The Human Risk on the Highest Peaks

A presentation by Rina Pacuku

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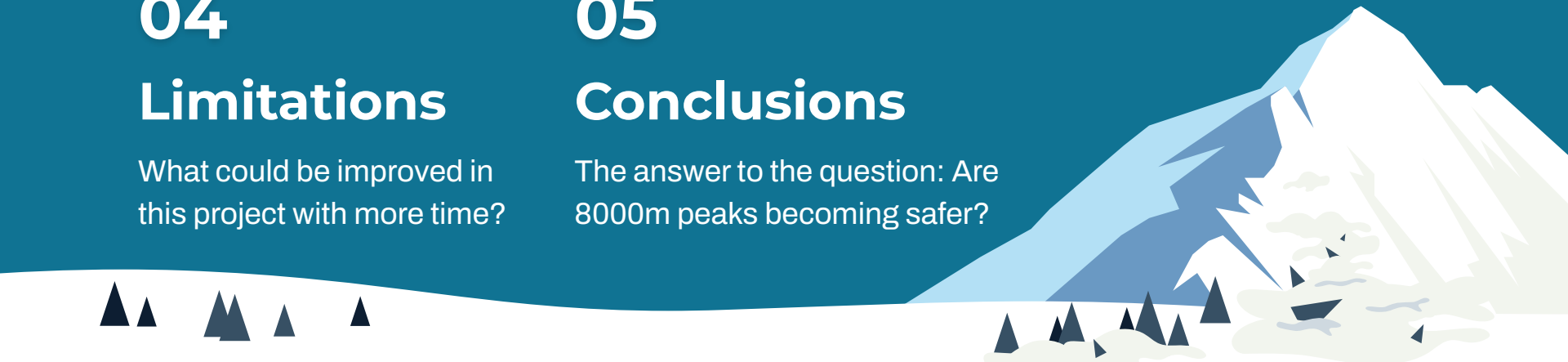
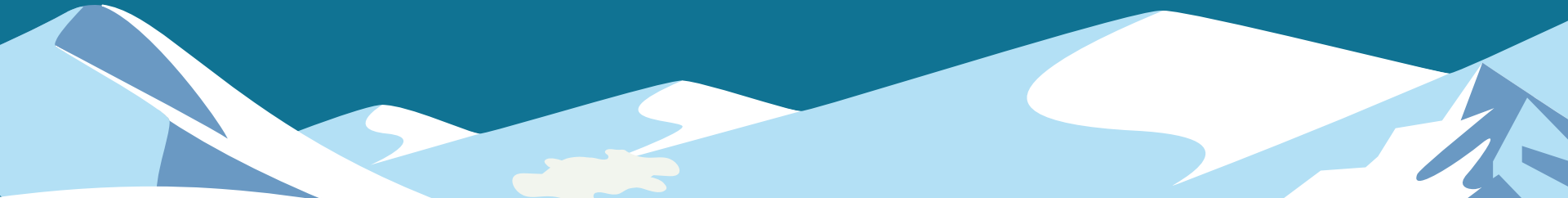


Introduction

There are only 14 mountains on the planet whose peak lie at an elevation of above 8000m. As a result of the scarcity of such summits, climbing 8000m+ peaks has long been considered the ultimate test of human endurance. Every year, mountaineers from across the globe attempt to reach the top of these mountains.

Some succeed, some fail, and unfortunately, some die. But over the decades, with better equipment, weather forecasting and climber experience, the question is: **are these mountains becoming safer to summit?**



Data Overview

Where does our data come from?

The data used is that of The Himalayan Database, a thorough record of every expedition, member, and outcome for expeditions on peaks above 8000 meters in Nepal.

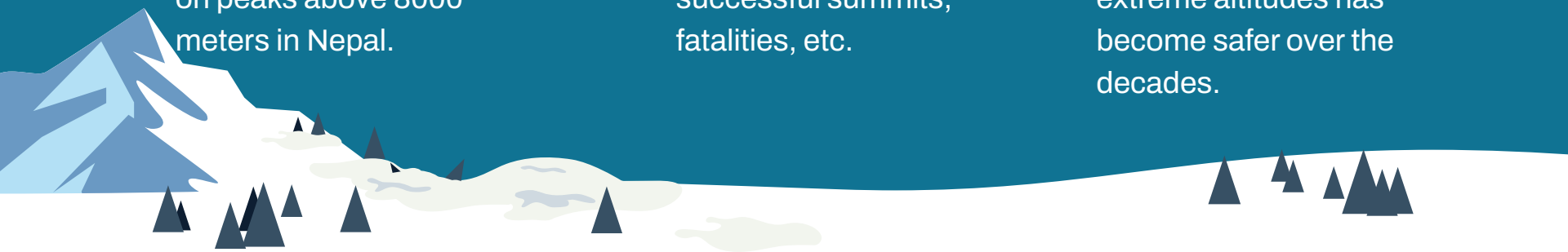
What does it contain?

The Himalayan Database contains information on:

- 490 Peaks
- 11500+ expeditions
- Information such as oxygen use, successful summits, fatalities, etc.

What is it useful for?

By analysing this data, we can take a look at trends in mortality and expedition outcomes over times, and see if mountaineering at extreme altitudes has become safer over the decades.



Data Overview

How was the data obtained

- The data was found in an application developed by The Himalayan Database.
- Within the application, data was separated into multiple tables. The tables I was interested in were: Expeditions (information on overall expeditions), Members (information on specific members of expeditions), Peaks (information on mountains).

What was the cleaning process like?

- Once i had exported my three tables into CSV files, I used python to join my tables together on shared columns.
- Following this, I removed any columns with repeated data and any sparse rows or columns.
- Finally, I referred to the Himalayan Database Guide to understand which columns would be beneficial to my analysis, and removed columns that were not useful.

Visualisations

But first, where on earth are we?

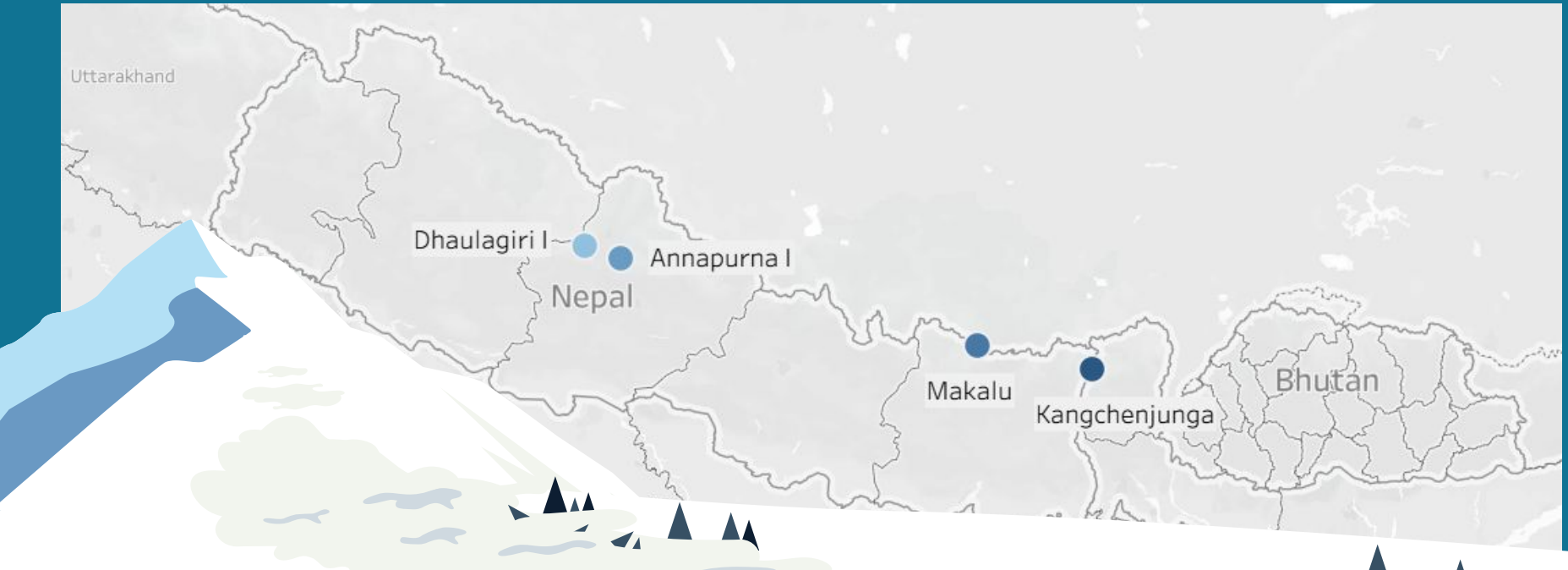
Nepal

Within Nepal's borders lie a significant portion of the Himalayan mountain range.

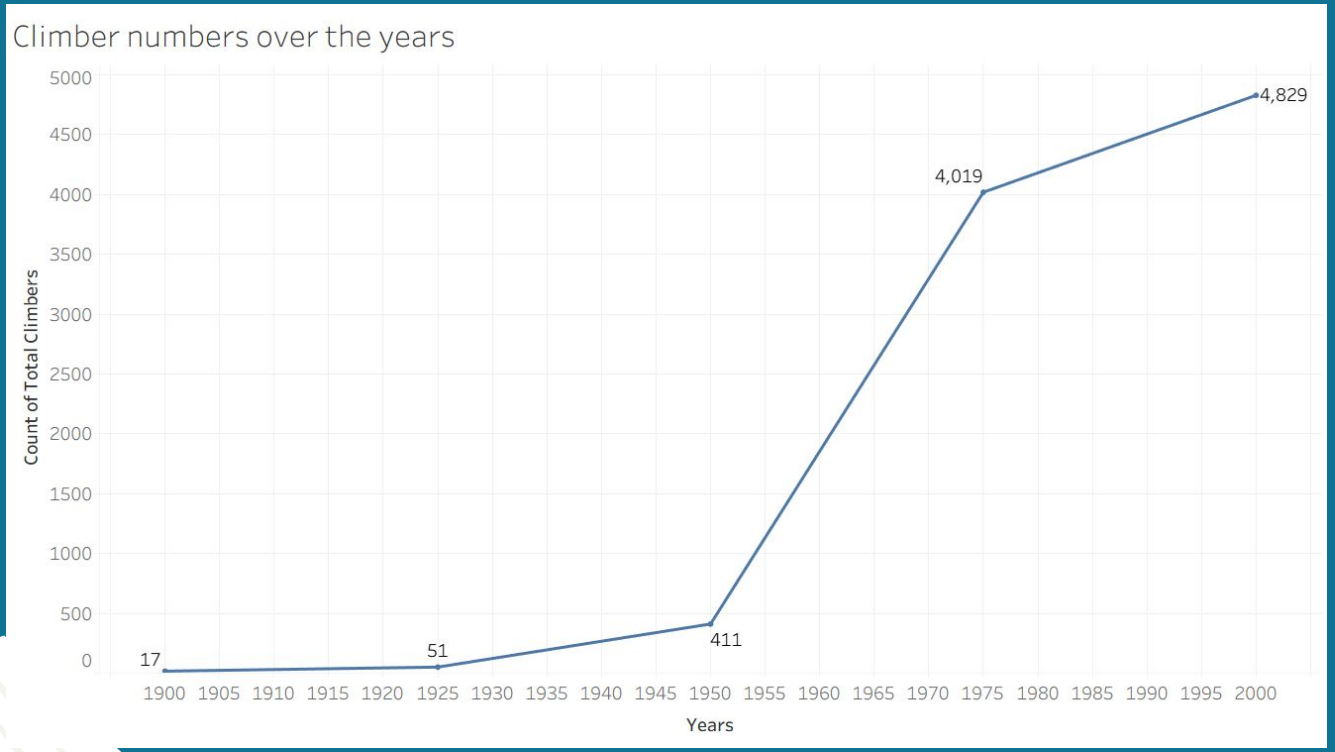
But first, where on earth are we?

Of the 490 recorded Nepalese Himalayan peaks, this analysis is of the following four mountains:

- Annapurna I
- Dhaulagiri I
- Makalu
- Kangchenjunga



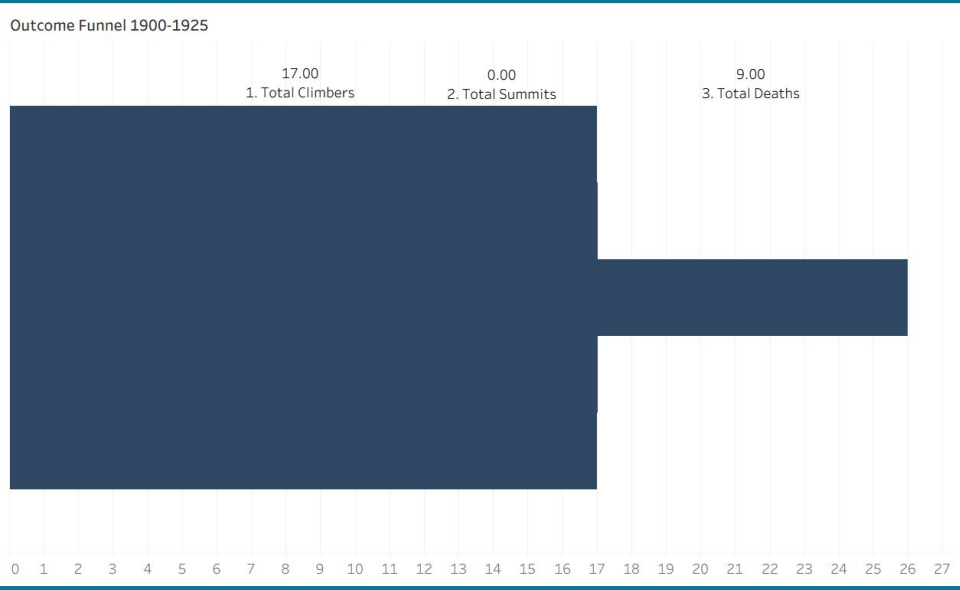
The increase in expeditions over time

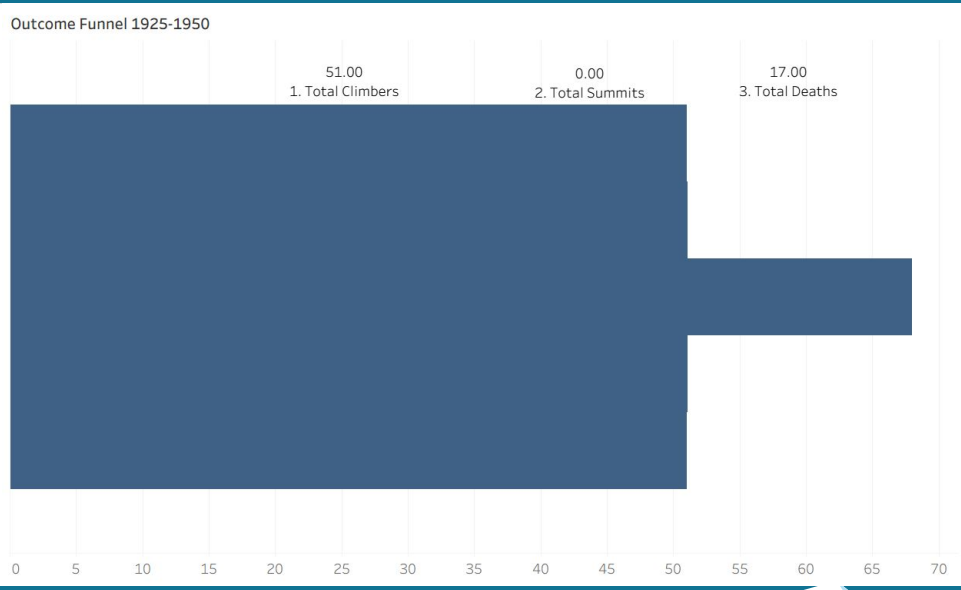


Since the 1900's, There has been a staggering increase in attempts to summit these four 8000-ers. In the last 25 years alone, nearly 5000 people have set out on expeditions.

A look at climbing outcomes over the years (1900-1950)

The following diagrams show the progression of high-altitude ascents: total climbers, those who reached the summit, and individual fatalities, grouped by time periods of 25 years from the 1900's to the present day.

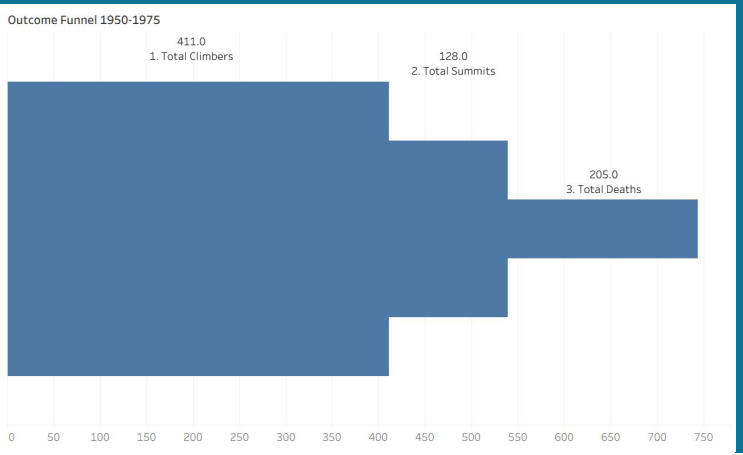




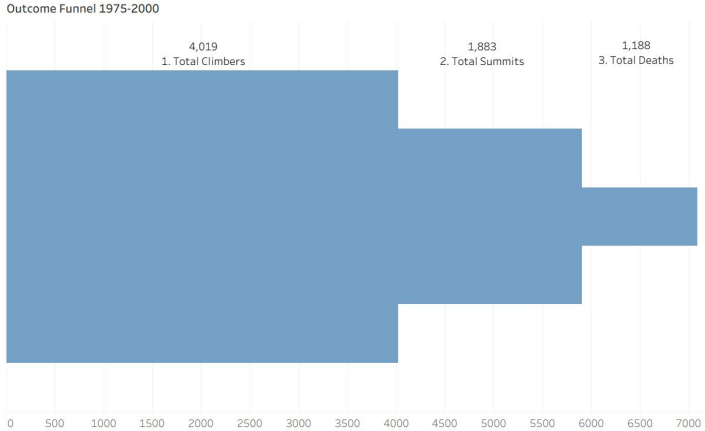
Between 1900 and 1950 there were 68 people who attempted climbing one of these four mountains

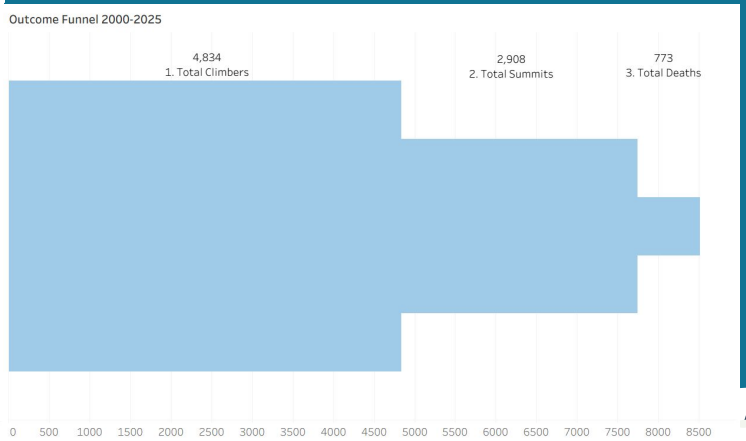
- none succeeded
- 26 died

A look at climbing outcomes over the years (1950-2025)



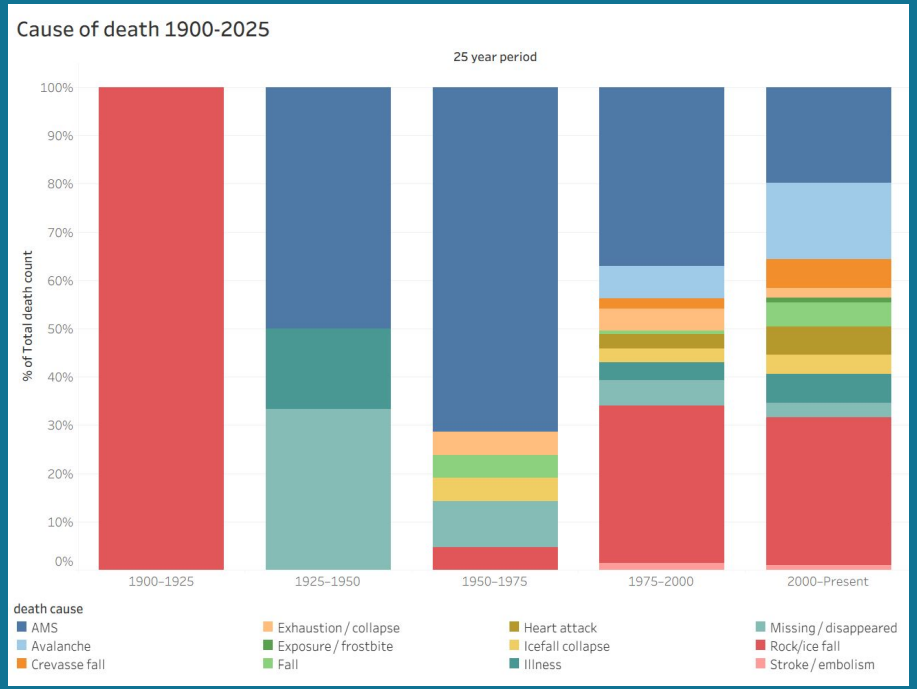
- Post-1950s: Increase in total climbers, With a sharp increase after 1975, reflecting growing interest and accessibility.
- Summits counts rise significantly after 1950.
- Fatalities show a decreasing trend despite more climbers attempting the peaks.
- Overall, the funnels illustrate that while human risk was very high in early high-altitude mountaineering, it has progressively decreased.





Causes of Fatalities (1900-2025)

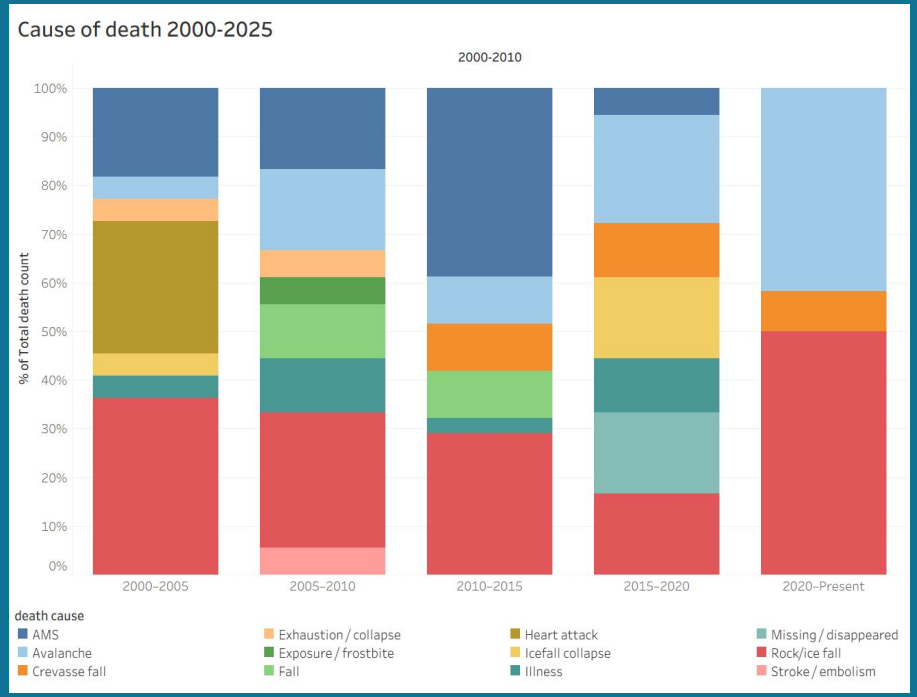
The next two visualisations are stacked bar charts. Each bar contains all types of deaths recorded, and the proportion of the total deaths for that time period



- 1900-1925: The only cause of fatality was attributed to rock/icefall, likely due to the small number of expeditions and lack of detailed recording at the time.
- 1925-1950: we see a massive increase in deaths due to illness, and a condition called AMS.
- 1950-1975: The majority of deaths seem to be attributed to AMS.
- 1975-2000: Death causes start to become almost equally split between illness and accidents

- 2000-2025: Similarly to the last period, death causes are split nearly equally between illness and accidents

Causes of Fatalities (2000-2025)



If we zoom into the final bar of the last graph, we can see the period of 2000-2025 in 5 year increments

The main point of interest lies in the period of 2020-present, where we can see that there were no recorded deaths due to any illness. All causes of death are due to rock/ice fall, crevasse fall or avalanche.

What is AMS?

AMS occurs when a person ascends to high altitude too quickly.
It is caused by reduced oxygen levels (AKA hypoxia).
Common symptoms include:

- Headache
- Nausea or vomiting
- Dizziness or fatigue
- Poor sleep
- Loss of appetite

AMS Usually appears within 6–24 hours above ~2,500 m.

AMS matters in answering our safety question as it has historically been one of the main causes of high-altitude fatalities. Changes in AMS-related deaths give us a clear indication of whether these peaks have become safer to climb.

What can AMS lead to?

AMS can progress to two potentially life threatening conditions:

High Altitude Pulmonary Edema (or HAPE):

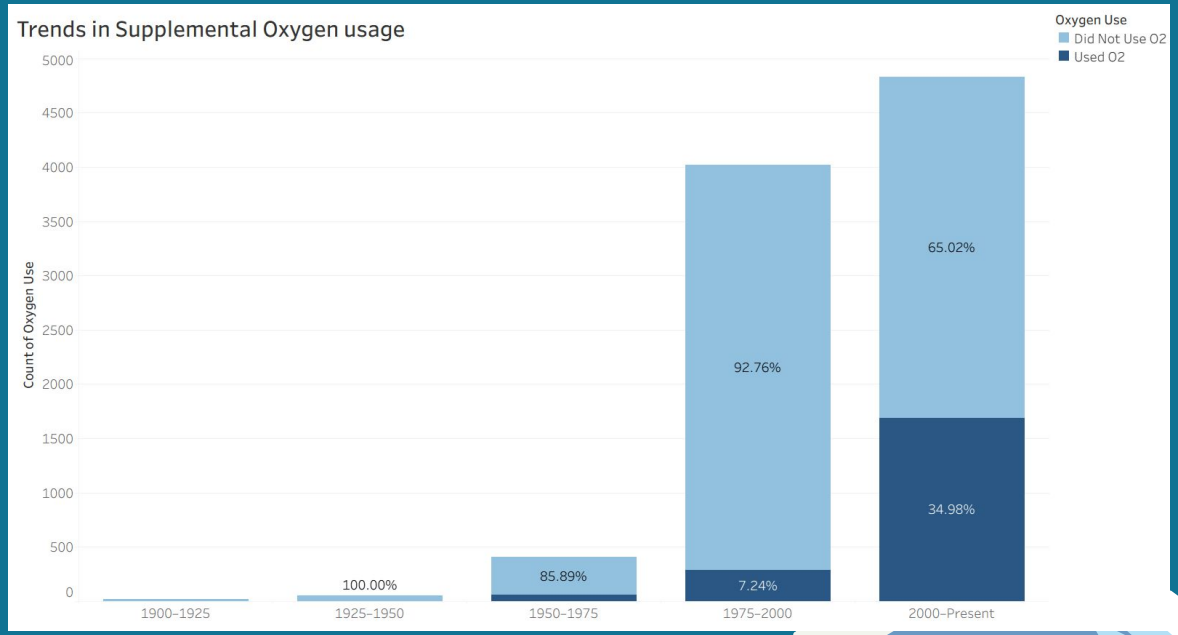
- Fluid leaks into the lungs due to low oxygen.
- Prevents proper breathing and oxygen exchange.
- Can lead to respiratory failure if untreated.

High Altitude Cerebral Edema (or HACE):

- Swelling of the brain caused by hypoxia (being starved of oxygen).
- Leads to confusion, loss of coordination, and unconsciousness.
- Can rapidly progress to coma and death.

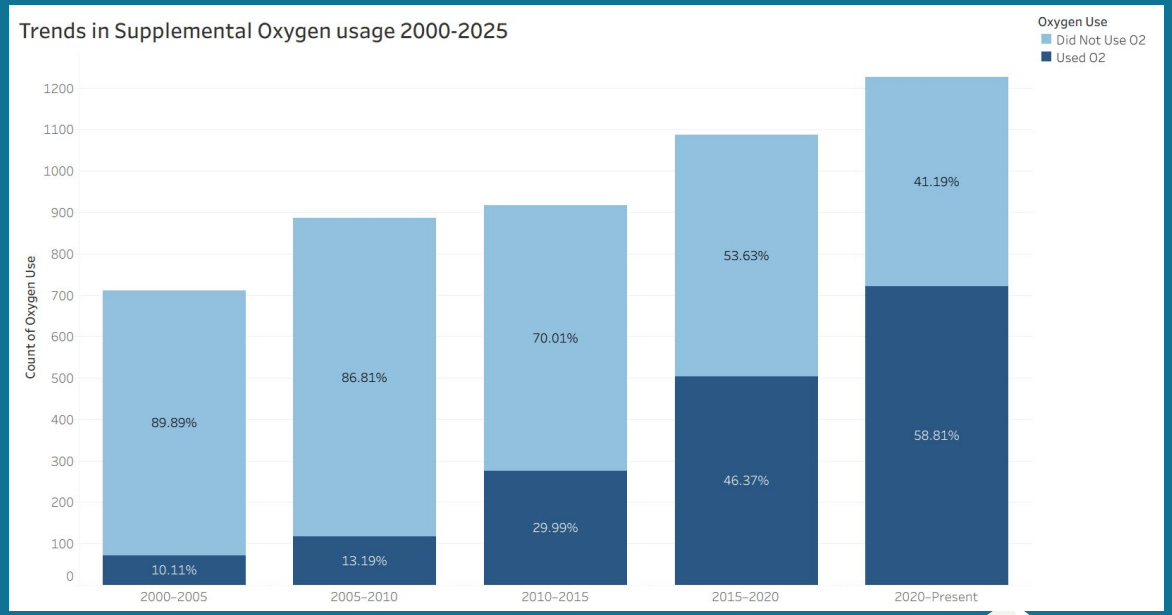
Supplemental Oxygen Use (1900-2025)

The next two visualisations both show the percentage of climbers that both do and do not use supplemental oxygen use on summit attempts



Trends show that supplemental oxygen use has increased from 0 before the 1950's, to nearly 35% in the last 25 years

Supplemental Oxygen Use (2000-2025)



If we look closer at the last 25 years, we can see an increase from just over 10% at the start of the century, to almost 60% in the last 5 years

Supplemental Oxygen and Reduced Altitude-Related Deaths

How does supplemental oxygen influence altitude related deaths?

- Increases the amount of oxygen available to the body at altitude.
- Helps maintain normal blood oxygen levels, reducing strain on the heart, lungs, and brain.
- Prevents the progression of AMS into **HAPE** (fluid in lungs) and **HACE** (brain swelling).
- Rapidly improves symptoms such as severe headache, confusion, and breathlessness.
- Particularly effective in emergencies when descent is delayed or impossible.

Overall, supplemental oxygen significantly reduces the risk of life-threatening complications and death at high altitude.

9327

Climbers have attempted these four peaks since 1900

2192

Did not make it back alive

Limitations and Future Project Improvement

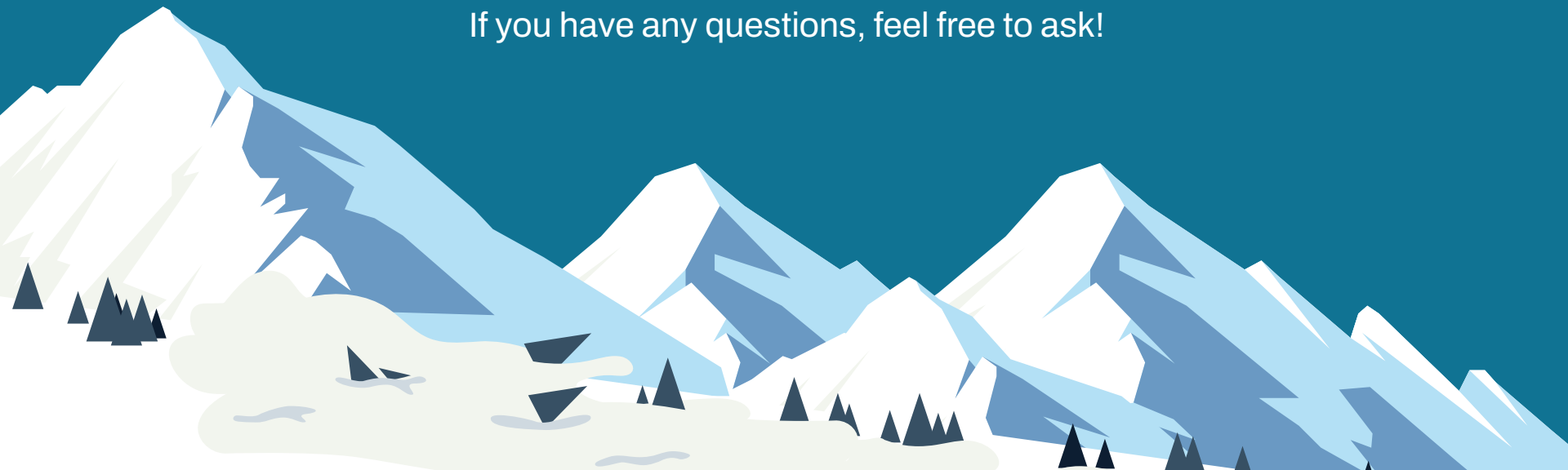
- The data source did not contain as much information on weather patterns as expected.
- With more time, this project could be improved by accessing separate data sources containing weather specific data, and appending to the current data set.

Conclusion

- Over the last 125 years, the number of climbers attempting 8000m peaks has increased dramatically, yet the overall mortality rate has decreased
- Illness-related deaths, especially those caused by AMS, HAPE, and HACE, have declined sharply, particularly in the last two decades
- This reduction strongly correlates with the rise in supplemental oxygen use, better acclimatisation practices, and improvements in equipment and forecasting
- However, environmental hazards (rock/icefall, crevasse falls, avalanches) remain a persistent and unpredictable risk.
- So, are 8000m peaks becoming safer?
  Yesn terms of altitude-related physiological danger.
  But climbers are still vulnerable to objective mountain hazards, meaning that while safety has improved, these peaks will always carry significant inherent risk.

Thank you for your attention

If you have any questions, feel free to ask!



Links and resources

- The Himalayan Database, The Expedition Archives of Elizabeth Hawley - Data source.
- Travel to High Altitudes | Travelers' Health | CDC - Detailed description of AMS and symptoms associated.
- High-Altitude Travel and Altitude Illness | Yellow Book | CDC - Detailed description of HAPE and HACE, and the effect that supplemental oxygen has on prevention.