



Eight-Thousanders

An Analysis on Death-Zone Mountaineering Using the Himalayan Database

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Introduction

In mountaineering, the death zone refers to altitudes above 8,000 m (26,000 ft) where the amount of oxygen is insufficient to sustain human life for an extended time span. There are a total of 14 mountains in the death zone (also known as the eight-thousanders) located in the Himalaya and Karakoram mountain ranges. Each year, climbers from all over the world are drawn to the beauty of eight-thousanders and venture into the death zone in attempts to summit the peaks. While many succeed and celebrate the triumph on the top of the world, some unfortunately never return and many more are injured or become ill during the expeditions.

Research Questions

The research explores the 16 eight-thousander peaks that are publically open to climbers with permits in the Himalayas mountain range. We begin the research with an analysis on the profiles of the 16 peaks. The question we ask is:

- What are the 16 eight-thousander peaks in Himalaya?

With the peak profiles explored, we turn our attention to the following three main research questions:

- Who are the people willing to risk their life venturing into the death zone?
- How do mountaineers' eight-thousander peak preferences change over time?
- Why is climbing eight-thousanders difficult?

The first question seeks to study the demographics of the climbers who are drawn to the eight thousanders. The second question, inspired by the surge in the number of expeditions to Mount Everest in recent years, focuses on analyzing the historical trend of mountaineers' preferences over time in the Himalayan mountain range. Lastly, by researching the risks associated with climbing eight-thousanders and combining the insights gained from prior questions, we attempt to propose safety guidelines for mountaineering expeditions in the death zone.

Data

Data Sources

The research is primarily based on the Himalayan Database, which can be best described by the creator's own words:

"The Himalayan Database is a compilation of records for all expeditions that have climbed in the Nepal Himalaya. The database is based on the expedition archives of Elizabeth Hawley, a

longtime journalist based in Kathmandu, and it is supplemented by information gathered from books, alpine journals and correspondence with Himalayan climbers.”

The Himalayan Database contains five primary datasets:

Table: The Himalayan Database

Dataset	Description
Peaks	Data of all peaks in the Himalayas
Expeditions	Data of all expeditions between 1905 and 2019
Members	Data of members of each expedition between 1905 and 2019
Expeditions Analysis	Calculated expedition analytics based on the Expeditions dataset
References	References used for constructing the Himalayan Database

Note that the 16 peaks explored in the research does not include the famous K2 (Mount Godwin Austen), the second highest summit after Mount Everest at 8,611m, because K2 is located in the Karakoram mountain range in Pakistan and China instead of the Himalayas mountain range in India, China, Nepal, and Bhutan that the report focuses on. Also note that although there are only a total of 14 eight-thousanders in the world, each mountain can have more than one peak above 8,000 meters. The mountain, Kangchenjunga, for example, has two officially listed peaks: Yalung Kang (YALU, 8505m) and Yalung Kang West (YALW, 8077m). While Yalung Kang has been climbed multiple times, no successful summit attempt has been made for Yalung Kang West as of the time the report is written in 2020.

Data Sanity Checks

The Himalayan Database is very well maintained. While there are missing data (possibly due to the difficulty collecting perfectly accurate data at this scale), we found no evidence of major flaws that would call the database’s credibility into question.

Previously in the proposal, the credibility of the Himalayan Database was questioned because it records Yalung Kang West (YALW) as an unclimbed peak while multiple sources indicate that the mountain has, in fact, been climbed. The confusion comes from the fact that each of the eight-thousanders analyzed in the research can have more than one peak. While the mountain, Kangchenjunga, has been climbed, the specific peak of our interest, Yalung Kang West, was opened to the public only recently in 2014 and no successful ascent has been claimed.

The Himalayan Database, however, does suffer from minor issues. For example, the variable [age] from the Members database contains only zero values while the true age of the climber is shown by the calculated variable, [calcage]. Some variables such as [smttime] and [smtdate] (summit time and days taken to ascend the peak) also use a nonstandard string, “ - -” (prefixed with two whitespaces), to indicate null entries, making the data cleaning process particularly

challenging and time-consuming. Lastly, the Members database can be confusing because the climbers included are associated with the expeditions found in the Expeditions database, meaning the same climber can appear twice if he or she participates in more than one expedition.

All issues found are handled and resolved during the data cleaning process. Overall, we believe that the Himalayan Database is a trustworthy source and are confident about the conclusions we draw from it.

Research Findings

The Peaks

A total of 16 eight-thousander peaks in the Himalayan mountain range are included in the research. Peaks are listed in alphabetical order by their IDs whenever possible in the report for easy lookup. The three tallest peaks are Everest (8850m), Kangchenjunga (8586m), and Lhotse (8516m). Mount Everest is arguably the most famous peak due to its high profile built up by the mainstream media, but Cho Oyu (CHOY) is also rapidly gaining popularity amongst mountaineers in recent years. A more in-depth analysis on trends will be discussed later in the report.

Table: Eight-Thousanders in Himalayas

	Peak Name	Height (m)	Height (ft)	Host Country
ANN1	Annapurna I	8091	26545	Nepal
ANNE	Annapurna I East	8026	26332	Nepal
ANNM	Annapurna I Middle	8051	26414	Nepal
CHOY	Cho Oyu	8188	26864	Nepal, China
DHA1	Dhaulagiri I	8167	26795	Nepal
EVER	Everest	8850	29035	Nepal, China
KANG	Kangchenjunga	8586	28169	Nepal, India
KANC	Kangchenjunga Central	8473	27799	Nepal, India
KANS	Kangchenjunga South	8476	27808	Nepal, India
LHOT	Lhotse	8516	27940	Nepal, China
LHOM	Lhotse Middle	8410	27592	Nepal, China
LSHR	Lhotse Shar	8382	27500	Nepal, China
MAKA	Makalu	8485	27838	Nepal, China
MANA	Manaslu	8163	26781	Nepal
YALU	Yalung Kang	8505	27904	Nepal
YALW	Yalung Kang West	8077	26499	Nepal

The 16 eight-thousander peaks are located in the Himalayas mountain range along the border of India, China, Nepal, and Bhutan. All expeditions attempting to summit the peaks require permits

purchased directly from the government officials. Mount Everest, for example, costs a whopping \$11,000 per climber on the south side (Nepal) and slightly cheaper in Tibet (China) at about \$8,000. The expeditions are NOT cheap! An attempt to summit the peaks can be a once in a lifetime opportunity, a reason why many climbers are unwilling to give up their attempt to ascend even when their (or even others') life is at risk.

A terrain view of the 16 eight-thousander peaks already says a lot about the costs and risks associated with climbing. Notice how the peaks are at inaccessible locations in the middle of the Asia continent, and the heights of which can be observed even from satellite imagery.

Figure: Locations of Eight-Thousanders



Except for Yalung Kang West (8,077m), which was officially open to the public only starting from 2014, all eight-thousander peaks have been climbed. Mount Everest, for example, was first ascended by the mountaineers, Edmund Hillary and Tenzing Norgay on May 29, 1953. It was an amazing accomplishment considering the lack of modern climbing equipment and logistics operations available at the time. Just look at their goggles and how heavy their oxygen bottles are!

Lastly, an examination of the nationalities of first ascenders shows that Europe is truly the origin of mountaineering in recent history, which started way back in the mid-18th century. The discussion of historical events in mountaineering will be briefly addressed below.

Figure: First Ascent Timeline

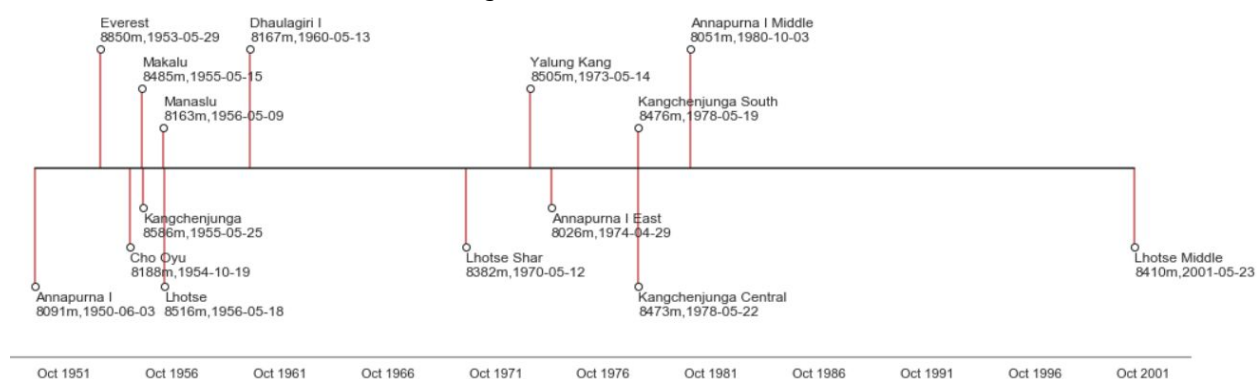


Image: Edmund Hillary and Tenzing Norgay



Table: Number of First Ascents by Country

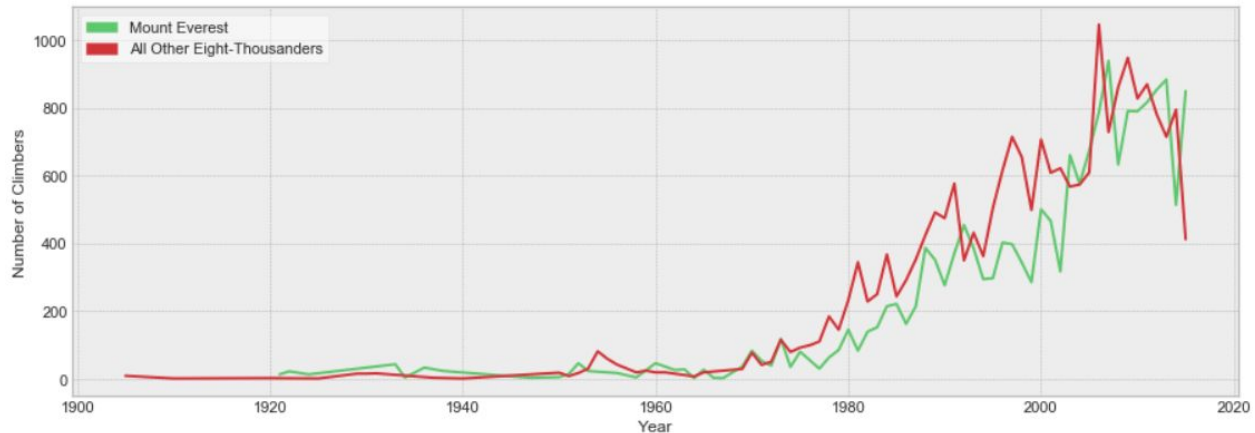
	No. of 1st Ascent
Austria	3
Nepal	3
France	2
W Germany	2
Switzerland	2
Poland	2
Japan	2
Spain	1
New Zealand	1
India	1
UK	1
Russia	1

The Climbers

Homes of the Daredevils

Eight-thousanders have seen a surge in popularity since 1980. We begin the research by asking ourselves: Who are the daredevils willing to risk their lives for a chance to summit the peaks in the death zone?

Figure: Eight-Thousander Climber Population (1905-2019)



Without question, Europe has the highest number of eight-thousander climbers given its long history in mountaineering. Our research also shows that most climbers come from developed countries including Japan, Korea, and the US, likely reflecting the high costs associated with the expeditions.

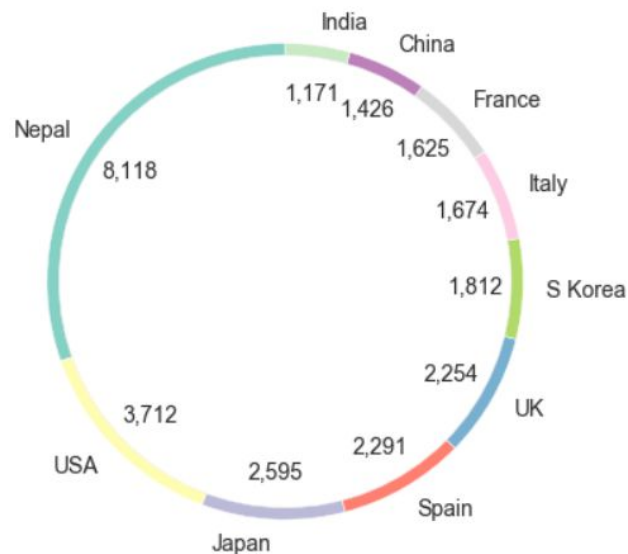
Figure: Eight-Thousander Climbers' Home Countries (1905-2019)



Underappreciated Sherpas

Nepal has the highest climber population because of the Sherpa mountaineers hired by the expedition teams. It is widely believed that most expeditions would otherwise not even be possible without the help of Sherpas. Unfortunately, they have not been well respected or even officially listed by the records until recent years. We suspect that the population of the Sherpa mountaineers is largely underestimated despite the already high number recorded by the Himalayan Database.

Figure: Top-10 Climbers' Home Countries (1905-2019)



Too Much Time & Cash

A high-level overview of the climbers' occupations also show interesting insights. Most mountaineers drawn to the eight-thousanders are, in fact, not professional climbers. Physicians predictably top the list because all expeditions require at least one physician to accompany the teams. The high number of alpine guides can also be explained by the experienced guides and Sherpas hired by the expedition teams.

The surprise is the engineers and students that show up as the top occupations for both Mount Everest and other eight-thousanders. Students can be comprehended by the fact that climbing eight-thousanders require the top-notch physical conditions possessed by young people. Yet the appearance of engineers puzzles us, and the only possible explanation we find in the literature is that engineers from developed countries have the spare cash, time, and youth (e.g. consider the \$250K salary of Facebook engineers in their twenties) required for the expensive expeditions into the death zone.

Figure: Top-10 Occupations by Percentage (1905-2019)

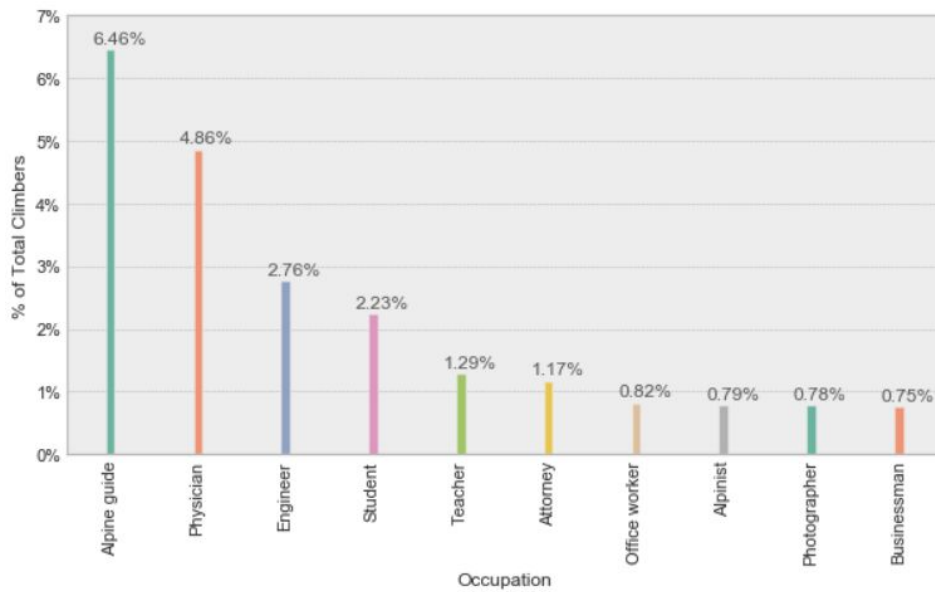


Table: Top-5 Occupations by Mountains (1905-2019)

Mount Everest	Physician	309
	Alpine guide	296
	Student	174
	Engineer	126
	Attorney	79
Other Eight-Thousanders	Alpine guide	818
	Physician	529
	Engineer	350
	Student	210
	Teacher	159

Rise of Girl Power

Mountaineering has historically been dominated by men: Only 1 out of 10 climbers were female between 1905 and 2019. However, there has been a rapid growth of female climbers since 1980. Our research also finds almost identical age distributions between male and female climbers, further demonstrating that climbing ability varies by age, not by gender. In fact, the youngest climber to ascend Mount Everest is a female climber, as shown later in the report.

Figure: Male vs. Female Climbers (1905-2019)



Figure: Number of Female Climbers by Year)

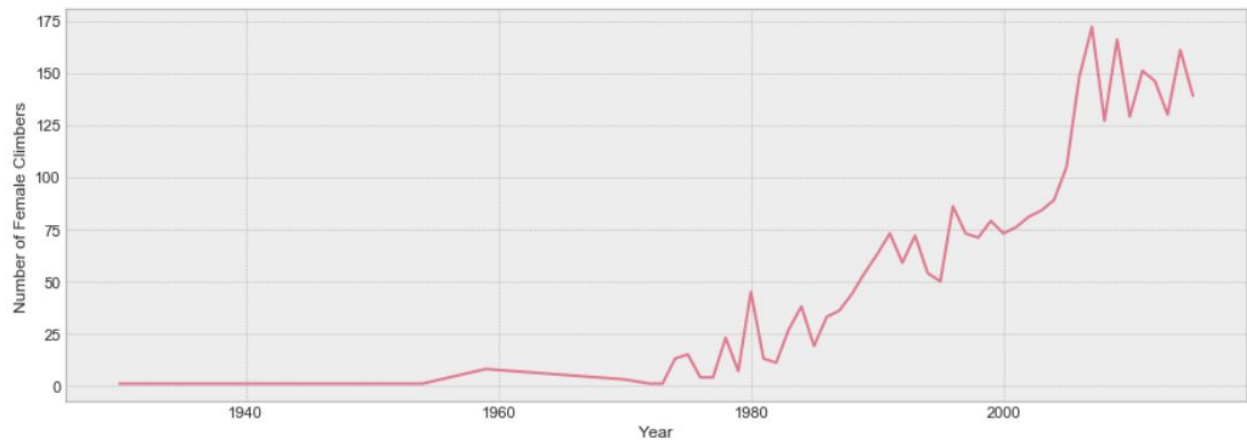
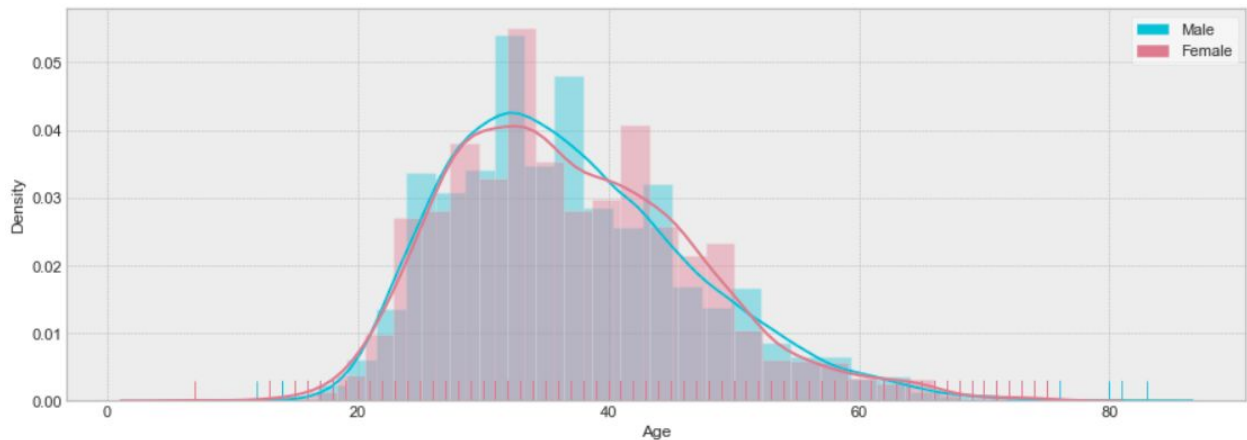


Figure: Age Distribution, Male vs. Female (1905-2019)



Age Is a Problem, Says Who?

Our research finds that the average age of climbers to the eight-thousanders has been increasing steadily since 1980. The trend is almost identical between Mount Everest and the other 15 eight-thousanders, so the increase cannot be attributed to the optimized operations that make climbing an easier challenge on Mount Everest.

In fact, the youngest climber to ascend Mount Everest is Malavath Pooma, a 13 year old girl from India, and the oldest climber is Min Nahadur Sherchan, a 76 year old man from Nepal. Age is definitely not stopping mountaineers from venturing into the death zone. Don't let age stop you from doing what you love!

Figure: Average Climber Age by Year

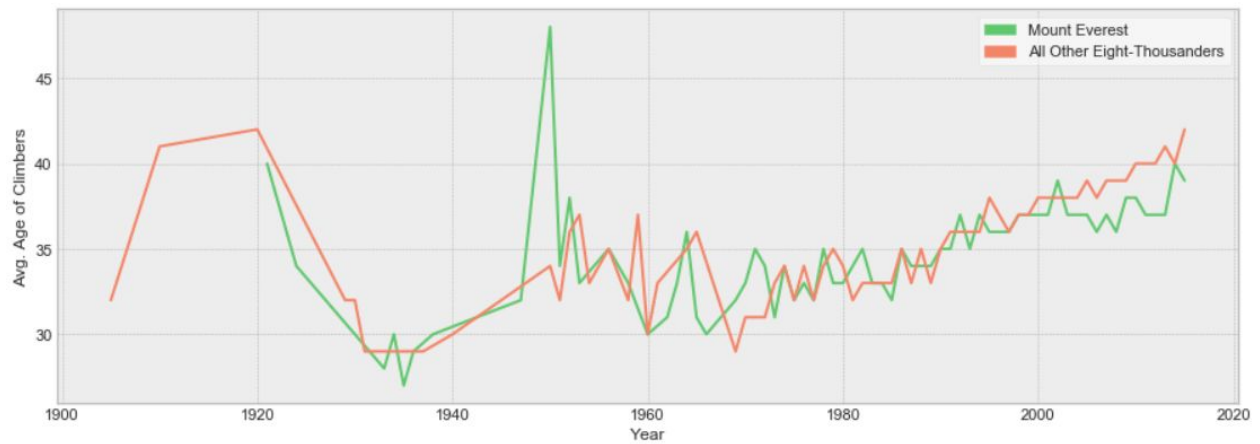


Table: Oldest Ascenders

First Name	Last Name	Age	Citizen	Year	Peak
Min Bahadur	Sherchan	76	Nepal	2008	EVER
Toshihiko	Ogiwara	73	Japan	2009	CHOY
Toshiko	Uchida	71	Japan	2002	CHOY
Michihiro	Masaki	71	Japan	2009	CHOY
Katsusuke	Yanagisawa	70	Japan	2006	CHOY

Table: Youngest Ascenders

First Name	Last Name	Age	Citizen	Year	Peak
Malavath	Poorna	13	India	2014	EVER
Jordan	Romero	13	USA	2010	EVER
Mingkipa	Sherpa	15	Nepal	2003	EVER
Raghav	Joneja	15	India	2013	EVER
Mark	Pfretzer	16	USA	1996	CHOY

Image: Min Nahadur Sherchan (Left) & Malavath Pooma (Right)



The Trends

Special Thanks: The section is written by [Scott Robertson](#) who interviewed two death-zone mountaineers who successfully ascended Mount Everest .

Climbing 8,000'ers Is a New Thing

While the idea of “climbing Everest” as a metaphor for accomplishing daunting tasks is widespread to the point of being trite, the actual history of modern mountaineering is surprisingly short. The idea of climbing peaks as a competitive venture seems to have begun in the French Alps in the late 18th century. By the late 18th century, all of the primary peaks in the Alps had been conquered, and the sport began looking for a more difficult challenge.

In keeping with the nationalistic trends at the time, the major European powers began to see summitting large mountains across the world as a way to demonstrate the primacy of their nation. As a result, the major European powers and the United States governments began sponsoring large, military-like expeditions to the largest peaks in the world, which naturally led to a focus on the Himalayas. Interestingly, each country essentially “laid claim” to a peak, and would spend an entire climbing season sending a single expedition to the peak with the hope of summitting.

This style of mountaineering continued until the outbreak of World War 2 (approx. 1939 - 1945), during which time mountaineering essentially stopped. After the war, the European nations continued their quest for the glory of summitting, but this time equipped with brand new technologies from war-time efforts, and a renewed interest in proving their national superiority.

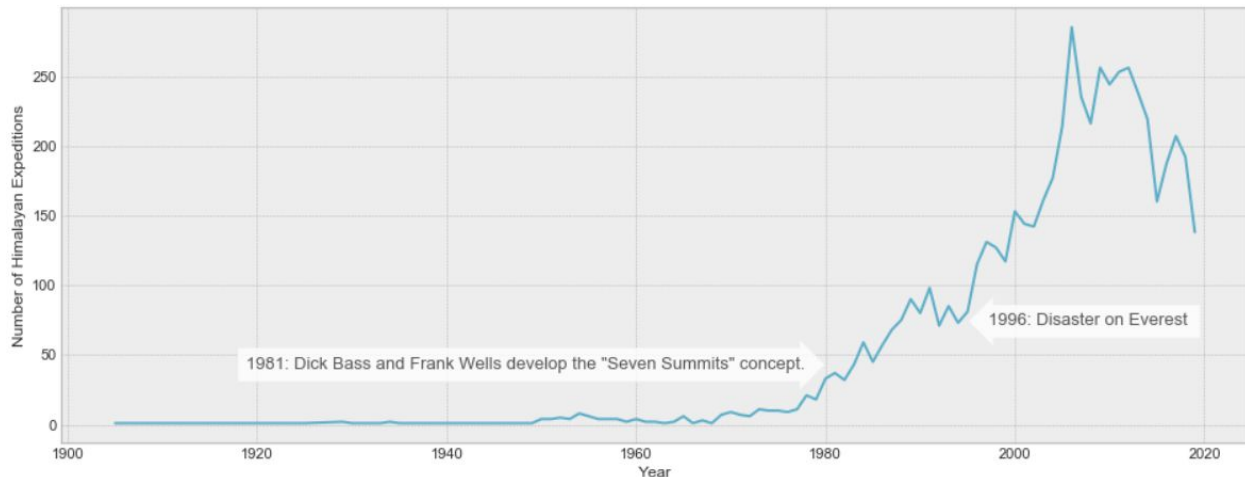
Annapurna was the first eight-thousand meter peak successfully climbed on June 3, 1950 by a Frenchman, Maurice Herzog. All of the remaining eight-thousanders would be climbed within the next decade, with special fanfare around Edmund Hillary and Tenzing Norgay’s ascent of Mount Everest in 1953. After the peaks had been conquered and the climbers became international celebrities, the sport turned to attempting more technically impressive - but less strategically important - feats like winter ascents and climbing without supplemental oxygen. Not surprisingly, as the headlines became less flashy the funding from national governments dried up.

This trend continued until the late 1970s, when two American businessmen named Frank Wells and Dick Bass decided to take up mountain climbing. They devised a concept that they coined the “Seven Summits”, which consisted of climbing the tallest mountains on each of the continents. Obviously, this was an expensive hobby, and was only made possible by the immense wealth of the two men who had made it their mission. They enlisted professional climbers (including Yvon Chouinard, the founder of Patagonia) to help them on their mission.

After years of trying, Dick Bass eventually accomplished the feat in 1985, although Frank Well’s public profile ensured that there were People Magazine covers extolling their mission long before the Seven Summits had been conquered in full. This public image of amateurs (albeit very rich amateurs) accomplishing a feat that was previously the purview of Olympic-level athletes lit a

spark in the public perception of mountaineering. As you can see in the chart below, what followed was an exponential growth in the popularity of mountaineering as a publicly accessible sport, and climbing Himalayan peaks as a “bucket list” worthy adventure.

Figure: Himalayan Expeditions by Year



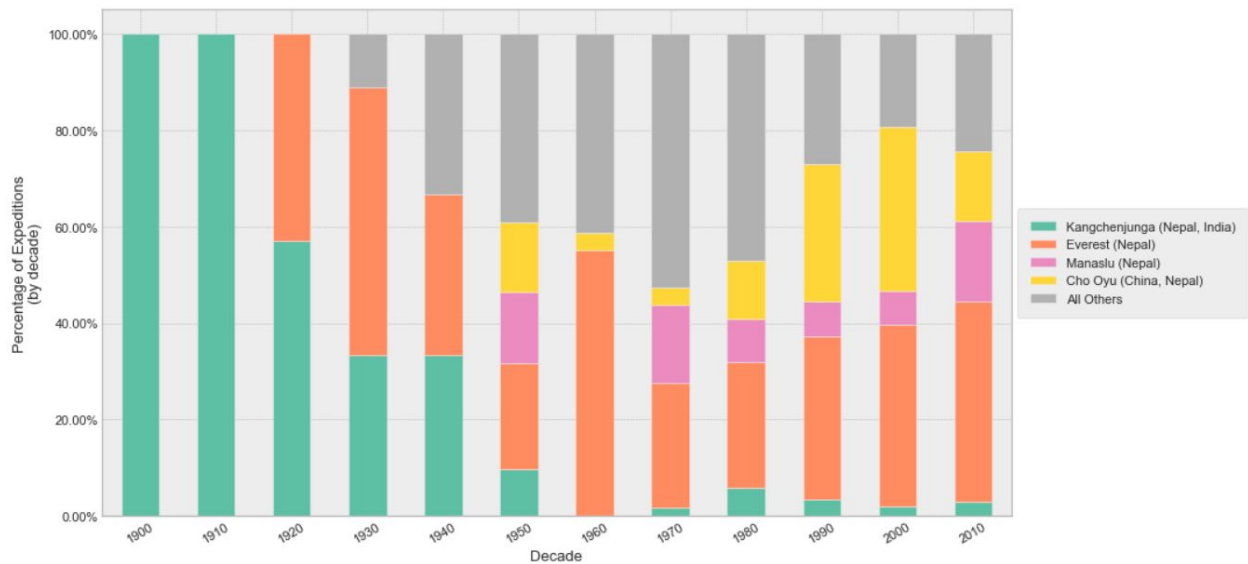
Modern Mountaineering Trends

Starting with Frank Wells and Dick Bass’s adventures, more and more “regular” people became involved in the sport of mountaineering. As you can see in the chart above, the number of Himalayan expeditions increased rapidly, and the number of commercial outfitters ready to take eager amateurs up the largest mountains in the world increased rapidly. As “accessible” as Everest and its brethren became, it is not surprising that there would eventually be trouble as more and more people with less and less experience attempted a feat that only 30 years prior was thought to be impossible.

Finally in 1996, the disaster finally struck. On May 10-11, 1996, 8 climbers were killed when they were caught in a blizzard while trying to descend from the summit. This caused a widespread reevaluation of the safety of climbing Mt. Everest. Today, there is an emphasis on a “climbing resume” before an adventurer can attempt Everest, and it explains some of what we see in the shift of peak preferences over time in the chart below.

Strikingly, our “Peaks” dataset contains 468 peaks in the Himalayan range. However, over 75% of the expeditions are focused on just 4 of those peaks. This speaks to two trends that we have come across: First, that there is an “economy of scale” in mountaineering. Large, popular peaks like Everest require extensive infrastructure to make climbing possible and economical. This leads to a concentration of expeditions to peaks where that infrastructure is in place and maintained. Second, there is an informal “training set” of large mountains (like Cho Oyu), and the outfitters tend to direct less experienced climbers to peaks with a lower level of danger.

Figure: Himalayan Peak Preferences by Decade (1905-2019)

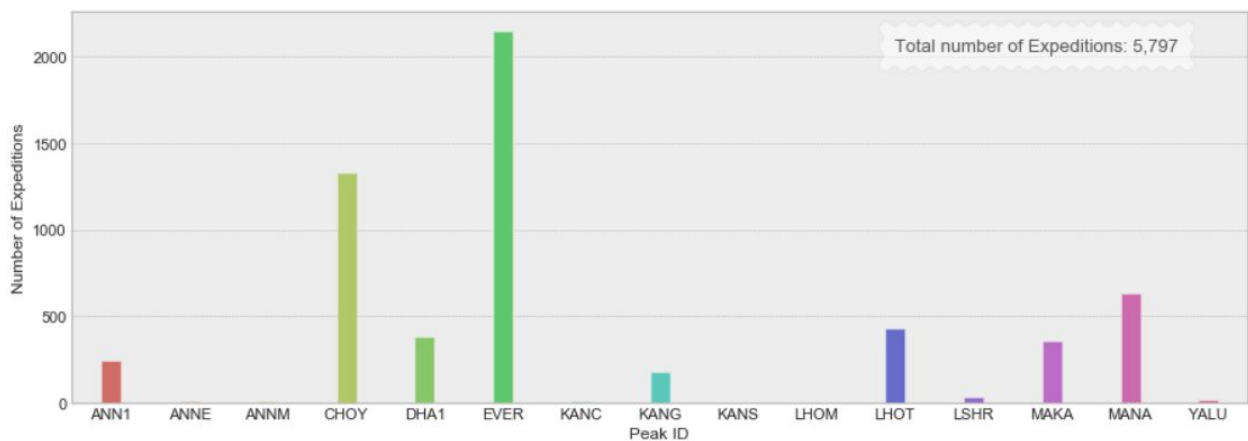


The Risks

Training Ground

Mount Everest (EVER) and Cho Oyu (CHOY) draws an uneven high number of climbers among the 16 eight-thousander peaks studied in the research. The popularity of Mount Everest, the highest peak on Earth, is unsurprising given its presence in the popular imagination. Cho Oyu, on the other hand, attracts climbers for a different reason: It is generally believed to be the easiest peaks above 8,000 meters, an ideal “training ground” for those planning a future attempt on other eight-thousanders.

Figure: Number of Expeditions by Peak (1905-2019)



Free WiFi in the Death Zone?

Our research findings show that the 16 eight-thousanders are 35.64% more dangerous to climb than the other mountains in the Hymalayan mountain range. Roughly 26% of the expeditions into the death zone fail to ascend while the failure rate for other mountains is only 17%.

While the failure rate is relatively consistent over time across most of the eight-thousanders studied in the research, we find a dramatic change in Mount Everest since 1980: the success rate and death rate continue to improve despite a steep increase in the number of expeditions. One main reason for the improvement is the highly optimized operations along the two main climbing routes on the mountain.

Ever since the first ascent by Edmund Hillary and Tenzing Norgay almost 70 years ago, routes to summit Mount Everest have been studied in great details by thousands of mountaineers through countless trials and errors. The newly available funding in recent years, thanks to the surge of climbers since 1980, has also been instrumental in building infrastructures and improving supply/medical logistics that greatly reduce the risks associated with climbing.

Today, even free Wi-Fi is available on Mount Everest up to the base camp at 17,000 feet. Perhaps the greatest challenge onwards is not to survive the death zone but clean up the garbage climbers leave behind on Mount Everest over the years.

Figure: Expedition Failure Rate on Eight-Thousanders (1905-2019)



Figure: Number of Expeditions, Mount Everest

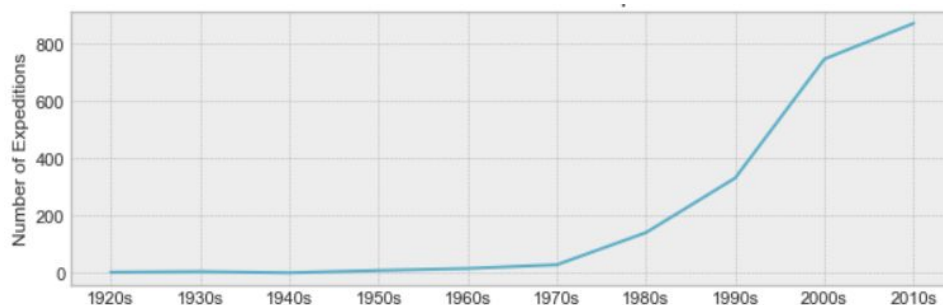


Figure: Success Rate, Mount Everest

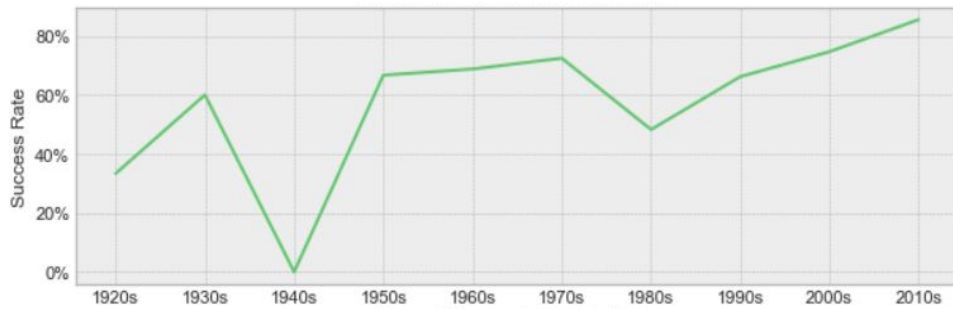


Figure: Death Rate, Mount Everest

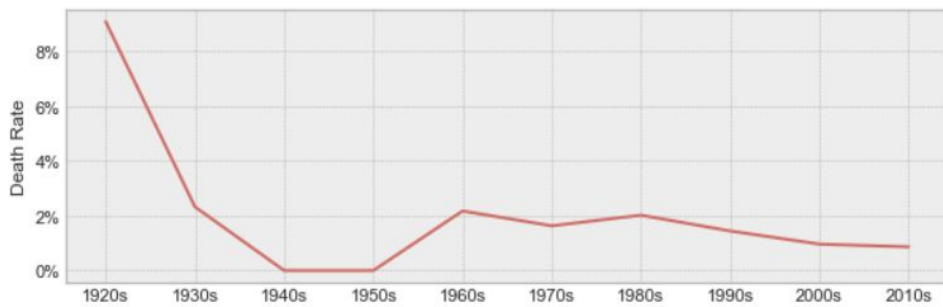


Figure: WiFi Station on Mount Everest

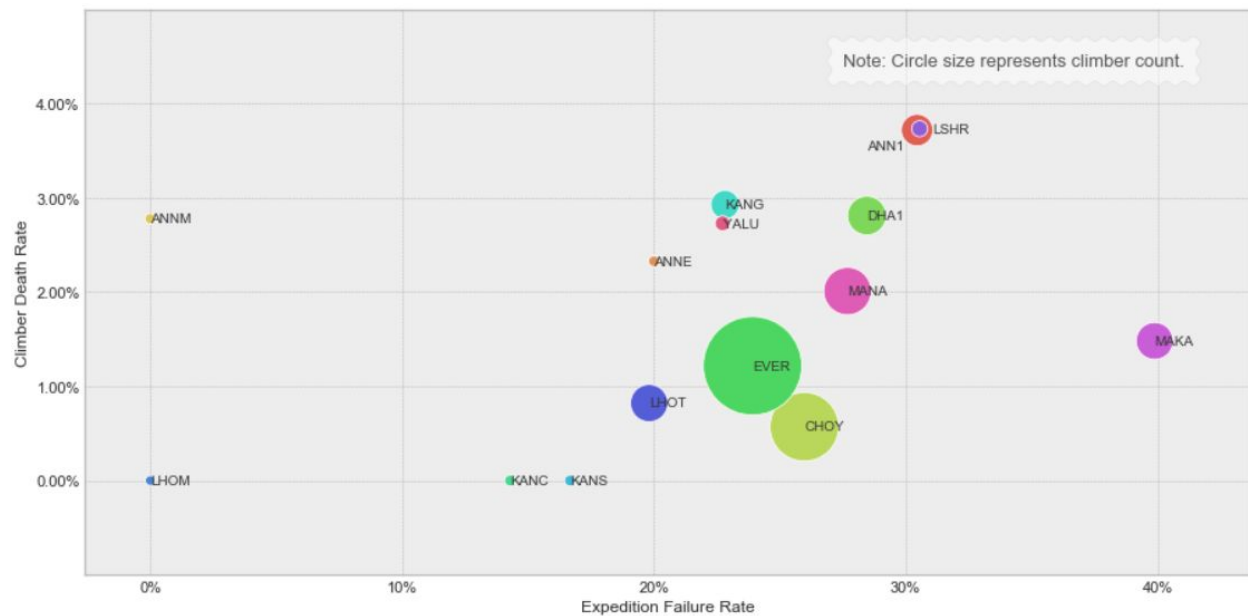


Most Deadly Peak

While Mount Everest is the tallest peak on Earth, it is not the most technically difficult to climb. A Failure Rate vs Death Rate plot shows that the top three most deadly peaks are arguably MAKa, LSHR, and ANN1 given the high death and failure rates. Zero death rate is recorded for peaks such as LHOM, KANC, and KANS not because they are easy but because these peaks have been climbed by a very small number of expedition teams consisting mainly of highly skilled and experienced mountaineers.

One surprise is that even though CHOY is generally believed to be the easiest peak to ascend among the 16 peaks studied in the research, it actually comes with failure and death rates on par with Mount Everest. One explanation can be attributed to the lack of experience because CHOY is mostly climbed by relatively inexperienced climbers. The finding echoes the importance of skills and experience when climbing into the death zone.

Figure: Failure Rate vs, Death Rate (1905-2019)



The Real Death Zone

Fatality in the death zone only accounts for a portion of deaths on eight-thousanders.

With the exception of Mount Everest, a high percentage of deaths occurs below 8,000m. The finding is consistent with the literature that most accidents happen during the descent (either after a successful summit attempt or due to unexpected factors such as weather, exhaustion, or illness).

However, data shows a very different death distribution by altitude between Mount Everest and other eight-thousanders. First of all, the death rate is much higher in the death zone above 8,000m on Mount Everest. In contrast to most other eight-thousanders, Everest is known to attract a lot more inexperienced climbers who tend to overestimate their ability to survive in the death zone. Shriya Shah, for example, is an inexperienced female climber from Canada who insisted on proceeding with the ascent in 2014 despite her expedition lead's strong advice against doing so given her condition. Shriya unfortunately died of exhaustion on her way down from the peak.

Additionally, there is an unexpected high number of deaths between 5,000m and 6,000m. Further investigation reveals that Khumbu Icefall, one of the most dangerous stages of the South Col route to Everest's summit, is located at 5,486 metres. This is exactly where the 2014 Mount Everest ice avalanche occurred and killed 16 climbers. In fact, data shows that the number one cause of death on eight-thousanders is avalanche.

Perhaps the real death zone on eight-thousanders is not the altitude above 8,000m, but overconfidence (due to lack of experience) and avalanche.

Figure: Death by Altitude Distributions (1905-2019)

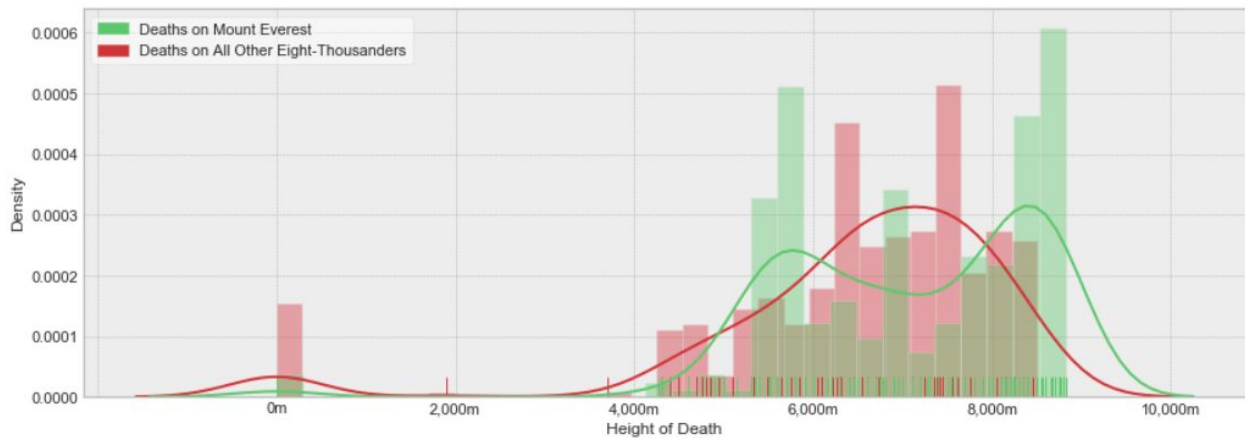


Figure: Death Counts by Type (1905-2019)

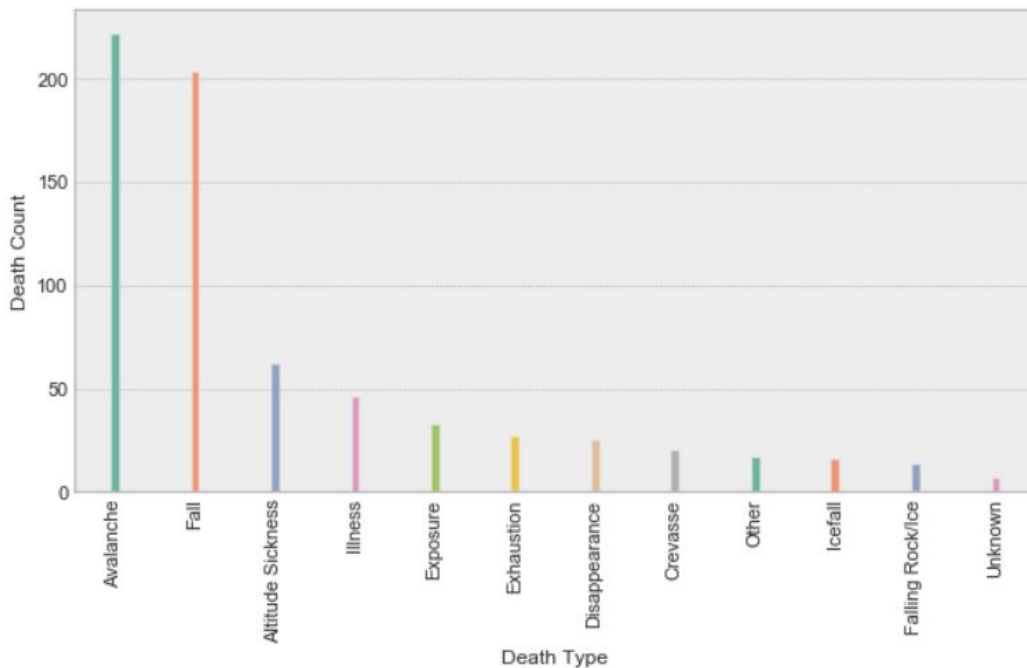


Image: Khumbu Icefall on Mount Everest at 5,486m



Age Is a Problem, Says Data

While stories like Malavath Pooma (the oldest climber to ascend Everest) and Min Nahadur Sherchan (the youngest climber to ascend Everest) are inspirational, data shows that age is, in fact, a major threat to climbers on eight-thousanders.

A density distribution plot shows that the risk of death rate does not decrease just because the climbers are young. On the contrary, the death age density peaks sharply around the age of 37, which is a strong contrast to the relatively smooth peak of the age distribution of all climbers. Unfortunately, age is a problem not because climbers are old, but because climbers are young and overconfident.

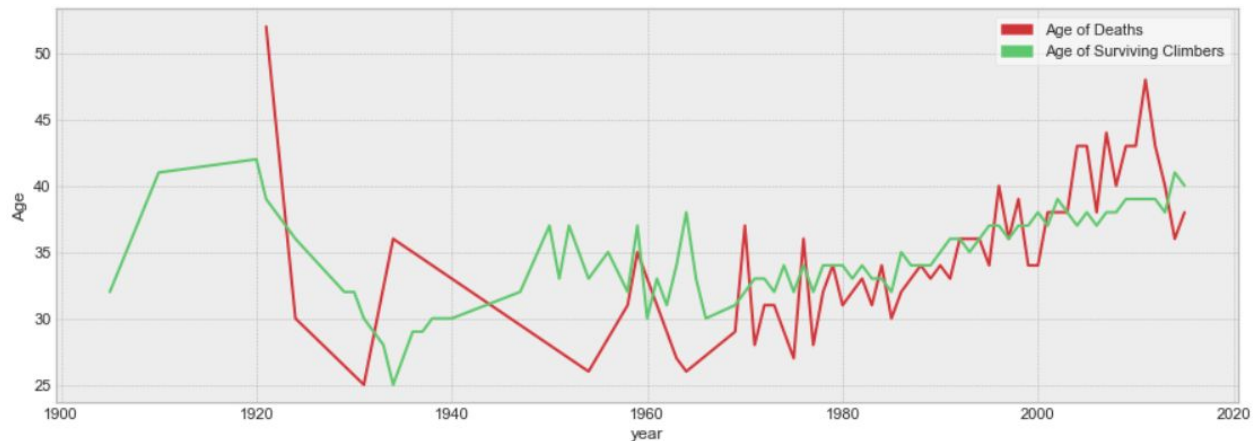
Figure: Age Distribution of the Deaths & Climbers (1905-2019)



Furthermore, our research shows that the average age of deaths is consistently on par with those who survive until Year 2000. Note that there has been a steady increase of age for all

climbers since 1980. Climbing the eight-thousanders seem to have become a sport of middle-age men and women who have the spare cash and time to take on expeditions. The lack of experience combined with the issue of youth's overconfidence unfortunately drives the death rate, as evident by the rise of the average age of deaths after Year 2000, surpassing the age of those who survive.

Figure: Average Age of Climbers by Year (1905-2019)



Conclusion

Sixteen eight-thousander peaks in the Himalayas mountain range are studied in detail using the Himalayan Database covering all expeditions from 1905 to 2019.

Our research findings show that the mountains have seen a steady increase of climbers since 1980, many of which are unfortunately relatively inexperienced and tend to overestimate their ability to survive the death zone. The same groups of novice climbers are also driving the death rate on Cho Oyu (CHOY), a peak generally regarded as the easiest to climb and a “practice ground” for all other eight-thousanders.

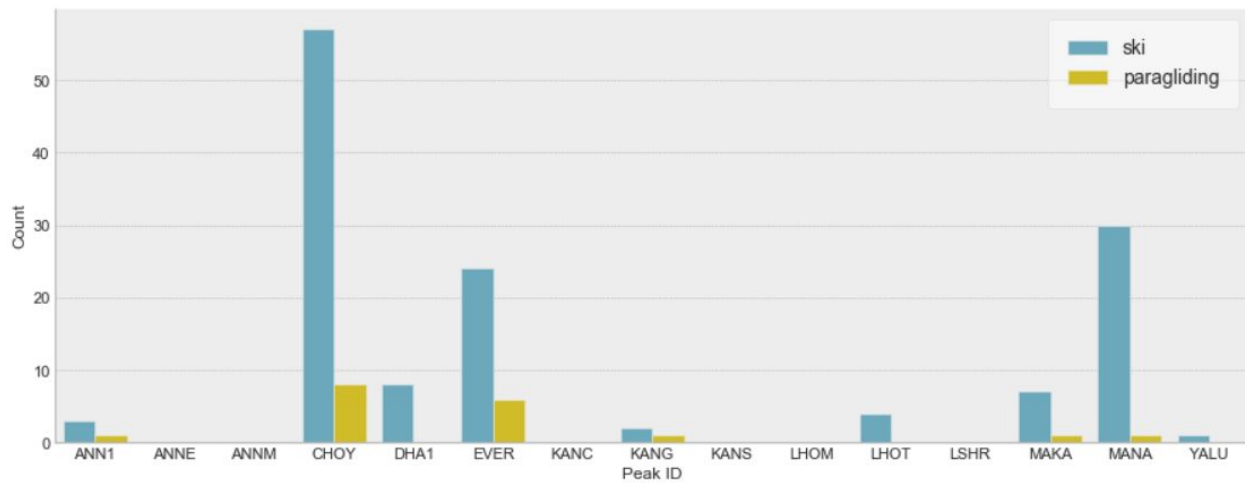
An in-depth exploratory data analysis on the causes of death incidents reveal while altitude is without a doubt a key risk factor, the “real” death zone that requires attention is perhaps where avalanche is likely to occur on the mountains (e.g. Khumbu Icefall on Mount Everest). The other major risk factor is the skill and experience level of the climbers. Age is a problem not because the climbers are old, but because they overestimate their capability of surviving the climb. Remember, a successful peak summit is only half of the climb. Most accidents occur not on the way up, but on the way down when climbers are most mentally and physically challenged.

Fortunately, new infrastructures and optimized operations including supply logistics made available to climbers through new fundings are all helping climbers better manage the risks associated with expeditions into the death zone. Yet climbers should stay cautious. A hot steak and free WiFi in a comfortable tent before the summit attempt on Mount Everest should not

translate to the confidence you have for the climb. Overconfidence is, in fact, one major risk factor frequently overlooked by many according to our research.

Lastly, while we have developed an admiration for those who risk their life venturing into the death zone, we are in awe of those who choose not to “walk” down after the summit. Will you be the next daredevil?

Figure: When Climbing Down Is Way Too Much Work... (1905-2019)



Appendix

The Himalayan Database

Excerpt from the database's official website:

The Himalayan Database is a compilation of records for all expeditions that have climbed in the Nepal Himalaya. The database is based on the expedition archives of Elizabeth Hawley, a longtime journalist based in Kathmandu, and it is supplemented by information gathered from books, alpine journals and correspondence with Himalayan climbers.

The data cover all expeditions from 1905 through Spring 2019 to more than 465 significant peaks in Nepal. Also included are expeditions to both sides of border peaks such as Everest, Cho Oyu, Makalu and Kangchenjunga as well as to some smaller border peaks. Data on expeditions to trekking peaks are included for early attempts, first ascents and major accidents.

The database can be found at:

<https://www.himalayandatabase.com/>

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