and 50 to 59 years, made up 51% of all deaths. Domestic visitors accounted for the majority of victims with only 13% consisting of visitors from Europe (Flores et al., 2008; Heggie et al., 2008; <http://www2.nature.nps.gov/stats>).

Deaths that were natural were due to pre-existing medical conditions like diabetes and cardiac conditions (Heggie et al., 2004; www.livescience.com/6816-dangerous-national-park.html). Exotic causes like bear and wildlife attacks were rare, for example nearly 2 million people visited Waterton-Glacier National Park in Montana and Alberta annually, but only 10 bear-related fatalities were reported since the Glacier opened in 1910 (www.livescience.com/6816-dangerous-national-park.html).

Reports from the Australian National Parks indicate extreme weather, rocky terrains, poisonous snakes, marine animals, insects, floods and bush fires as leading causes of deaths (www.nationalparks.nsw.gov.au/; Harrison et al., 2004). Data of National Park deaths in South Africa is limited. SANParks have reported on isolated incidents of deaths due to wild animals or following altercations between animal poachers and Park officials mainly in the Kruger National Park (www.sanparks.co.za/parks/kruger/news.php; Leggat et al., 2001).

There have been no formal studies investigating deaths in South African National Parks or in particular, the TMNP.

Suicides

The most significant finding from the American National Park mortality studies, were the large contribution of suicide to death. Suicide is defined as a ‘fatal self-inflicted, self-destructive act with an implicit or inferred intent to die’ (Costanze et al., 2013). It is a universal social, medical and public health problem (Lin et al., 2004). Suicide and suicidal behaviour is a complex multi-factorial phenomenon which results from interactions between environmental, developmental, genetic, economic and psychosocial factors (Ernst et al., 2004; Lin et al., 2004). The global burden of suicide according to the WHO is one million deaths per year which corresponds to a mortality rate of approximately 14.5 per 100 000 (Constanze et al., 2013; Schlebusch, 2013).

Almost 17% of American National Park deaths were attributed to suicide, with the majority of victims being male with a mean age of 43 years (range: 16-84 years). The highest number of suicides occurred in June, August, and January. The commonly reported suicide methods were firearms (33%), jump (19%), drug overdoses (7%), cut/pierce (6%) and transportation from driving off a cliff (6%). The most common methods for males were firearm (36%) and jumps (19%); for females, firearm (21%), falls (19%) and drug overdoses (16%). Overall Blue Ridge Parkway and Grand Canyon National Park were the most common locations chosen for suicide (Heggie et al., 2008; www.cdc.gov/mmwr/preview.mmwrhtml/mm5947a2.ht).

A possible reason to explain the high incidence of suicides in National Parks is the global phenomenon of suicide hotspots. This peculiar behaviour is when a natural or man-made iconic location is specifically sought out as a death location. These hot spots can include mountain ranges, forests, buildings and waterfalls. Sometime a National Park is chosen because it may have an iconic feature like a mountain range, waterfall or forest (en.wikipedia.org/wiki/list_suicide_sites; en.wikipedia.org/wiki/Suicide_bridge; en.wikipedia.org/wiki/suicide_in_Japan).

In an attempt to understand such behaviour, interviews with survivors who chose specific locations for death, reported that dying at famous landmarks added dignity and grandeur to their existence and provided a sense of tranquillity and peace before dying. Others cited the lethality of the method, easy accessibility to cliffs and bridges, lack of security and absence of engineering barriers ([https://.ukgovernment/...Annual report](https://.ukgovernment/...Annual%20report)).

Globally the top suicide locations/ hot spots are (en.wikipedia.org/wiki/list_of_suicide_sites):

National parks:

- The Grand Canyon National Park of Arizona in the United States of America reported over 21 suicides per year.

Mountains:

- The chalky cliffs of Beachy Head in England has over 20 suicides per year
- The ocean cliff known as the Gap is one of Australia's top suicide spots with over 50 jumpers a year.

Bridges:

- The Golden Gate Bridge in San Francisco. At 227 meters high, it is the place where the most number of suicides take place in the world. In 2005, there were 1200 suicides reported. Because of its height only 2% survive (en.wiki.org/wiki/Golden_Gate_Bridge).

- The Humber Bridge in the United Kingdom is the 5th largest suspension bridge and more than 200 people have committed suicide since its opening in 1981.
- The Nanjaing Yangtze Bridge in China. There had been over 2000 suicides from 1968 to 2006.

Buildings:

- New York with its famous landmarks is a common suicide location. The statistics show that 10% of suicide cases were tourists who chose to die at a famous landmark. The Empire State Building in New York is a 1,250 feet skyscraper and there have been over 30 recorded suicides per year. The George Washington Bridge has an average of 10 suicides per year.

Waterfalls and forests

- The Aokigahara Forest on the northwest slope of Mount Fuji is known as the Suicide Forest with over 108 suicides per year.
- Niagara Falls at the Canadian/United States Border has reported 2780 suicides from 1856 to 1995.

In an effort to decrease the number of suicides, authorities in these countries have implemented site specific suicide prevention strategies (Berman et al., 1994; Blaustein et al., 2009; Cox et al., 2013; Daigle, 2005; Florentine et al., 2010; Gunnell, 2010; Goldsmith et al., 2002; Knox et al., 2004, Linquist et al., 2004). These have included:

- Increased presence of staff patrols and camera surveillance.
- Erection of nets and physical barriers areas: for e.g. in Bern Switzerland erecting a net at a site where people jumped from eliminated suicide attempts.
- Suicide prevention messages and suicide hotline numbers displayed on signage at the locations or along the pathways to the location.
- Engineering modifications to limit the amount of people who can access these sites.

There has been limited information on site specific suicide in South Africa. The Van Stadens Bridge in the Eastern Cape was identified as common suicide locations/hot spot, with 88 suicides since it was built in 1971; however no local research has fully explored this phenomenon (en.wikipedia.org/wiki/Suicide_bridge; en.wikipedia.org/Van_Stadens_Bridge).

Golden Gate Bridge



Aokigahara Forest-base Mount Fuji



Beachy Head



The Nanjaing Yangtze Bridge



The Grand Canyon National Park



Niagara Falls



Figure F: Photographs of the top suicide hotspots in the world

In South Africa, the national suicide rate has increased from 8% in 1999 to 11% currently (Naidoo et al., 2014). In 2008, approximately 6500 suicides were reported nationally. Approximately 11% of all unnatural deaths and 9.5% of unnatural deaths in young people are attributed to suicide. Males are the predominant victim, between 15-44 years with an average age of 34 years. In juveniles, the most affected are in the 15-19 year age group. The most frequent suicide methods are: hanging, shooting, drug overdoses and poisoning followed by gassings, burning, electrocution and jumping off buildings. Overall males chose hanging and suicides as their method of death while females chose poisoning and hanging. Suicides occur predominantly during weekends, have seasonal variations and peak at the end of the year. (Naidoo et al., 2014; Matzopoulos et al., 2003; Matzopoulos et al., 2004; Schlebusch et al., 2013; Schlebusch, 2012; www.mrc.ac.za/crime/reports).

Suicide studies specific to Cape Town are limited. There is a single record of a retrospective autopsy-based study that was done in 1998 to investigate the epidemiology, prevalence and toxicology of suicides at a SRFPL (Lourens, 1998). That study found that 4.1% of all SRFPL admissions were confirmed suicides, African and Coloured individuals made up 60% of the suicide victims; males were more affected than females; the average age of victims was 37.8 years, a high percentage of victims had a psychiatric background; shootings and hangings accounted for 64% of the methods used and the majority of victims (58%) were sober at the time of death. There was mention made of three victims who gassed themselves in Cecelia Plantation and Chapman's Peak; however there were no observations or discussions regarding site specific suicide.

There has been no formal epidemiological study of suicide fatalities in Cape Town since 1998 and there have been no investigations into the prevalence and types of suicidal deaths in the TMNP.

Mountain deaths:

As mentioned one of the most popular attractions in the TMNP is Table Mountain. Each mountain range is different and deaths can occur due to hazards that are associated with the location, the climate, the mountain's terrain or human factors. The leading cause of death in mountain mortality studies is trauma, usually sustained while participating in mountain associated activities or from environmental objects or hazards (Windsor et al., 2009; Williamson et al., 2007). The incidents are usually accidents, the victims in their early thirties, with multiple blunt injuries to the chest, head and abdomen.

Studies of climbing expeditions and mountain fatalities in the Himalayan mountains (Firth et al., 2008; Salisbury et al., 2007) and in Nepal trekkers (David et al., 1989) showed that the commonest cause of death was trauma, related to falls, hazards or objects (icefalls, avalanches and falling rocks). Sherpas who accompanied climbers died at a higher rate from trauma than the climbers and increased experience did not decrease the likelihood of accidents on the mountain. The main non-traumatic causes of death in extreme mountain ranges were high altitude sickness, sudden death due to underlying medical conditions (often cardiac) and hypothermia (Dickinson et al., 1983; Faulhaber et al., 2007, Kayser, 1991; Polard et al., 1988).

A study from Balkaria Russia found that mountain deaths were due to polytrauma from accidents, hypothermia, asphyxia from being buried under snow, lightning, high mountain hypoxia and underlying somatic illnesses (Mechukaev et al., 2006). In mountainous regions with snow, skiers died from injuries sustained from collisions with trees or with other skiers (Burtscher et al., 1993; Williamson et al., 2007). Ice and rock falls, hypothermia and asphyxia as a result of avalanches also contributed to death both in recreational visitors and seasoned mountaineers (Burtscher et al., 1993; Williamson et al., 2007; Windsor et al., 2009).

An autopsy study of mountaineering accidents in Scotland (Reid et al., 1986) found that individuals died predominantly from head injuries while rock or hill climbing, hypothermia and underlying medical conditions. Alcohol was not a contributor to death. Mountain biking in some instances was identified as a source of injury despite protective equipment (Kim et al., 2006). In the case of volcanic mountains, deaths (while not common) were due to visitors getting too close to the erupting volcano or being struck by lightning. Mount Etna in Sicily Italy is a prime example with only 77 human deaths recorded. The most recent death was in 1987, when two tourists were killed by an eruption near the summit (www.lifeinitaly.com/sicily/mt_etna_volcano.asp; en.wikipedia.org/wiki/Mount_Etna; www.italiasus.com/articles/etna.htm).

Overall the most common non-traumatic cause of mountain deaths were medical conditions (often cardiac) precipitated by vigorous activity (skiing or mountain hiking) in individuals who followed a sedentary lifestyle and who had underlying coronary artery disease (Burtscher et al., 1993; Faulhaber et al., 2007; Windsor et al., 2009). The second contributor directly related to the altitudes greater than 2500 meters above sea-level. Extreme climbers who ascended too rapidly died as a result of high altitude sickness which manifested as pulmonary and cerebral oedema (Kayser et al., 1991; Pollard et al., 1988; Windsor et al., 2009).

There has been limited information on mountain fatalities in South Africa. Studies from the Drakensberg Mountain Range in Kwazulu Natal have shown that the majority of deaths occurred from falls when individuals had strayed or had been climbing alone. Rock falls, fire, flash floods, exposure (hypothermia and to a lesser extent hyperthermia), dehydration, lightning, drowning and snake bites completed the list of mountain mortality. A seldom but lethal hazard in the Drakensberg mountain range was snow and ice, which increased the likelihood of accidents due to the slippery conditions and obstacles along simple routes (kzn.msc.org.za/...route/Drakensberg/hazards-precautions-and-rescue; www.ventureforth.co.za/wp-content/themes/.../9mountainHazards; www.samdt.co.za/drakensburg-mountain-rescues.html).

Table Mountain makes up a large part of the infrastructure of the TMNP, however very little is known of the Mountain's contribution to Park mortality. Sporadic information has come from local media reports which have highlighted the dangers of the mountain and reported, albeit sensationalized the deaths of foreign tourists (www.news24.com/Tag/Topic/table_Mountain; <https://www.awoltours.co.za/...table-mountain-the-worlds-most-underestimated>; www.iol.co.za/news/south.../tourist-dies-on-table-mountain-1.1762828).

One of the few sources which have consistently kept records of mountaineering incidents, accidents and deaths across the Cape Peninsula and Table Mountain is the South African Mountain Accident Database (alewis.its.uct.ac.za/sama) which was established by Andrew Lewis, a staff member at the University of Cape Town. This database contains information of mountain related statistics since the early 1800's and is updated on a regular basis by Mr Lewis.

According to the website there were 79 deaths and approximately 1123 search and rescue incidents on Table Mountain and the surrounding Cape Peninsula from 2000 to 2011. Individuals died while walking, hiking, climbing, scrambling, rock climbing, paragliding and abseiling. Falls and medical conditions were the leading causes of death. The website cites climber's inexperience, climbing alone or failing to follow directions as the main contributors to accidents and death (alewis.its.uct.ac.za/sama).

There have been no formal studies of deaths on Table Mountain to compare or validate the website's information

Conclusion:

The TMNP and Table Mountain Range are world renowned tourist destinations. Very little is known of the number and types of fatalities that occur in the National Park and the contribution of the mountain range to mortality figures. Hence the necessity of this study, which retrospectively aims, to analyse all the deaths that occurred in the TMNP from 2000 to 2011. Of interest, stemming from the literature review will be to determine if TMNP and its top attraction Table Mountain are possible suicide hotspots in Cape Town South Africa.

Part two: Publication ready manuscript

Abstract:

Background:

The TMNP is one of the more famous of Cape Town's tourist attractions. Stretching across the Peninsula, this conservation site is home to rare indigenous flora and fauna, biodiverse habitats and the spectacular Table Mountain. Despite its seemingly safe infrastructure, there have been media reports of accidents and deaths that have occurred in the TMNP and on Table Mountain.

Aim:

To determine the number and types of fatalities in the TMNP from 2000-2011.

Method:

The Salt River Forensic Pathology Laboratory is a state mortuary which serves the Cape Peninsula. Included in its drainage area is the TMNP. Approximately 3000 medico legal investigations are performed per annum, the details of which are stored in databases at the SRFPL and at the Division of Forensic Medicine at the University of Cape Town. These and archival records were retrospectively searched for all deaths that occurred in the National Park between 2000 and 2011. The collected information was categorised and analysed according to the demographic profile of victims, cause and manner of death, blood alcohol levels and activities prior to death.

Results:

Between 2000 and 2011, there were 98 confirmed deaths in the TMNP. The deaths occurred mostly during the South African summer months and on Fridays and Sundays (weekends). The victims were predominantly Caucasian (59%) and male (90%) with a mean age of 39.4 years. The majority of victims were local, while 15% were foreign, European and tourists. Overall accidents contributed to 53% of all unnatural deaths with victims predominantly sustaining head injuries and polytrauma which occurred from falls (71%) during mountain recreational activities. 24% of victims who fell tested positive for alcohol (>0.01g/100ml). Body mass index (BMI) calculations of the 98 victims revealed that 53% had BMI above 25. A pre-existing medical condition (predominantly cardiac) was the cause of the natural deaths.

A significant finding of the study was that 22% of deaths were due to suicides that took place on or surrounding Table Mountain. Suicides occurred commonly during summer with Fridays and Mondays being the common suicide days. The victims, all men, in the age range of 30-39 years (mean age of 39 years) were predominantly Caucasian (68%) and used hanging (45%) and jumping (27%) off the mountain as the two most preferred methods of death. 22% of suicide victims tested positive for alcohol at time of death.

Conclusion:

The TMNP is one of South Africa's most popular tourist attractions, due largely in part to the presence of Table Mountain. A retrospective study of deaths that occurred within the Park and on the mountain range over a 12 year period identified a predominantly Caucasian male victim demographic and found that head and polytrauma sustained from falls while participating in mountain associated activities as the leading cause of death. A significant finding was the high percentage (22%) of suicide deaths that took place. This study has helped to identify Table Mountain as a possible local suicide hotspot and points to a need for TMNP authorities to include in their safety protocols, strategies for suicide prevention. Larger collaborative studies are recommended as this would significantly impact on public health through the improvement of Park and mountain safety.

Introduction:

The TMNP in Cape Town South Africa is a world renowned tourist destination. Established in 1998, this open access park extends across large parts of the Cape Peninsula from Signal Hill in the North to Cape Point in the South (Figure 1). Within its borders are an urban city and the natural iconic landmark, Table Mountain. The TMNP, a major conservation sanctuary, is part of the UNESCO Cape Floral Region World Heritage site and boasts an estimated 4.2 million visitors annually (www.sanparks.co.za; George, 2003).

Table Mountain, one of the oldest mountain ranges in the world, overlooks the City of Cape Town and Table Bay. It is universally recognised for its flat top, distinctive land formations, cable car way and easy accessibility via numerous hiking and walking trails. Declared a natural wonder of nature, this biodiverse mountain range continues to be the most frequently visited of all the Park attractions (www.new7wonders.com; [en.wikipedia.org/wiki/Table Mountain](http://en.wikipedia.org/wiki/Table_Mountain)).

With such large numbers of local and international visitors, the issue of Park safety is of utmost importance. Despite the implemented safety regulations and guidelines, there have been reports of accidents and fatalities within the Park borders (www.sanparks.co.za). In fact, Table Mountain, despite its seemingly benign appearance, has been labelled dangerous by the local media and criticized for the frequent accidents and incidents involving foreign tourists ([www.news24.com/...Row-over-safety-on-Table Mountain-20130411](http://www.news24.com/...Row-over-safety-on-Table-Mountain-20130411); www.iol.co.za.../us-diplomat-falls-to-his-death-during-hike-1.1622303; www.iol.co.za.../toll-rises-as-mountain-dangers-are-ignored-1.365853; www.news24.com/...News/Man-dies-in-Table-Mountain-fall-20110322).

Statistics from the South African Mountain Accident Database appear to substantiate these claims. This database which is managed by Mr Andrew Lewis contains information of incidents and deaths on Table Mountain and the Cape Peninsula since the 1800's (alewis.its.uct.ac.za/sama). The records show that there have been 79 deaths and over 1123 search and rescues incidents from 2000 to 2011. Of all the mountain Park regions in South Africa, Table Mountain is the most active with the highest number of rescue operations (mcsacapetown.co.za).

While the website information is useful, it is limited in its descriptions of the demographic profiles of victims or types of death. Furthermore there has been no autopsy based, Cape Town studies to allow comparison or validation of the fatality figures from the website or those reported in the media.

The SRFPL, one of two state mortuaries in Cape Town, is under the control of the Forensic Pathology Services. It receives bodies which require a medico legal autopsy as specified by South African legislation (Inquest Act-Act 58 of 1959 and National Health Act No.61 of 2003). Hence deaths that:

- are due to external forces (blunt, sharp, electrical, thermal, chemical or drugs),
- are due to an act of omission or commission,
- occur during a surgical procedure or under the influence of an anaesthetic,
- are sudden and unexpected,

are referred for a medico legal autopsy. On average, approximately 3000 bodies are received annually. Located within the geographic drainage area of the SRFPL is the TMNP.

Mortality studies are essential and impact on public health, especially if the deaths are potentially preventable. So to obtain a representation of Park and mountain fatalities, a retrospective study was initiated at the SRFPL, in which the autopsy reports of victims who died in the TMNP were collected and analysed for a 12 year period beginning in January 2000 and ending in December 2011.



Figure 1: Operational map of the TMNP. The location of Table Mountain is shown (red arrow).

Materials and methods:

At the SRFPL, the death scene, identification and demographic details of bodies are uploaded on a daily basis by mortuary staff into an access restricted database. Such record keeping has been in place since 2005. Each body is assigned a numeric code and all information is confidential. Similar record keeping is done by forensic pathologists in the Division of Forensic Medicine at the University of Cape Town. This confidential office autopsy database which was established in 2005 contains victim information, summaries of cause and manner of death, autopsy pathology and list of investigations performed.

After full ethical approval was obtained, acquisition of records occurred in the following systematic manner:

1. The SRFPL database for years 2005-2011 was retrospectively searched for all deaths which occurred in the TMNP and on Table Mountain.
2. Simultaneously, two investigating officers from the Cape Town SAPS were recruited to help with study. In the first phase, they were tasked with searching current and archival dockets in the police database and to identify cases that occurred in the TMNP and on Table Mountain prior to 2005. For the second phase, once an exact number of confirmed fatalities was known, they were tasked to determine if the cases had been finalised at inquest level
3. The office autopsy database in the Division of Forensic Medicine at the University of Cape Town was searched for fatalities specific to Table Mountain and within the National Park. This was done from 2005-2011. There was no or limited electronic record keeping prior to 2004, so a manual search of divisional archive files was done from 2000 to 2004.
4. Mr Andrew Lewis, the manager of the South African Mountains Accident database website was contacted. He allowed access to website information which contained details of incidents, fatalities and mountain rescues across the Cape Peninsula and Table Mountain from 2000-2011.

Once a list of possible fatalities were obtained a cross sectional comparison was made with all the databases mentioned and after elimination, verification and addition, a list of confirmed deaths within TMNP and Table Mountain was generated.

From this generated list, the autopsy reports of deaths from the National Park and on Table Mountain, including (where available) scene script information, body retrieval forms, paramedic notes and eyewitnesses statements were collected and examined. All the data was captured in Excel spread sheets in the following categories for analysis:

1. type of remains (intact, decomposed, skeleton)
2. category of death (natural, unnatural or undetermined)
3. specifics of the fatalities (month, day, time of death, time of discovery, location of death, season, activities prior to death, possible reasons for death). The day hours were specified as 06H00-18H00 and night as 18H00-06H00.
4. profiles of victims (age, race, gender, BMI, nationality, presence of medical conditions). The age and BMI of the victims were placed in clearly defined categories while the seasons were designated according to criteria from the South African weather bureau (see Table 1).
5. manner of death (accident, suicide, murder, undetermined).
6. autopsy pathology.
7. Blood alcohol results (and/or toxicology). Blood alcohol levels were standardised into range categories for interpretation (see Table 1)
8. For each victim the place of residence was noted and then categorised into a suburb of Cape Town (en.wikipedia.org/wiki/List_of_Cape_Town_Suburbs).

Standardisation of the BMI, age, suburb of Cape Town, seasons and blood alcohol categories are depicted in Table 1.

Table 1: Standardisation of BMI, age, suburbs of Cape Town, seasons and blood alcohol categories.

BMI (weight/height ²)	Age group	Suburb of Cape Town	Season	Blood alcohol categories g/100ml.
18.4 and below: underweight	10 - 19	Atlantic Seaboard	Summer: December-February	0
18.5 - 24.9: healthy	20 - 29	Northern Suburbs		0.01-0.05
25.0 - 29.9: overweight	30 - 39	City Bowl	Winter: June to August	0.06-0.10
30 and above: obese	40 - 49	Southern Suburbs		0.11-0.15
Unknown	50 - 59	Cape Flats	Autumn: March to May	0.16-0.20
	60&above	South Peninsula		0.21-0.25
	Unknown	Helderberg Basin	Spring: September-November	0.26-0.30
		West Coast		Unknown
				Not tested

Results:

General

Between January 1, 2000 and December 31, 2011 there were 98 confirmed fatalities in the TMNP. The average interval between body admission and autopsy was 5 days. Figure 2 shows the state of the bodies at time of autopsy. 78 bodies were intact with no signs of decomposition, 20 had signs of decomposition and 4 were skeletonized.

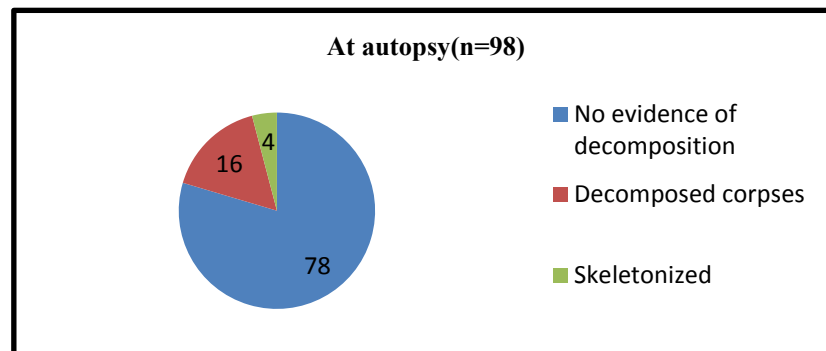


Figure 2: State of bodies at autopsy

Table 2 shows the yearly distribution of TMNP deaths and comparison to total SRFPL admissions. The deaths averaged of 8.16 per year (mean) for the 12 year period, with the highest number of fatalities recorded in 2006. The TMNP fatalities accounted for 0.28% of total SRFPL admissions during the study period. Seventy one percent of deaths (70/98) occurred during the day, 26% (26/98) at night and 2% were unknown (2/98).

Table 2: Yearly distribution of TMNP deaths vs SRFPL admissions

Year	TMNP Deaths	Total SRFPL admissions	%
2000	5	3124	0,16
2001	7	3325	0,21
2002	7	3255	0,22
2003	7	2970	0,24
2004	9	2604	0,35
2005	6	2533	0,24
2006	14	2720	0,51
2007	9	3085	0,29
2008	8	3037	0,26
2009	10	2929	0,34
2010	6	2963	0,20
2011	10	2904	0,34
Total	98	35449	0.28(mean)

Table 3 shows the monthly distribution of deaths. Deaths were highest from December to March with the most deaths occurring in January.

Table 3: Monthly distribution of TMNP deaths

Month	Total deaths	Season
January	20	Summer
February	13	Summer
March	11	Autumn
April	7	Autumn
May	4	Autumn
June	6	Winter
July	3	Winter
August	8	Winter
September	7	Spring
October	4	Spring
November	6	Spring
December	9	Summer
Total	98	

Table 4 shows the seasonal distribution of deaths which indicates a peak in the South African summer months (46%). The lowest number of deaths occurred in spring (14%).

Table 4: Seasonal distribution of TMNP deaths

Season	Total	%
Summer	46	46.94
Autumn	22	22.45
Winter	16	16.33
Spring	14	14.29
Total	98	100

Table 5 shows the daily distribution of deaths, with Fridays and Sundays being the common death days. Thirty six victims (dead and alive) were airlifted off the mountain; 5/98 were hospitalised with an average hospital stay of 3 days.

Table 5: Daily distribution of TMNP deaths

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
2000	0	0	1	0	2	0	2	5
2001	0	2	1	1	1	1	1	7
2002	0	0	0	2	1	1	3	7
2003	1	0	2	1	2	0	1	7
2004	1	0	2	1	2	3	0	9
2005	1	1	4	0	0	0	0	6
2006	2	1	2	1	5	0	3	14
2007	3	1	0	3	1	0	1	9
2008	2	0	0	0	3	1	2	8
2009	0	1	3	2	1	0	3	10
2010	2	0	0	2	0	2	0	6
2011	4	0	1	1	1	0	3	10
Total	16	6	16	14	19	8	19	98

Locations of death

Fatalities occurred at different locations across the TMNP however deaths directly on Table Mountain contributed to 78% of Park fatalities (77/98). The common death areas across the TMNP are depicted in Figure 3. The most common location of death in the National Park was the Silvermine Nature Reserve (6.13%).

The most common locations of death on Table Mountain are depicted in Figure 4. These included the paths, trails and rock formations on and surrounding Table Mountain (front face of the mountain, Africa Ledge, Cable Car Way, Devil's Peak, India Venster, Platteklip Gorge and Lion's head). Overall, the most common death location on Table Mountain was Devil's Peak (15.31%).

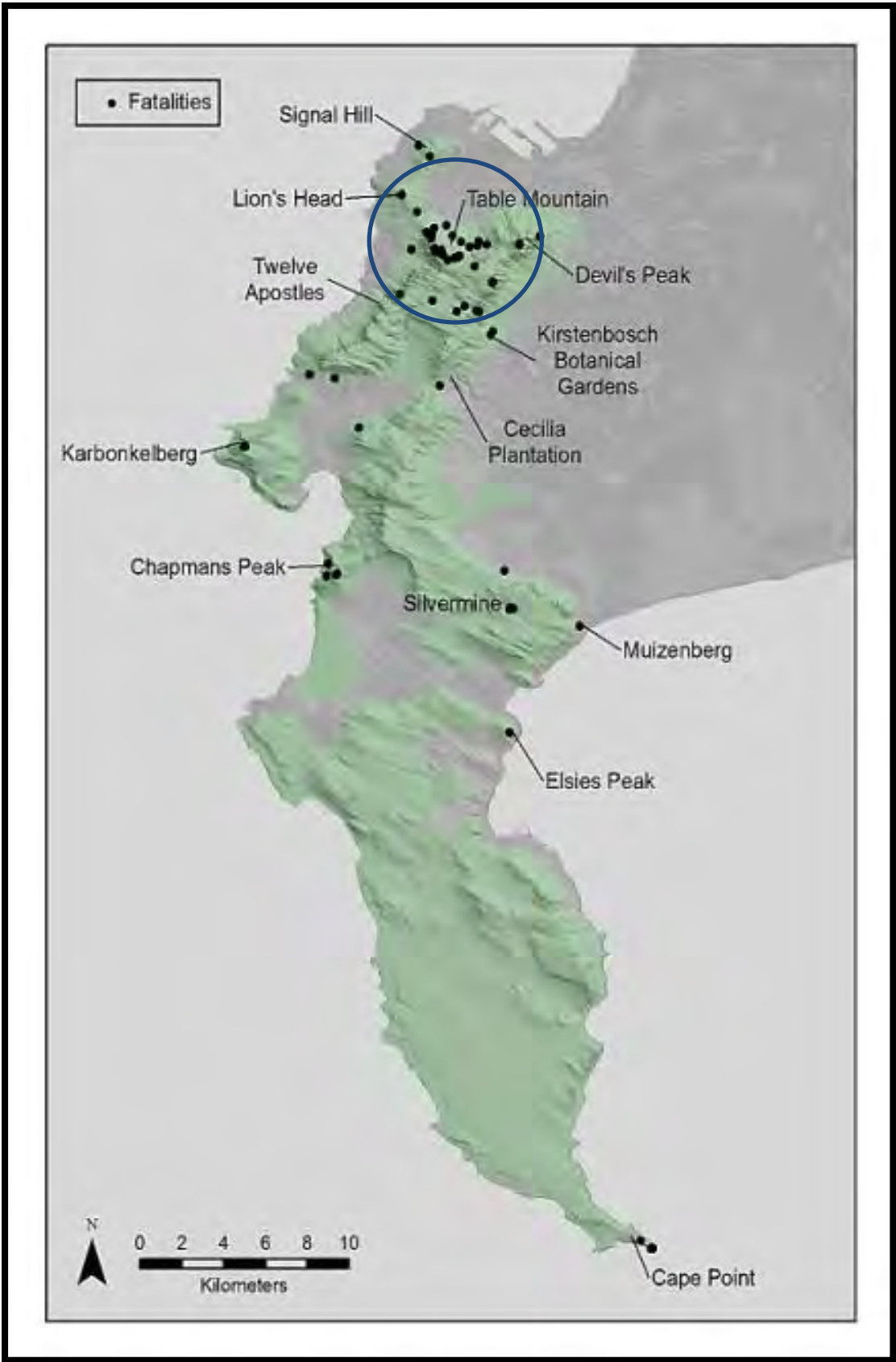


Figure 3: Locations of death in the TMNP

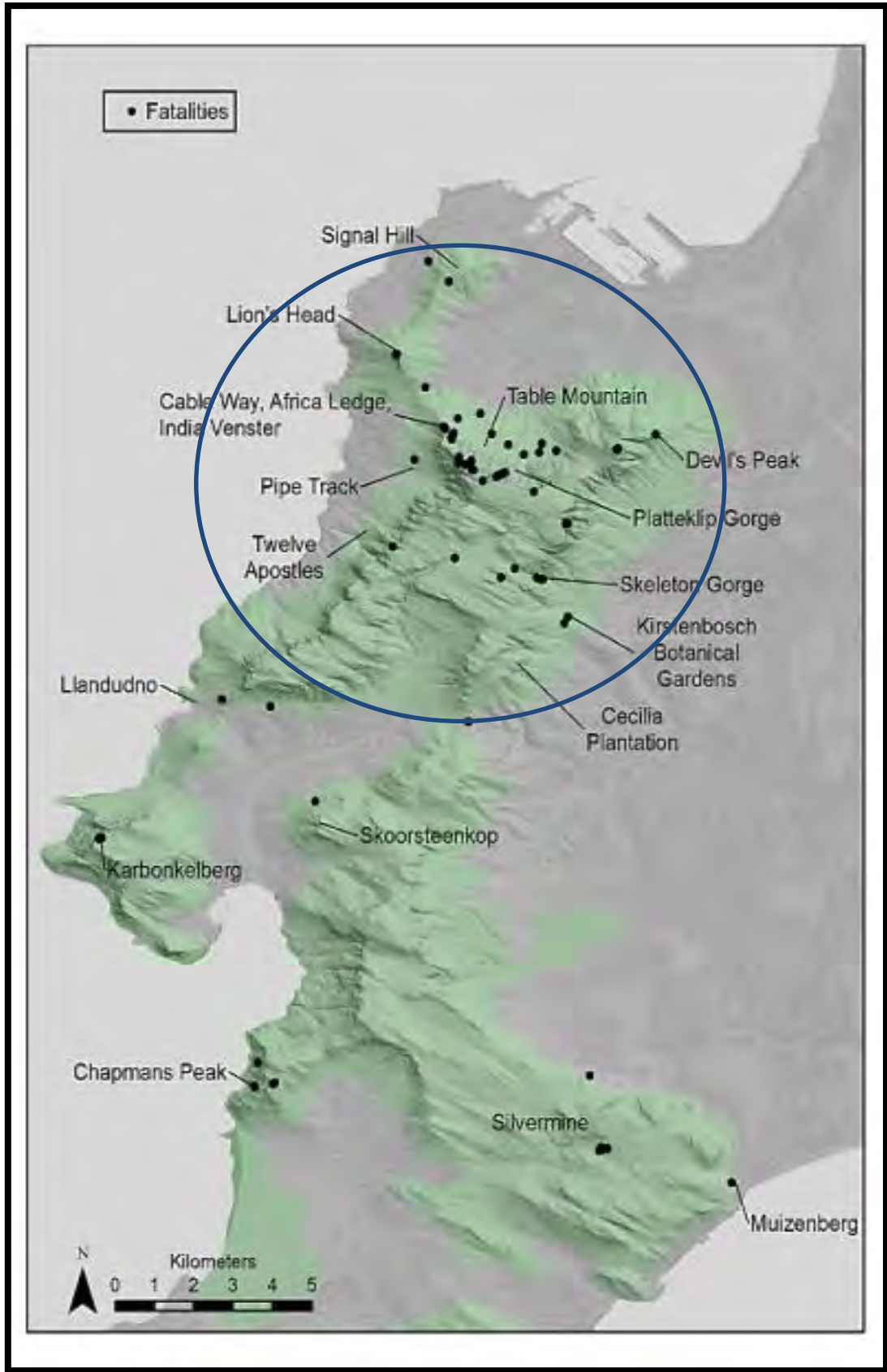


Figure 4: Locations of deaths on the Table Mountain Range

Victim demographics

The study cohort consisted of 88 males and 10 females indicating a male dominance of 90%. The age range of the victims was 14-75 years, with a mean of 39.4 years. Overall the majority of victims (24%) were in the 20-29 year age group. Table 6 shows the age, race and gender of TMNP fatalities.

When gender and age were compared, the common age category for female victims was 20-29 years, while males predominated in two age categories viz 20-29 and 40-49 years. The racial distribution of victims showed a Caucasian dominance (59%) followed by Coloured (19%) and African (16%).

Table 6: Cross tabulation of age, race and gender of TMNP fatalities

Age categories	Coloured (19, 39%)		African (16, 33%)		Caucasian (59, 18%)		Hispanic (1, 02%)		Asiatic (2, 04%)		Unknown (1, 02%)		Total
	M	F	M	F	M	F	M	F	M	F	M	F	
10 – 19	4	0	0	0	1	1	0	0	0	0	0	0	6 (6, 12%)
20 - 29	5	0	3	0	9	4	0	0	2	0	1	0	24 (24, 49%)
30 - 39	5	0	5	1	8	0	0	0	0	0	0	0	19 (19, 39%)
40 - 49	2	0	4	0	13	1	1	0	0	0	0	0	21 (21, 43%)
50 - 59	1	1	2	0	9	0	0	0	0	0	0	1	14 (14, 29%)
60&above	1	0	1	0	10	1	0	0	0	0	0	0	13 (13, 27%)
Unknown	0	0	0	0	1	0	0	0	0	0	0	0	1 (1, 02%)
Total	18	1	15	1	51	7	1	0	2	0	1	1	98 (100%)

BMI could be calculated in 88 victims: 28/88 was in the overweight category of 25-29.9, and 19 in the obese group of 30 and above. Hence 53% of all victims had an increased BMI above 25 at time of death. When BMI was compared among the race and age groups, it was found that 56.9% of Caucasian victims had BMI>25 (overweight and obese). Furthermore, the 30-39 age group were predominantly overweight and 60 years and above, predominantly obese.

Verified information (Table 7) of the place of residence was available in only 37 local victims and from this limited data, the Southern suburbs (32%) was identified as the most common home location(12/37).

Table 7: Distribution of place of residence according to Cape Suburbs

Cape suburb	Number of residents
Atlantic Seaboard	6
Cape Flats	4
City Bowl	3
Northern Suburbs	7
South Peninsula	4
Southern Suburbs	12
West Coast	1
Total	37

Nationality

In total there were 81 (82.6%) South African nationals, 15 (15.3%) foreigners and 2 of unknown nationality (2%). The foreign fatalities were visitors to the city of Cape Town and were mostly male (12 males and 3 females). The youngest fatality was 14 and the oldest 70 years (mean 39.5years). The age range of the female victims was 14-45 years (mean: 36.25years) and the men 14-70years (mean: 39.5 years). Overall visitors from European countries (12/15) accounted for the majority of foreign fatalities with Germans being the most represented (4/15). Eighty percent of the foreign victims had elevated BMI greater than 25 and medical histories of ischemic heart disease, atherosclerosis and diabetes. Figure 5 summarises the nationalities of the victims in the TMNP.

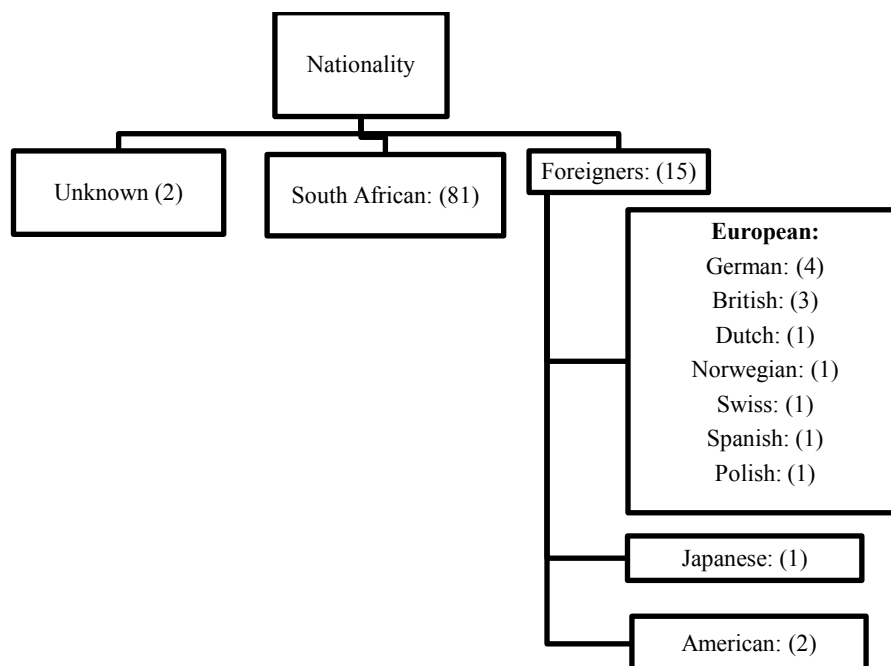


Figure 5: Nationalities of TMNP fatalities

Cause of death

Overall:

The cause of death was confirmed in 95 victims. Three remained undetermined due to advanced decomposition or skeletonisation. From the data, 10 (10.2%) victims died from natural causes and 85 (86.7%) from unnatural causes.

The unnatural deaths were further categorised and the most common manner of death was accidents 52/98 (53.0%) followed by suicides 22/98 (22.4%), murder 5/98 (5.10%) and heatstroke 3/98 (3.06%). There was one victim who died from a seizure that was due to post traumatic epilepsy. In two victims the cause of death was determined at autopsy however the manner could not be conclusively established (lack of information and not finalised at inquest). Figure 6 depicts the cause and manner of death of the TMNP fatalities.

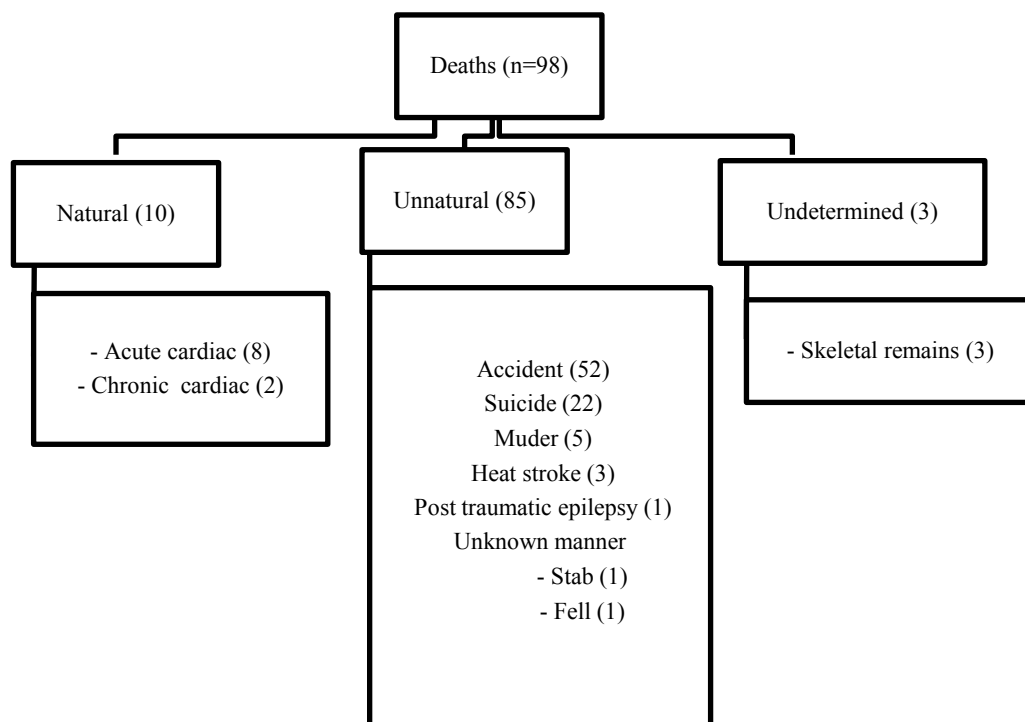


Figure 6: Cause and manner of death of TMNP fatalities

When the categories were applied to the foreigner deaths, a similar trend was present (Table 8). The causes of death in foreigners were: 73.3 % (11/15) due to accidents, 13.3 % (2/15) due to heatstroke and 13.3 % (2/15) due to natural pathology (cardiac).

Table 8: Summary of deaths of foreign fatalities

Nationality	Accident	Natural	Heatstroke	Total
Dutch	1	0	0	1
German	2	1	1	4
Japanese	1	0	0	1
Norwegian	1	0	0	1
Polish	0	1	0	1
Spanish	1	0	0	1
Swiss	1	0	0	1
British	2	0	1	3
American	2	0	0	2
Total	11	2	2	15

Figure 7 shows the yearly distribution of all deaths indicating the predominance of accidents and suicides throughout the 12 year period.

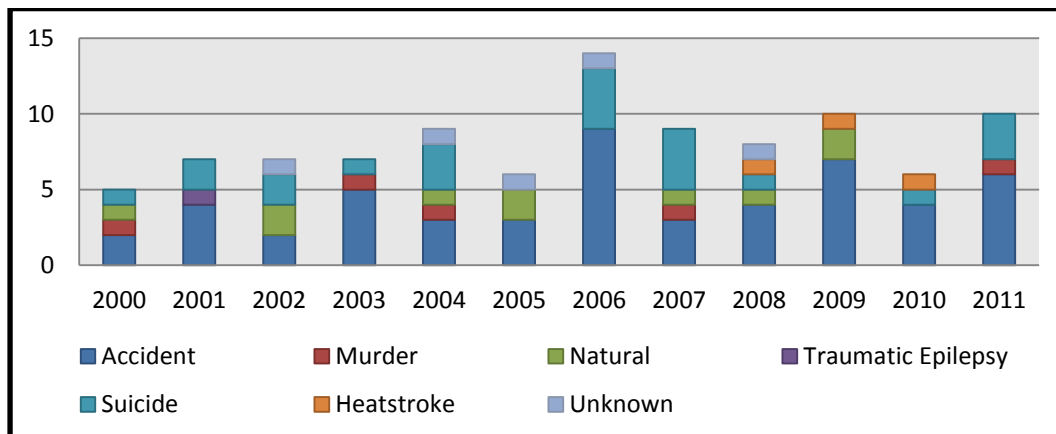


Figure 7: Yearly distribution of manner of TMNP deaths

The data also revealed a strong association between victim's age and manner of death (Figure 8). The victims in the 20-29 age groups died from accidents, 60 years and above age group, died from natural causes and the 30-39 age groups from suicides and murders. Suicides were gender specific to males.

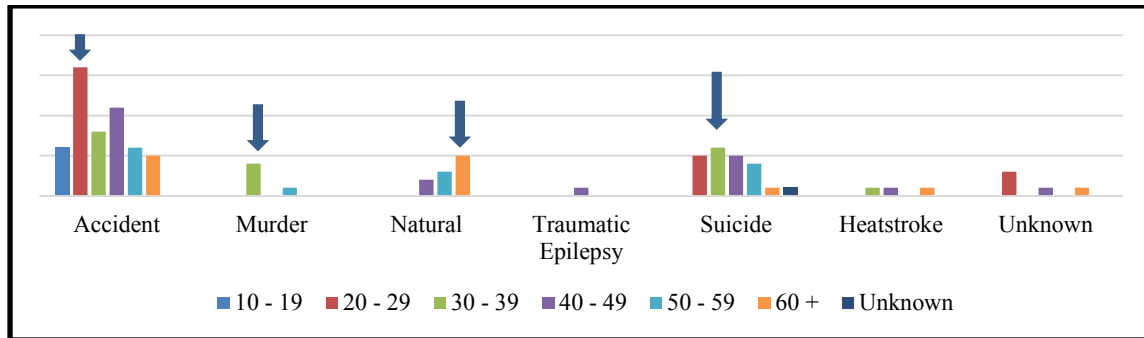


Figure 8: Age categories and manner of death

Natural deaths:

There were 10 fatalities that were due to natural causes (Table 9). The victims were predominantly male and Caucasian. Eight were local and 2 were foreign. Two of the victim's at autopsy were decomposed, but a cause of death could still be determined.

The age range of the victims was 40 -60 years and above (mean 58.3 years). The time of death was mostly recorded as occurring during the day (9/10 during the day and 1/10 night). At the time of death the victims were either walking (7/10) or hiking (1/10). Two of the victim's pre-death activity was unknown.

Nine of the victims demised on Table Mountain (Lion's Head, Devil's Peak, Platteklip Gorge, Chapman's Peak, and Nursery Ravine) and one died in the Cape Point Nature reserve. All of the deaths were cardiac related (acute or chronic) and the victims had similar characteristics of raised BMI (>25), ischemic heart disease, atherosclerosis, hypertension or diabetes. Alcohol testing was done in two victims and the results were negative.

Table 9: Cross tabulations of race, age and gender of natural deaths in the TMNP

Age	Coloured		African		Caucasian		Total
	M	F	M	F	M	F	
10 – 19	0	0	0	0	0	0	0
20 - 29	0	0	0	0	0	0	0
30 - 39	0	0	0	0	0	0	0
40 - 49	0	0	2	0	0	0	2
50 - 59	0	1	1	0	1	0	3
60 +	0	0	1	0	4	0	5
Total	0	1	4	0	5	0	10

Unnatural deaths:

Accidents:

There were a total of 52 accidental deaths which occurred in the TMNP which averaged 4.3 per year (Figure 9). The accidents occurred mostly in summer, on Sundays (23.08%) and during the day (69.23%). The highest number was recorded in 2006. The majority of victims who died were South Africans and 11 were foreigners. The victims were mostly male in the 20-29 age categories (30.7%) with a mean age of 35.7 years (Table 10). Caucasians (67.3%) were the common racial demographic, 38.46 % were overweight and 13.45% obese.

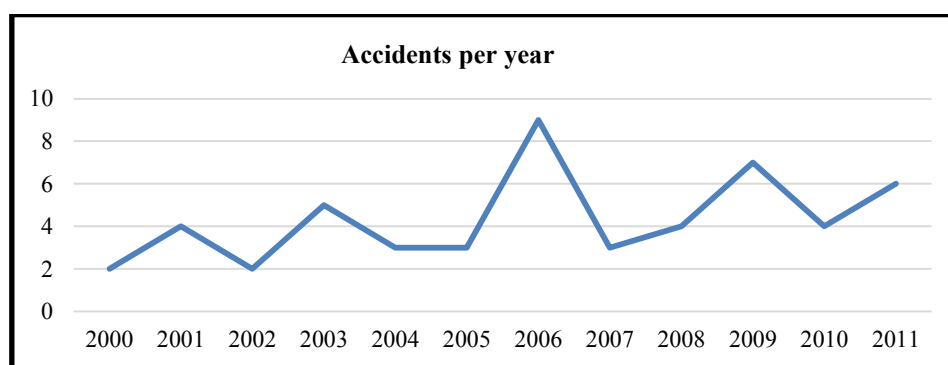


Figure 9: Yearly distribution of accidents

Table 10: Cross tabulations of race, age and gender of accidental deaths in the TMNP

Age	Coloured (21, 15%)		African (7, 69%)		Caucasian (67, 31%)		Hispanic (1, 92%)		Asian (1, 92%)		Total
	M	F	M	F	M	F	M	F	M	F	
10 - 19	4	0	0	0	1	1	0	0	0	0	6 (11, 54%)
20 - 29	3	0	1	0	7	4	0	0	1	0	16 (30, 77%)
30 - 39	3	0	1	0	4	0	0	0	0	0	8 (15, 38%)
40 - 49	0	0	1	0	8	1	1	0	0	0	11 (21, 15%)
50 - 59	1	0	1	0	4	0	0	0	0	0	6 (11, 54%)
60 +	0	0	0	0	5	0	0	0	0	0	5 (9, 62%)
Total	11	0	4	0	29	6	1	0	1	0	52 (100%)

Victims were engaged in different recreational activities prior to death (Table 11) however the top three activities in accidental deaths were hiking, scrambling and walking (19.23%). The deaths occurred predominantly on Table Mountain along the various recreational/hiking paths and rock trails. The top locations for accidental falls were Africa Ledge, Devils Peak, India Venster, Platteklip Gorge, Chapman’s Peak, Lion’s Head, Signal Hill and the Cable Car Way.

Table 11: Activities prior to accidental deaths

Activity	Total	%
Abseiling	1	1.92
Climbing	5	9.62
Diving	2	3.85
Driving	2	3.85
Fishing	2	3.85
Flying	1	1.92
Hiking	10	19.23
Paragliding	1	1.92
Sightseeing on foot	3	5.77
Scrambling	10	19.23
Swimming	4	7.69
Walking	10	19.23
Working(bark stripper)	1	1.92
Total	52	100.00

Detail of the accidents and corresponding autopsy pathology are tabulated in Table 12. 71.1% of victims fell while engaging in recreational or sporting activities. This was true for local and foreigner victims. Confirmation of the accident was provided by eye witnesses and most of the victims had on hiking/climbing gear at time of death. The common pathology in the victims who died from falls was extensive severe poly and head trauma.

Table 12: Type of accident and autopsy pathology

Type of accident	Total (N=52)	Pathology seen:
Burnt	2 (3.85%)	Burn wounds and CO poisoning
Crushed by falling boulder	1 (1.92%)	Head and chest injuries
Drowned	8 (15.38%)	Emphysema aqueosum and congested organs
Falls from height	37 (71.1%)	32/37- polytrauma; organ lacerations and multiple fractures of upper and lower limbs, pelvis and/or spine 5/37-head trauma; fractured skull and intracranial hemorrhages
Helicopter crash	1 (1.92%)	Extensive severe polytrauma
RTA(driver)	2 (3.85%)	Poly trauma Chest trauma
Trapped(rocks)	1 (1.92%)	Poly trauma

Of the 52 victims who died from accidents, blood alcohol results were available in 36 cases. There were 12 cases which were not tested and 4 remained unknown as the results had not been released from the state laboratory. Despite this, contributors to accidents were analysed.

Overall 24 victims had negative blood alcohol tests and 12 (23%) had positive blood alcohol tests (above 0.01g/100ml). The majority of victims (9/12) who tested positive for alcohol died from falls. This meant that 24% of victims who fell had alcohol levels above 0.01g/100ml (Table 13).

Reports from the scene and eyewitnesses state that victims attempted activities which exceeded their abilities, climbed alone or failed to follow directions. In other instances poor path maintenance and inadequate signage contributed to death. Two of the foreign victims that fell had alcohol levels in the 0.11-0.15g/100ml range.

Table 13: Cross tabulations of types of accidents and blood alcohol levels

Alcohol range g/100ml	Burnt	Crushed	Drowned	Fell	Crash	RTA	Trapped	Total
0	2	1	4	17	0	0	0	24
0.01 - 0.05	0	0	0	6	0	1	0	7
0.06 - 0.10	0	0	0	1	0	0	0	1
0.11 - 0.15	0	0	0	2	0	0	0	2
0.16 - 0.20	0	0	2	0	0	0	0	2
Not tested	0	0	1	8	1	1	1	12
Unknown	0	0	1	3	0	0	0	4
Total	2	1	8	37	1	2	1	52

Drowning also contributed to death. There are a number of beaches and coastlines on the TMNP borders. However this study only focused on drowning deaths within the pay points of the TMNP and deaths on the beaches and coastlines were excluded. The top locations of drowning deaths within TMNP were the Silvermine Nature Reserve, Karbonkelberg, Kirstenbosch Botanical Garden, Van Riebeck Park, Devils Peak Quarry and Hely Hutchinson's dam. Two of the victims who drowned were intoxicated and had blood alcohol levels in the range of 0.16-0.20g/100ml. Some of the reasons given for death were that the victims were poor swimmers, who got into difficulties because of underestimating the water depth or from reckless diving.

Veld fires were the cause of death in 2 victims, who died from burn wounds or the effects of carbon monoxide inhalation (carbon monoxide levels of 70%).

Transportation fatalities made up a minority of accidents (2/52). Two victims (drivers) died from polytrauma sustained in road traffic accidents on Tafelberg Road and Chapman's Peak Drive. Both had been speeding and lost control of their cars and had driven off the road. Only one driver tested positive for alcohol but it was within the South African legal limit for driving (0.01-0.05g/100ml). A single helicopter crash was documented for the 12 year period and the victim (pilot), experienced mechanical difficulties and sustained multiple severe polytrauma.

Murder:

There were 5 (3 males and two females) murder victims who died from gunshots (2), assault (1) and strangulation (2). The victims were all local, in the 30-39 age group and African. The bodies were discovered in Devil's Peak (2), Tafelberg Road (2) and Cape Point (1). The time of death for the male victims was recorded as day while no conclusive time was given for the female victims (due to advanced decomposition). Three of the deaths were certified on a Monday. Alcohol levels were determined in only two of the homicide victims and were negative. The two male victims were shot (one during a car hijacking and the other during a robbery). The victims each sustained single gunshot wounds to the head and chest. The victim of the gunshot wound to the head survived long enough to be transferred to Groote Schuur hospital. A third male victim died from injuries sustained from an assault following a verbal altercation.

Both females had evidence of fatal neck pressure due to strangulation. The motive for the female murders was unknown; however sexual assault was suspected but could not be proven due to the extent of decomposition.

Heatstroke:

There were three heatstroke victims (1 female and two male). All the victims were Caucasian and had BMI >30. Both male victims were foreign and European with a mean age of 40.5 years. The female victim was a local Caucasian woman of 71 years. The deaths occurred during summer. One died on the mountain and two victims were airlifted to the hospital. Only the female victim survived long enough to be admitted to hospital. At time of death all of the victims were engaged in recreational activities (hiking, walking and climbing) on paths and hiking trails on Table Mountain. Alcohol tests were done on the male victims and were negative. Due to the hospital stay of the female victim no alcohol testing was done. At autopsy, the victims had different degrees of multi-organ failure, subendocardial haemorrhages in the heart, mottled liver and histological evidence of rhabdomyolysis (positive myoglobin stain of the kidneys).

Suicides:

A significant finding of the study was that 22% (22/98) of victims committed suicide. All the victims were South African locals. The majority (15/22) died on Table Mountain with the remaining (7/22) at locations scattered throughout the TMNP. The rate of suicides was 1.8 per year with the highest number of 4 recorded in 2007 (Figure 10). Most suicides occurred in summer with Fridays and Mondays being the common suicide days. No suicide notes were found however the victims had verbalised the intention to die to family members or friends. A medical history of depression was elicited in two of the suicide victims. Limited information was obtained as to motivation of the suicide but some reported terminal illnesses, financial and personal problems as triggers.

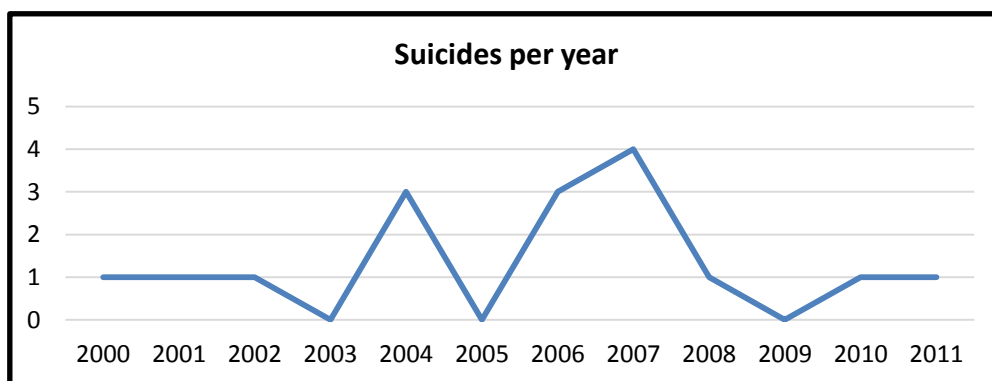


Figure 10: Yearly distribution of suicides in the TMNP

All of these victims (Table 14) were male with a mean age of 39 years. The predominant age range was 30-39 years and the victims were mainly Caucasian (68.18%) and African (18.18%).

Table 14: Cross tabulations of race, age and gender of suicide victims

Age	Coloured (9, 09%)	African (18, 18%)	Caucasian (68, 18%)	Asiatic (4, 55%)	Total
10 - 19	0	0	0	0	0 (0%)
20 - 29	1	1	2	1	5 (22, 73%)
30 - 39	1	2	3	0	6 (27, 27%)
40 - 49	0	1	4	0	5 (22, 73%)
50 - 59	0	0	4	0	4 (18, 18%)
60 &above	0	0	1	0	1 (4, 55%)
Unknown	0	0	1	0	1 (4, 55%)
Total	2	4	15	1	22 (100%)

The common methods of suicide (Table 15) in descending order was hanging (45%), jumping off the mountain (27%) and gassing in motor vehicles (13%). The 20-29 age groups chose to hang themselves, while those in the 30-39 age category, used hanging and jumping of the mountain as the preferred methods of death.

Table 15: Suicide methods

Method of suicide	Total	%
Car crash	1	4.55
Gas	3	13.64
Hang	10	45.45
Jump	6	27.27
Overdose	1	4.55
Shot	1	4.55
Total	22	100.00

In Table 16 alcohol levels and suicide methods were compared. 11/22 victims tested negative for alcohol, 6 were unknown or not tested and 5/22 (22%) were under the influence of alcohol (>0.01g/100ml). One victim was intoxicated at time of death (alcohol range: 0.26-0.30g/100ml).

Suicides deaths in which victims jumped off the mountain took place predominantly off the Northern and front face of the mountain, while hanging deaths took place predominantly at Signal Hill, Cecilia plantation, Kirstenbosch Gardens, Silvermine, Devil's Peak, India Venster and Cape Point.

The residences of only 10/22 suicide victims were confirmed. There was no information on the socioeconomic status of victims and the employment history and marital status was known in only 4 victims (1 married, 1 single, 2 unemployed). The Southern Suburbs was identified as the common suburb of residence.

Table 16: Suicide methods and blood alcohol levels

Alcohol Range: g/100ml	Car Crash (4, 55%)	Gas (13,64)	Hang (45, 45%)	Jump (27, 27%)	Overdose (4, 55%)	Shot (4, 55%)	Total
0	0	2	5	3	1	0	11 (50%)
0.01 - 0.05	0	1	2	0	0	1	4 (18, 18%)
0.26 - 0.30	1	0	0	0	0	0	1 (4, 55%)
Not Tested	0	0	1	3	0	0	4 (18, 18%)
Unknown	0	0	2	0	0	0	2 (9, 09%)
Total	1	3	10	6	1	1	22 (100%)

Hanging:

45% of victims committed suicide by hanging. The predominant age range of hanging victims was 20-29 years and they were mostly Caucasian (5/10). The deaths were evenly distributed both in the TMNP and on Table Mountain (Signal Hill, Cecilia plantation, Kirstenbosch Gardens, Silvermine, Devils Peak, India Venster and Cape Point).

Trees were the preferred suspension point and victims used belts, shoelaces, rope and nylon bands as ligatures. One individual hung himself, in a Muslim kramat on the mountain. All the victims had asphyxial signs, imprint ligature abrasions and only two had fractures of the hyoid bone.

Jump:

27% of victims jumped off mountain. They chose locations that were on Table Mountain (usually the front face of the mountain, Africa Ledge, Platteklip Gorge, Chapman’s Peak and, India Venster). All were above 30 years of age and Caucasian. Only one victim was African. 3/6 jumpers tested negative for alcohol. The suicides were confirmed as there were eye witness statements and police collateral information.

Gassing:

There were three victims that gassed themselves in cars. These incidents took place on Tafelberg Road, Silvermine Nature Reserve and Table Mountain Dam. The victims died from anoxia due to the effects of carbon monoxide poisoning (85% carboxyhemoglobin levels and cherry red discolouration of organs and blood). Only one victim had an alcohol level of 0.03g/100ml.

Gunshot wound:

There was only one suicidal gunshot wound to the head. The victim used a hand gun and the wound was in the right temporal area of the head. The motivation was thought to be a terminal illness (which was discovered at autopsy) and the victim had an alcohol level of 0.03g/100ml.

Overdose:

There was only one victim who committed suicide by overdose. This occurred in a Moslem kramat and the victim was alleged to have taken an overdose of sertraline (antidepressant-confirmed on toxicology).

Road traffic accident:

There was one victim who committed suicide by driving his vehicle off the road. SAPS who investigated this incident suspected it to be a suicide and at time of death the deceased was intoxicated with an alcohol level in the 0.26-0.30g/100ml range.

Discussion:

There are several important findings from this descriptive study. Table Mountain is a major tourist attraction within the National Park, however contrary to public perception the majority of victims were not foreigners, instead they were South African nationals, predominantly male, Caucasian, 20-29 years of age with a mean age of 39 years.

Fatalities occurred during the peak South African vacation summer months of mid-October to February and over the weekend days of Friday and Sunday. While deaths occurred at different locations throughout the Park, the majority took place along the popular hiking and climbing trails on Table Mountain, and were due to head injuries and polytrauma sustained from falls (71%) while participating in mountain based activities.. These findings are consistent in part with published reports of national park deaths and mountain mortality studies which identified trauma and accidents as a leading cause and manner of death (Arizia et al., 2007; Bauer L, 2002; Flores et al., 2008; Heggie et al., 2004; Heggie et al., 2008; <http://www2.nature.nps.gov/stats>).

The contribution to accidental falls in this study included:

- 24% of victims, who fell, tested positive for alcohol.
- victims attempted activities which exceeded their abilities.
- victims climbed alone or failed to follow directions.
- external factors like poor path maintenance and inadequate signage.

Hence it is apparent that some victims not only failed to follow the safety guidelines advertised by the TMNP but also consumed alcohol despite its prohibition on the mountain and within the Park boundaries.

The study found that 10% of natural deaths were due to a cardiac event. This is consistent with national park and mountain mortality reports which identified cardiac death often precipitated by vigorous activity in individuals with underlying coronary artery disease as the leading non-traumatic cause of death (Burtscher et al., 1993; David et al., 1989; Firth et al., 2008; Faulhaber et al., 2007; Heggie et al., 2008; Mechukaev et al., 2006; Pollard et al., 1988; Reid et al., 1986; Salisbury, 2007; Williamson et al., 2007; Windsor et al., 2009). The study was also able to identify possible risk factors for natural and heatstroke deaths in the TMNP. These included advanced age (60 years and above), increased BMI, pre-existing medical conditions and in the case of foreign visitors not allowing enough time to acclimatise to the hot Cape Town weather.

The single most significant finding of the study was that 22% of deaths in the TMNP were due to suicide. The victims all men, age range of 30-39 years were predominantly Caucasian (68%) and used hanging (45%) and jumping (27%) off the mountain as the two most preferred methods of death. 22.4% of the suicide victims were under the influence of alcohol (0.01g/100ml and greater) and deaths occurred commonly during summer with Fridays and Mondays being the common suicide days. The results from our study agree with national suicide studies, however the victims in this study were slightly older than the national mean age of 34years (Naidoo et al., 2014; Matzopoulos et al., 2003; Matzopoulos et al., 2004; Schlebusch, 2012; www.mrc.ac.za/crime/reports).

While the intent of our study was not to investigate suicide, a possible link between suicide and a location of death was identified. Globally there are well-documented reports of suicides specific to manmade and natural landmarks. International landmarks like the Golden Gate Bridge in San Francisco, Japan's Aokigahara Forest at the base of Mount Fuji (Suicide Forest), Niagara Falls at the Canadian/American border and the Gap Cliffs in Australia are some of the top suicide hotspots ([En.wikipedia.org/wiki/list_of_suicide_sites](http://en.wikipedia.org/wiki/list_of_suicide_sites)). There is limited information on site specific suicide in South Africa however the Van Stadens Bridge in the Eastern Cape (88 suicides since it was built in 1971) was identified as common suicide locations/hot spot (en.wikipedia.org/wiki/suicide_bridge; en.wikipedia.org/Van_Stadens_Bridge).

The study indirectly has uncovered the TMNP and in particular Table Mountain as a possible local suicide hotspot/location. Contrary to the international norm of jumping off famous landmarks, the suicide victims in this study predominantly chose hanging from trees at various locations on the mountain and across the Park as the preferred method of death (Berman et al., 1994; Blaustein et al., 2009; Cox et al., 2013; Daigle 2005; Florentine et al., 2010; Gunnel 2010; Knox et al., 2004, Linquist et al., 2004; O'Connor et al., 2011).

Hence it seems that Table Mountain on a psychological level has special significance for South Africans who actively choose to be close to the mountain at the time of their premeditated death. More research into this phenomenon is needed.

Study limitations:

1. The data recorded in this study may not be truly representative for several reasons. The different databases, mortuary records and archives were searched and only confirmed fatalities from the TMNP were recorded. However: lost records, administrative errors, omissions, inaccurate and nonspecific recordings could have resulted in the number of fatalities being underestimated. Sometimes database entries were not listed under specific keywords of Table Mountain or TMNP and instead listed as unknown or undetermined. These variations in data recording could have affected the final number of fatalities obtained. Attempts were made to counteract this by cross checking with multiple sources, but inaccuracies might still have occurred
2. Lack of collateral information and inaccurate recording of victim information. Time of death was sometimes confused with the time the body was certified dead. Missing data were noted in particular categories studied, such as marital status, socioeconomic status, occupation and residential address. This was especially true for deaths prior to 2005, as most records were destroyed or lost. Relatives and family members could not be interviewed, hence further limiting the amount of information obtained
3. This study precluded a deeper investigation and exploration of precipitating factors of death especially of suicides which emerged as a significant finding of the study (Naidoo et al., 2014). This was largely due to poor recording and lack of information particularly in categories such as history of mental illness, history of depression, previous suicide attempts and drug/medication use. There was also poor recording of the presence or absence of suicide notes.

4. The small sample size of 98 deaths in 12 years makes this study purely descriptive. However it is crucial to emphasize that the majority of deaths (accidents and suicides) in this study are possibly preventable. The financial burden placed on TMNP during each search and retrieval of missing and dead persons can be great, so information gained from this study could be significant both in death prevention and from a budgetary standpoint.
5. No comment could be made on mountain fatality rates due to the inconsistent and conflicting estimates of people who climbed Table Mountain and those who visited the National Park. There are at least 100 entry points to the National Park and only 4 pay points; hence any numbers reported would be an underestimation rather than an accurate representation.
6. Lack of sources to validate the study findings. The results was compared to data from the South African Accident Mountain database website, despite the fact that the author declared the data incomplete and inferential (alewis.its.uct.ac.za/sama). Our study recorded more fatalities (98 as opposed to 77), and could provide more details as to the cause and manner of death. The common locations of death differed in some instances as we recorded locations from death scene scripts and body retrieval forms as completed by forensic pathology officers, rather than actual GPS map coordinates.
7. Not all blood alcohol results of victims were available for examination. In some cases the finalised blood reports were lost; while in other cases, the autopsy blood specimens had not yet been analysed by the state laboratory. Hence the blood alcohol percentages presented, might be an underestimation rather than an accurate representation of blood alcohol levels in TMNP fatalities.

Study recommendations

1. The existing TMNP safety guidelines need to be periodically assessed and updated. A number of death locations were identified in the study. This information needs to be brought to the attention of TMNP authorities, so that the common paths and trails in the Park and on Table Mountain are regularly inspected and properly maintained, especially after torrential rains and heavy winds. Tafelberg Road was identified as an additional death location; hence it should be included in the schedule for the routine patrols and monitoring.

2. TMNP and SANParks need to be educated about the problem of mountain based suicide and the need for implementing site specific prevention programs. This could include training of staff in recognising suspicious suicidal behaviour on the mountain, increased Park officials' presence and video surveillance at the common suicide locations across the Park and on the mountain. Efforts could also be directed at engineering modifications at limiting/restricting access to the common suicide sites. This could include erecting of physical barriers which research have shown is a good deterrent to suicidal behaviour (Berman et al., 1994; Blaustein et al., 2009; Cox et al., 2013; Daigle, 2005; Florentine et al., 2010; Gunnel, 2010; Goldsmith et al., 2002; Knox et al., 2004; Linqvist et al., 2004; O'Connor et al., 2011). Efforts should be directed at strategic placing of pamphlets, posters and signage with suicide hotlines numbers, in souvenir shops, walk ways, restaurants and restrooms along the common suicide locations. This could be expanded to awareness campaigns in newspaper and television media (www.cdc.gov/mmwr/preview/mmwrhtml/mm5947a2.htm). Co-operation on all levels would be required.
3. Information from this study could form the basis of public awareness campaigns aimed at the people intending to visit and participate in mountain activities. Such individuals should not underestimate the potential risks of the mountain. Ideally they should clear their visit with a doctor especially if they are overweight and have an underlying medical condition. Overseas visitors, particularly those from cooler/colder climates should be aware of their vulnerability to heatstroke and allow adequate time for acclimatisation to the mountain environment (http://www.sanparks.co.za/parks/table_mountain/tourism/attraction.php).
4. This study has illustrated the importance of follow up studies. This would involve forming collaborations between important role players like the TMNP, SANParks, Mountain rescue clubs, Wilderness Search and Rescue, Forensic Pathology Service, suicide awareness organisations, depression treatment societies and community support groups. This multi-disciplinary team approach will help to effectively validate the findings of this study and help devise comprehensive strategies for the prevention of all mountain fatalities especially suicide (www.cdc.gov/mmwr/preview/mmwrhtml/mm5947a2.htm).

5. More research into the epidemiology of suicides in Cape Town. This should include methods of improved data collection from the next of kin of suicide victims. Standard operating protocols (including a suicide questionnaire) should be implemented, in which it is mandatory to note any risk factors and information regarding marital status, employment history, socioeconomic status, presence or absence of suicide notes, previous suicide attempts and medical, mental and depression history. Such information will be useful as it would help in identifying risk factors unique to the Cape Town context.

Conclusion:

Table Mountain and the National Park are frequently visited tourist destinations in Cape Town South Africa. This study has helped to identify site specific suicide as a problem which requires awareness and preventative strategies. It is a challenging task that requires further research, collaboration, ongoing analysis and monitoring. This study has emphasized the need to begin the process in light of the significant findings.

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Appendix A:

Research proposal:

Deaths in the TMNP 2000-2011

Submitted 2010.

Introduction:

Table Mountain is one of most widely recognized and frequently visited landmarks in Southern Africa^{2,8}. Forming a magnificent backdrop to the City of Cape Town; this mountain range attracts almost 4.2million visitor's annually^{2,6}.

Although a seemingly benign playground for tourists and locals there are inherent risks and dangers associated with the mountain.¹ This fact has been consistently highlighted by the media. An internet article published on the 11th of August 2007⁶ discussed safety on Table Mountain and reported 20 fatalities in 2006 and 10 in 2007. Another article⁴ claimed that Table Mountain killed more people a month than shark attacks of the Cape coast.

The 'Cape times' and 'Argus' newspapers have also printed recent articles which highlighted the dangers of the mountain⁷. Some examples were:

- 'Dead hiker on Table mountain'
- 'Rescuers have hands full on Table Mountain'
- 'Man falls to death on Table mountain'
- 'Two German tourists plunge to their deaths'

Further evidence is provided by the South African Mountain Accident Database³ which reported 284 incidents and 29 deaths on Table Mountain and surrounding area from 2008 to May 2010.

Thus a formal retrospective study investigating fatalities on Table Mountain could prove beneficial. By examining the autopsy reports, the cause and manner of death, types of injuries, pre-existing or undiagnosed medical conditions, blood alcohol levels and demographic profiles of the victims could be analysed. Secondly examining the circumstances surrounding the deaths could help in identifying the most dangerous areas on the mountain and the high risk recreational activities.

Thirdly information gained from this study would help in educating tourists and locals about the potential health risks and necessary precautions to be taken when visiting the mountain. Finally the study would yield practical methods and suggestions which would be presented to Park officials with the aim of improving safety and reducing mountain mortality.

Aims:

- To accurately determine the number of deaths within the Table Mountain National Park and Table Mountain from 2000 to 2011;
- To obtain demographic profiles of the victims, including identifying potential risk factors that could have contributed to their deaths;
- To identify the areas and activities that proved the most risky on the mountain;
- To propose methods to improve safety on the mountain.

Design and Methods:

Study design: Retrospective study

Study population: Autopsy, death scene and police reports of deaths received at the Salt River Forensic Pathology Laboratory 2000-2011.

Method:

Electronic and manual searches of all autopsy, death scene and police reports of the cases at the Salt River Forensic Pathology Laboratory for the period 2000-2011, will be done to identify fatalities within the Table Mountain National Park and Table Mountain.

Analysis:

1. The collation of data will be done using Microsoft Excel spreadsheets.
2. Analyses will be done using standard statistical packages.

Ethical considerations:

Only reports of individuals who required a medico-legal autopsy according to South African legislation will be included in this study. During collection and presentation of data each case will be identified by a death register number and all personal identifiers will be removed so as to ensure anonymity. Guidelines of the Inquest Act 58 of 1959 will be adhered to and confidentiality will be maintained.

Results:

This study will provide relevant data on the number, risk factors, cause, manner and circumstances of deaths that occurred on Table Mountain and within the national Park. The study will be submitted as part of the requirements for an MMED degree (Forensic pathology) at the University of Cape Town. The study will be made available to the TMNP with the foreseen benefit of public health education, improved safety and prevention of mountain mortality. The study will be submitted for publication in a peer review journal. The study will be presented at national and/or international conferences.

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Appendix B:

Health Research Ethics Committee study approval and renewal forms:



FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001638)			
This serves as notification of annual approval, including any documentation described below.			
<input type="checkbox"/> Approved	Annual progress report	Approved until/next renewal date	30/07/2015
<input type="checkbox"/> Not approved	See attached comments		
Signature Chairperson of the HREC	<i>L. Egedi</i>	Date Signed	22/07/2014

PP

Principal Investigator to complete the following:

1. Protocol Information

Date form submitted	11/07/14		
HREC REF Number	451/2010	Current Ethics Approval was granted until	
Protocol title	Retrospective analysis of deaths in the Table Mountain Wildlife Park - 2000-2011		
Principal Investigator	SAIRITA MAISTRY		
Department / Office Internal Mail Address	Sairita Maistry P.O. Box 29		
1.1 Does this protocol receive US Federal funding?	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	

2. Protocol status (tick ✓)

<input type="checkbox"/> Research-related activities are ongoing	NO
<input checked="" type="checkbox"/> Data collection is complete, data analysis only	REQUEST IS FINISHED FOR SUBMISSION

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval	2000-2011 (95)
Total number of records or specimens collected, reviewed or stored since last progress report	(98)
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

4. Signature

Signature of PI	Signed by candidate	Date	17/7/14
Signature of Supervisor (if PI is a student)	Signed by candidate	Date	17/7/2014

Appendix C:

Publication submission guidelines:

American Journal of Forensic Medicine and Pathology

Online Submission and Review System

SCOPE

Drawing on the expertise of leading forensic pathologists, lawyers, and criminologists, The *American Journal of Forensic Medicine and Pathology* presents up-to-date coverage of forensic medical practices worldwide. Each issue of the journal features original articles on new examination and documentation procedures.

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Journal article

1. Rand NS, Dawson JM, Juliao SF, et al. In vivo macrophage recruitment by murine intervertebral disc cells. *J Spinal Disord.* 2001; 14: 339-342.

Book chapter

2. Todd VR. Visual information analysis: frame of reference for visual perception. In: Kramer P, Hinojosa J, eds. *Frames of Reference for Pediatric Occupational Therapy*. Philadelphia, PA: Lippincott Williams & Wilkins; 1999:205-256.

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Online journals

5. Friedman SA. Preeclampsia: a review of the role of prostaglandins. *Obstet Gynecol* [serial online]. January 1988; 71:22-37. Available from: BRS Information Technologies, McLean, VA. Accessed December 15, 1990.

Database

6. CANCERNET-PDQ [database online]. Bethesda, MD: National Cancer Institute; 1996. Updated March 29, 1996.

World Wide Web

7. Gostin LO. Drug use and HIV/AIDS [*JAMA* HIV/AIDS Web site]. June 1, 1996. Available at: <http://www.ama-assn.org/special/hiv/ethics>. Accessed June 26, 1997.

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