

SUCCESS AND DEATH ON MOUNT EVEREST

How the main routes and seasons compare.

BY RAYMOND B. HUEY AND RICHARD SALISBURY

If you're going to climb Mt. Everest, you'll first need to choose a season and a route. Until now, your choices would have been guided by an avalanche of books and reports that chronicle the conditions, hazards, and histories of the various seasons and routes. Even so, you'd have had to make choices without answers to vital questions. Questions like: Which route has the highest success rate? Which route has the highest death rate? Do success or death rates differ between spring and fall? Have success rates improved (or have death rates declined) in recent years?

These questions can now be answered. The necessary data were graciously supplied by Miss Elizabeth Hawley. Starting with the American Everest Expedition in 1963, she has extensively interviewed nearly every mountaineering team passing through Katmandu (see her extensive reports in the Nepal section of this AAJ, and in nearly every AAJ for the last 40 years!). Richard Salisbury has transcribed her detailed records into an extensive computer database, which will soon be published by the American Alpine Club and The Mountaineers Books. We have now mined those data to help mountaineers make informed decisions when planning a climb of Everest, as well as to describe some fascinating historical trends in Everest climbing.

To better understand the recent statistics, let's quickly review the history of climbing on Everest. The earliest expeditions (British, 1920s) approached Everest from the north (Tibet). None is believed successful. George Leigh-Mallory made the first attempt to reconnoiter a route from the south (Nepal) in 1921. Looking down at the Khumbu Icefall and the Western Cwm from the Lho La (the pass between Everest and Pumori), Mallory concluded: "...I do not much fancy it would be possible..." (Leigh-Mallory, 1921, pg. 215).

The possibility of a southern route remained academic for decades simply because Nepal closed itself to foreign climbers. In 1949, however, Nepal suddenly opened its doors; and Charlie Houston and Bill Tilman penetrated the Khumbu region in 1950 to continue Mallory's search. Houston summarized the potential advantages of a southern route: "For one thing the sun would be on the climber most of the day to mollify somewhat the extreme cold on the shadowed northern slopes. The strata of the sedimentary rocks, which slope downward like shingles on a roof on the unusual northern route, would offer better hold on the south" (Houston 1952, pg. 9). But once they saw the Khumbu Icefall, Houston and Tilman's enthusiasm for a southern route was dampened. Houston concluded "...it does not appear to us as a practicable route" (ibid., pg. 18).

As Nepal was opening to foreign climbers, Tibet was closing, following China's invasion in 1949. As a result, expeditions of the early 1950s had no choice but to push a southern route in Nepal. In 1953, they succeeded. For most of the next three decades, Tibet remained closed and almost all expeditions climbed via Nepal. The few northern expeditions were mainly

Chinese, Sino-Russian, Sino-Iranian, and Sino-Japanese. In 1960, a Chinese expedition made the first ascent from the north (via the north ridge), though their success was controversial.

In 1979, China opened foreign access to routes in Tibet. Two expeditions (Japanese and Messner solo) successfully summited via Tibet the next year. Thereafter, Everest has been accessible from both countries in all years and has been attempted from both in most years.

TECHNICAL DETAILS

We restrict most analyses to the period 1980 through 2002, years in which both Nepal and Tibet were open. We focus mainly on the spring, which has become the major climbing season on Everest (Fig. 16). For some analyses, however, we report patterns for other years, for autumn, or for all seasons combined.

We separated expeditions into three groups: 1) those using only the classical South Col-Southeast Ridge (“South Col”) in Nepal (or minor variants thereof), 2) those using only the North Col-North Face-Northeast Ridge (“North Col”) in Tibet (or minor variants), and 3) all “other” expeditions, including those using non-standard routes, multiple routes, or different routes on ascent and descent. In general, the non-standard routes are much steeper than the two main routes. Note that some expeditions classified as “other” switched to a main route after initially failing on a non-standard route.

We analyze data for “climbers” (that is, individuals listed on a climbing permit) separately from those for locally hired high-altitude porters (hereafter “H-A porters”) because most climbers are trying to summit, whereas many H-A porters are not. Climbers are usually foreigners but are sometimes Nepali or Tibetan. Foreign guides are considered as climbers, as per permit policies. Most H-A porters are Sherpas, but some are from other ethnic groups such as Tamangs, Gurungs, or Tibetans. We include only those climbers and H-A porters who went above base camp. Expeditions with multiple independent teams (several teams on the same summit) were treated as separate expeditions. Our analyses for spring 1980 through autumn 2002 are based on 5,218 climbers, 3,276 H-A porters, and 627 expeditions. We exclude several Chinese expeditions, for which climbers and H-A porters were not distinguished. Many climbers and H-A porters have made repeated attempts on multiple expeditions, but we here treat each attempt as if it were statistically independent.

We analyze patterns both for individual attempts (for example, what percentage of individual climbers reached the summit?) and for expeditions (what percentage of expeditions had at least one climber who reached the summit?). (For statistical reasons, analyses of expeditions are preferred {see Eguskitza and Huey, 2000; Huey and Eguskitza, 2000}. We did not correct for team size in analyses of expeditions {Huey and Eguskitza, 2000}.) An expedition is considered successful if at least one climber reached the summit. Statements we make below as to the significance of rates of success or of death are based on formal statistical analyses. Thus, if we state that the success rate is significantly higher on Route A than on Route B, that statement is backed by traditional criteria for statistical significance. To help illustrate historical trends, we added smoothed curves (“lowess smoothers,” which are similar to running averages) to the graphs.

SEASONS AND ROUTES, CHANGING PATTERNS

It is no surprise that the total number of mountaineers on Everest has increased markedly over the past half century. In fact, the traffic of climbers per year has increased about five fold in the last quarter century (Fig. 1a). Note, however, that the number of climbers per year has leveled off at about 265 over the past decades.

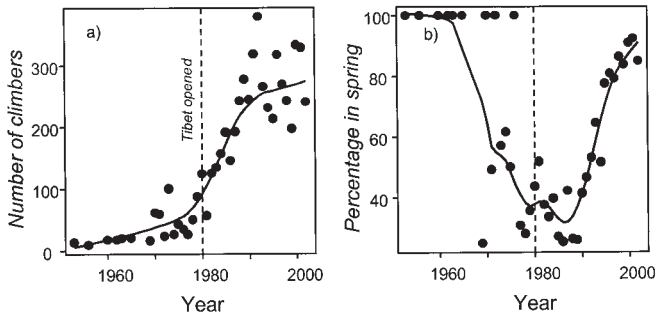


Fig. 1. a) Total number of climbers per year on Everest between 1953 and 2002. b) Percentage of all climbers who attempted Everest during the spring. The trend lines are fitted “loess smoothers.”

The favored climbing season has changed dramatically over the years. Between 1953 and 1979, most climbers went in spring (64%), and only 33% went in autumn (3% in winter, 0% in summer). During the 1980s, however, more climbers actually attempted Everest in autumn than in spring (50% vs. 33%), and 10% went in winter (6% in summer). Since the early 1990s, climbers have increasingly switched back to spring (Fig. 1b). In fact, during the last five years, nine of ten climbers (89%) went in spring (Fig. 1b), 11% went in autumn, only one climber went in winter, and none went in summer. This dramatic shift to the spring may reflect an awareness that a calm-weather period is relatively predictable in May and perhaps a growing awareness that the success rate of climbers in spring is relatively high (see below).

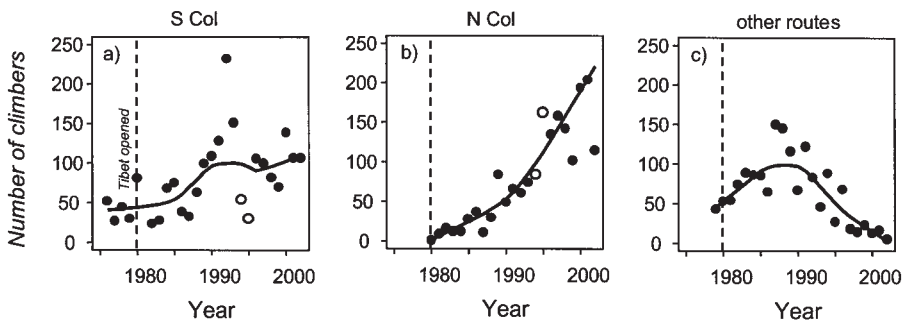


Fig. 2. Number of climbers per year (1976 to 2002) that used a) the South Col, b) the North Col, or c) other routes. The circles in a) and b) are for the two years (1994, 1995) in which Nepalese restrictions on the number of expeditions were in effect (see text).

The relative usage of the different routes has also changed markedly over time. Before Tibet was opened, most climbers attempted the classical South Col route (Fig. 2a). In the early 1980s, more climbers actually attempted routes (Fig. 2c) other than either the South Col

(Fig. 2a) or North Col routes (Fig. 2b). This trend reversed in the early 1990s: now few climbers attempt routes other than the two main ones (Fig. 2c). The relatively high use of alternative routes in the early 1980s might reflect either a preference of elite mountaineers at that time to explore virgin routes, or the likely difficulty of obtaining financial support for expeditions to the main routes, which had already been climbed multiple times.

The relative popularity of the two main routes (North Col vs. South Col) has also shifted since Tibet was opened. Until 1993 more climbers used the South Col than did the North Col (Fig. 2a,b). But in that year, Nepal simultaneously increased the climbing fee (royalty), restricted the number of expeditions to four per season, and restricted the number of climbers per expedition. Climbers responded by shifting to Tibet in 1994 and especially in 1995 (circles in Fig. 2a,b). In fact, only 16% of climbers on the main routes used the South Col in 1995. Confronted with the resulting drop in foreign income and jobs, Nepal quickly rescinded its restrictions (though not its large royalty!). Even so, fewer than half of climbers (Fig. 2a,b) and expeditions on these two routes have used the South Col in subsequent years. Seemingly, the South Col has lost its preeminence as the preferred route in spring (Fig. 2a,b).

Nevertheless, the South Col remains the route of choice in autumn: seven of ten main-route climbers used the South Col over the past five autumns. This may reflect the very low success rate on the North Col in autumn (see Climbing Seasons Other Than Spring, Fig.3).

SUCCESS RATES

How successful are mountaineers on Everest? We focus initially on success in spring and discuss autumn in a subsequent section. The success rate in spring for all routes combined is surprisingly high: almost one in four climbers and H-A porters reached the summit between 1980 and 2002 (Table 1). (By comparison, about 1 in 2 climbers who attempt Denali reach the summit; and perhaps 1 in 8 does so on K2 {Huey and Eguskitza, 2001}.) Moreover, almost two of three expeditions were successful (Table 1). Likely contributing to this high success rate are numerous factors, including superb equipment, cumulative knowledge of the routes, good weather forecasting, extensive use of fixed ropes, and growing experience of leaders and Sherpas.

Success rates in spring differed markedly, however, among routes (Table 1). Climbers had roughly a 1 in 3 chance of success on the South Col, a 1 in 4 chance the North Col, and

Route	Success rates		
	Climbers	H-A porters	Expeditions
All routes	25.2% (3101)	23.3% (2096)	60.6% (406)
N Ridge	26.7% (1261)	25.0% (571) ns	57.5 (181)
SE Ridge	34.0% (1134)	27.1% (1197) ns	77.0% (160)
Other routes	9.0% (801)	6.4% (328)	34.8% (66)
	Death rates		
All routes	1.8% (3101)	0.6% (2096)	10.3% (406)
N Ridge	1.8% (1261) ns	0.2% (571) ns	9.9% (181) ns
SE Ridge	1.4% (1134) ns	0.8% (1197) ns	7.5% (160) ns
Other routes	2.4% (801)	0.3% (328)	10.7% (66)

Table 1. Rates of success and of death during spring climbing season (from 1980 to 2002) on various routes on Mt. Everest. Data are partitioned by climbers, H-A porters, and expeditions. Sample sizes are in parentheses. Statistical comparisons (Fisher exact tests) compare rates for the two main routes (NE Ridge v. SE Ridge) and are highly significant statistically unless otherwise noted ("ns" = not significant).

only a 1 in 10 chance on the other routes. H-A porters show a similar pattern, although their chances of success on the two main routes were not significantly different (Table 1). Expedition success was also highest on the South Col, intermediate on the North Col, and lowest on other routes. Note that higher success rate on the South Col relative to the North Col holds even if one compares the relative success rates on these routes in the same year (a “paired” test): climbers had higher success rates on the SE Ridge than on the NE Ridge in 12 of 16 years in which both routes were attempted in spring.

Is a year that is good on the North Col also good on the South Col? Surprisingly, the answer is no! The success rates of climbers in spring from the north vs. from the south are completely uncorrelated.

Has a mountaineer’s chance of summiting increased over time? On the South Col, success rates in spring have increased sporadically (though significantly) since 1980; but note that the best year ever was early: 1985 (Fig. 3a). On the North Col, success rates were generally low prior to 1995 but increased dramatically thereafter. Climbers (or commercial companies) have obviously learned how to succeed on both routes—and especially so on the North Col. Factors contributing to this increased success are probably the “collective experience” on the routes, greater cooperation among expeditions, and fixing of ropes on almost all sections (Eric Simonson, personal communication).

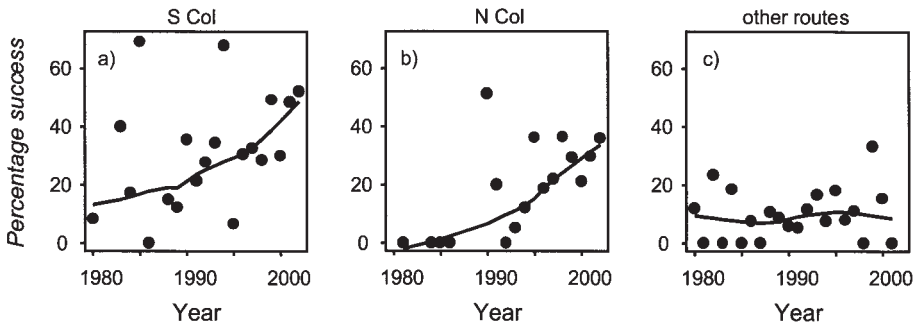


Fig. 3. Percentage of climbers reaching the summit in spring from 1980 to 2002 on a) the South Col route, b) the North Col, and c) all other routes combined. The trend lines are fitted “lowess smoothers.”

In stark contrast to the pattern seen on the main routes, success rates on the alternative routes have not changed over time. They were low in the early years. They are still low (Fig. 3c).

DEATH RATES

How deadly is Everest? A total of 91 climbers and 38 H-A porters died on Everest between 1980 and 2002. The average number of deaths per year was 5.6 (climbers and H-A porters combined), and two or more deaths occurred in all but one year (no death occurred in 1981).

Death rates provide an insight into risk. Fortunately, observed death rates are surprisingly lower than what one might expect from the media. In the spring, roughly 1 in 54 climbers and 1 in 175 H-A porters died attempting Everest (Table 1). By comparison, 1 in 415 climbers died on Denali between 1990 and 2000; and roughly 1 in 25 died on K2 between 1954 and 1994 {Huey and Eguskitza, 2001}. These data are consistent with the view that Everest is more dan-

gerous than Denali, but safer than K2—especially given that climbers who attempt K2 are more skilled and experienced on average than those who attempt Everest.

About 1 in 10 expeditions suffered the deaths of one or more climbers (Table 1); and about 1 in 19 suffered the deaths of one or more H-A porters. In contrast to patterns seen above for success rates, death rates by year have not changed significantly over time, either for climbers or for H-A porters (Fig. 4).

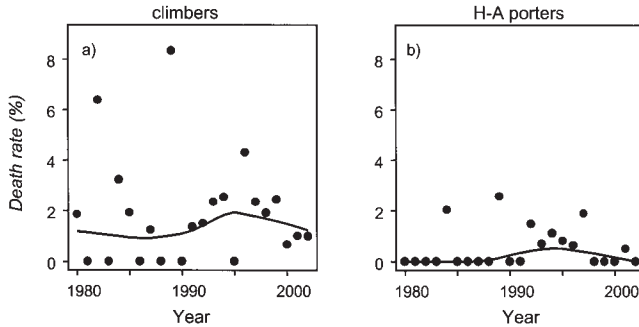


Fig. 4. Death rate a) of climbers and b) of H-A porters on Everest in spring from 1980 to 2002. All routes are combined.

How do death rates compare on the routes? Death rates of climbers, of H-A porters, and of expeditions in spring don't differ significantly between the North Col and South Col routes (Table 1). Death rates of climbers and expeditions are slightly higher on alternative routes, but not significantly so (Table 1). Very likely, only the most skilled climbers attempt such steep routes, such that the observed death rates (relative to those on the main routes) are not a true indicator of relative risk.

Is a year that was relatively deadly on the north side also relatively deadly on the south side? No, the probability of a death in an expedition in a given year is uncorrelated on the two routes. Given the disaster in spring 1996, when mountaineers on both sides were killed by a single storm, this independence is surprising. Apparently, spring 1996 was exceptional.

Overall death rates during descent from the summit were about 1 in 29 for climbers and 1 in 163 for H-A porters. (By comparison, 1 in 590 climbers died during descent on Denali; and about 1 in 7 died on K2 between 1978 and 1999 {Huey and Eguskitza, 2000}.) The overall death rate during descent is actually significantly higher for climbers than for H-A porters, even though climbers carry lighter loads. (Note: we have not partitioned these data by use of supplemental oxygen {see Eguskitza and Huey, 2000}.)

Death rates of climbers descending from the summit in spring (1980 to 2002) were similar on all routes (4.5% N, 2.6% S, 3.4% other) and do not differ significantly between the North and South Cols. Death rates of H-A Porters descending from the summit are at or near zero on all routes (0.0% N, 0.9% S, 0.0% other).

CLIMBING SEASONS OTHER THAN SPRING

Our analyses so far have concentrated on the spring, which is currently the dominant climbing season on Everest (Fig. 1b). However, patterns for other seasons sometimes differ strikingly from those in spring. Here we summarize a few basic comparisons mainly for climbers between

1980 and 2002 (unless otherwise noted, patterns for H-A porters are qualitatively similar to those for climbers).

Climber success rates are markedly lower in autumn than in spring. For the South Col, success rate drops by roughly one half (34% to 16%). For the North Col, it plummets to near zero (27% to 1%). The overall reduced success for autumn may reflect less favorable weather conditions then. But why is the success rate in autumn so much worse on the North Col than on the South Col? After the heavy monsoon snows in summer, post-monsoon winds from the west tend to deposit dangerous accumulations of snow on the east-facing, lee slopes leading to the North Col from the East Rongbuk Glacier. The resulting treacherous avalanche danger probably discourages many north expeditions (E. Simonson, personal communication).

Few climbers (1980 to 2002) have attempted Everest during the monsoon (147) or winter (248). All are likely skilled and experienced, yet their success rate is very low (only 4% in both seasons). The low success rate during the monsoon adds new significance to Reinhold Messner's remarkable 1980 ascent, which took place during the monsoon, largely on a new route, solo, and without supplemental oxygen.

Although climber success rate drops strikingly in autumn, climber death rates in autumn are similar to those in spring on the South Col (1.9% and 1.4%, respectively) and also on the North Col (1.1% and 1.8%). For H-A porters, however, the autumn is significantly more dangerous than the spring both from the south (2.1% and 0.8%) and from the north (2.8% and 0.2%).

PLAYING THE ODDS

If the past is a reliable guide to the future, then the South Col in spring offers the best chance of success. However, the North Col in spring is a close second and may even be catching up (Fig. 3). Even so, the South Col has had the higher success in four of the past five springs. In any case, climbers on these two routes in spring have enjoyed a remarkable 36% success rate over the past five years. That pattern does not hold on these routes in the autumn, as success rates on both routes then are strikingly reduced, especially on the North Col. Not surprisingly, climber success rates on non-main routes are relatively low (Table 1), and even in spring have averaged only 12% over the past five years, despite the high likelihood that climbers who have attempted such routes are relatively skilled and experienced.

Climber death rates are uniformly low (1% to 2%) and essentially the same on various routes and in spring or autumn. Death rates of H-A porters are, however, elevated in autumn relative to spring. Surprisingly, the climber death rate on "other" routes is only slightly elevated above those for the two main routes. However, the observed death rate on these other routes undoubtedly underestimates the danger of these routes compared to the main ones, simply because only relatively skilled and experienced climbers attempt these routes.

These analyses illustrate clear historical shifts in climbing on Everest. For the first decade following the first ascent, most expeditions repeated the South Col route. Beginning in 1963 (USA expedition to the West Ridge) and lasting through the early 90s, however, many climbers on Everest attempted alternative routes (Fig. 2c). This was an era of bold climbing, with ascents on the southwest (British, Polish, Soviet), Kangshung (American, International), and northwest faces (Japanese, Australian). One in ten climbers even went in winter!

Times have changed. In the past five years, very few climbers attempted anything other than the two main routes. Moreover, 9 of 10 climbed in spring; and only one individual climber went in winter. These recent shifts seemingly reflect an increasing conservatism on Everest, with the vast majority of climbers concentrating on the season and routes that maximize their chance of success. Indeed, 95% of all “Seven Summiters” to date climbed a main route on Everest.

Even many of the elite climbers are seemingly becoming more conservative. Consider the 50 climbers who have summited 10 or more of the 8,000m peaks (including Everest). Of those who first summited Everest between 1978 and 1989, 1 in 3 climbed a non-standard route; but of those who summited thereafter, significantly fewer (1 in 15) climbed a non-standard route. Perhaps the expanding quest for all fourteen 8000ers is encouraging even elite climbers to just “bag” Everest and get on with the remaining peaks.

Success rates on the main routes have increased the past quarter century (Fig. 3), yet death rates have remained stable. In some ways these patterns are surprising, given the widespread belief that contemporary Everest climbers are on average less experienced and skilled than their predecessors. If that belief is accurate, then the decline in average skill and experience has been more than balanced by improved equipment and logistics, better weather forecasting, greater cumulative knowledge of the routes, and enhanced skill and experience of H-A porters and leaders.

We are deeply indebted to Miss Elizabeth Hawley, whose extraordinary efforts over four decades have contributed so much to Himalayan mountaineering and have made studies such as this possible. We also thank J. Harlin III, T. Hornbein, and E. Simonson for thoughtful suggestions and discussion.

BIBLIOGRAPHY

- Eguskitza, X., and Huey, R. B. “Supplemental Oxygen and Mountaineering Deaths.” In *American Alpine Journal* 284:135-138. 2000.
- Houston, C. “Towards Everest, 1950.” In *Himalayan Journal* 17:9-18. 1952
- Huey, R. B., and Eguskitza, X. “Supplemental Oxygen and Death Rates on Everest and K2.” In *Journal of the American Medical Association* 284:181. 2000.
- Huey, R. B., and Eguskitza, X. “Limits to Human Performance: Elevated Risks on High Mountains.” In *Journal of Experimental Biology* 204:3115-3119. 2001.
- Leigh-Mallory, G. H. “The Northern Approach—continued.” In *Mount Everest: the Reconnaissance*, 1921, by Howard-Bury, C.K. (and others), 203-220.

Raymond B. Huey is a professor of biology at the University of Washington. He has published over 100 research papers on the ecology, physiology, and evolution of fruit flies and lizards, but is also fascinated with analyses of factors influencing mountaineers on Himalayan peaks.

Richard Salisbury is a retired computer analyst who specialized in databases while at the University of Michigan. He has been trekking and climbing in the Himalayas for 25 years. For the last 10 years, he has been working closely with Elizabeth Hawley to convert her vast Himalayan archives into a database for eventual publication by the American Alpine Club.

