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Hiking fatalities on Angels Landing Trail – factors identified from Zion National Park

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Case study

Abstract

Hiking is a popular outdoor activity with approximately 45 million participants in the United States each year. The growing popularity of hiking has given rise to an increasing number of hiking-related deaths. Within the U.S. State of Utah and Zion National Park, the Angels Landing Trail has been identified as a trail recording a high number of hiking deaths. The popular trail ascends 454 m and is lined with slippery edges and steep drop-offs along its 8 km roundtrip trail. The most minor mistakes will easily result in death. Utilizing a case study approach, this study identified unsafe hiking behavior, pre-existing health conditions, the physical environment, and the social environment as primary contributing factors in hiking fatalities on the trail. In the 1950s – 1960s guard rails were added to the trail, in 2010 a total of 55 meters of posts and chains were installed along the trail, and in 2022 Zion National Park instituted a permit system aimed at reducing overcrowding and improving the hiking experience. Since 2022, only a single hiking death has been recorded on the trail. Further monitoring of the trail is warranted so that of the number of fatalities and the factors contributing to any death can be compared from before and after the implementation of the permit system.

Keywords

- hiking
- fatality
- Angels Landing Trail
- Zion National Park

Contribution

A – Preparation of the research project
B – Assembly of data
C – Conducting of statistical analysis
D – Interpretation of results
E – Manuscript preparation
F – Literature review
G – Revising the manuscript

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Introduction

Hiking is a popular outdoor activity that helps maintain a healthy lifestyle.[1,2] In the United States, hiking is the fourth most popular outdoor recreation activity with approximately 45 million participants each year.[3] Existing research has identified children as young as six years of age participating in hiking activities and a propensity for many hikers to venture into wilderness and extreme environments.[4,5] Unfortunately, the growing popularity of hiking has given rise to an increase in hiking related injuries and deaths.[2] Following cardiovascular events, injuries have been identified as leading cause of hiking deaths.[5-7] In popular hiking destinations such as U.S. National Parks, hiking-related injuries account for 48% of search and rescue (SAR) operations that cost millions of dollars.[8,9] In total, hiking accounts for 10% of all deaths in U.S. National Parks.[8,10]

In recent years National Parks in the U.S. State of Utah have reported heavy emergency medical (EMS) and SAR workloads.[11] Zion National Park, the most visited National Park in Utah, has received considerable media attention due to multiple hiking deaths on the Angels Landing Trail. Established in 1919 and recognized as the first national park in Utah, the Zion National Park landscape is characterized by deep and narrow canyons, steep cliffs, broad upland plateau areas, and isolated mesas, pinnacles, and rock formations.[12,13] Hiking and canyoneering are popular activities in the park, but for many the park is synonymous with overcrowding and high visitation numbers.[14,15]

Angels Landing Trail, one of the most popular hikes in Zion National Park, has a reputation as a busy 8 km roundtrip trail that ascends 454 meters. The trail is steep with slippery edges and steep drop-offs. The trail is also narrow with 21 switchbacks and chain railings to assist hikers along the more difficult sections (Figure 1 & 2). It takes approximately 2–4 hours to complete the hike and is deemed possible for novice hikers with a reasonable level of fitness. The trail is not recommended for children. At the summit of the trail hikers are rewarded with a 360 degree postcard-like view of red rock canyon scenery (Figure 3).

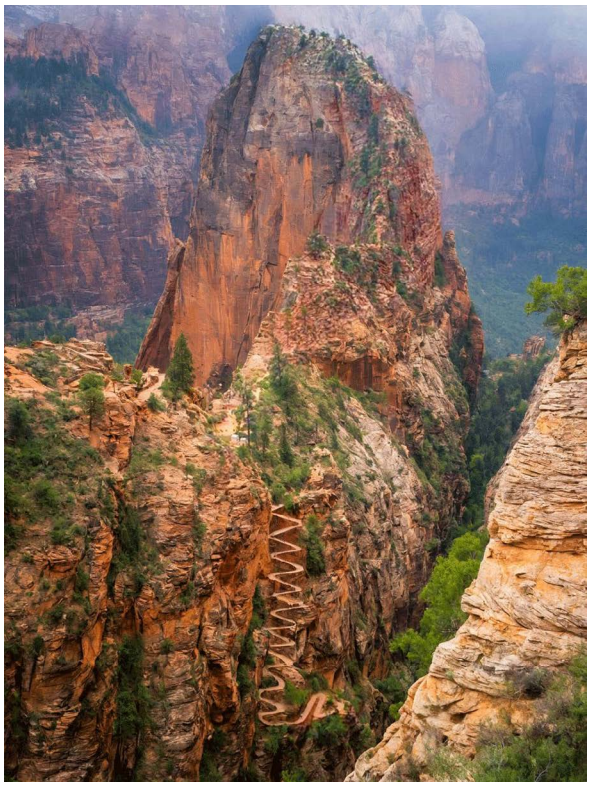

Figure 1. Narrow trail and switchbacks on Angels Landing Trail

Figure 2. Chain railing to assist hikers on difficult sections of Angels Landing Trail

Figure 3. Summit view from Angels Landing Trail

As of 2024, local and national media reported the death of at least 17 hikers on Angels Landing Trail. Despite not being a technical hike requiring ropes, Angels Landing has earned the reputation as one of the most dangerous hiking trails in the United States. Given the popularity of the trail, concern about the safety of hikers and the prevention of future deaths has been expressed. However, the factors contributing to hiking deaths on the trail are not well understood. As a result, the purpose of this study is to utilize a case study approach to identify and examine the factors contributing to the death of seven hikers on the trail. The information for each case study was retrieved from official government incident reports (NPS Forms 10-343 and 10-344). Received through a Freedom of Information Act (FOIA) request for all fatalities on the Angels Landing Trail, the reports contain information about the date, time, location, and nature of each incident. The reports also include information about all involved hikers and a detailed narrative describing the emergency response, a summary of investigative actions, and witness statements.

Case Report 1

A 14-year old male from California fell 245 m from a point near the summit of Angels Landing. The victim was part of a Boy Scout troop comprised of 40 hikers. The scouts were initially divided into four hiking groups but were later described by witnesses as crowded together and making trail conditions dangerous. At the time of the incident (14:30 hours) the victim had ventured away from the main trail and was attempting to climb down to a lower ledge out of his reach. The victim had been dared by other scouts to reach the ledge and carve his name in the sandstone rock. Witnesses stated there was no adult supervision in the immediate proximity and the scouts were behaving carelessly in their movements near the edge of the trail. At 16:35 hours, a helicopter located the body of the victim below the southeast face of the trail and lowered two rescue personnel into the area. However, due to a lack of daylight the remainder of the SAR team were not lowered until the next morning. No description of the victim's injuries was provided other than the case being classified as a traumatic fatality resulting from a fall from 245 m in height. The search and rescue costs for the incident totaled USD $20,084.

Case Report 2

A 63-year old female from California was hiking solo when she fell 220 m to her death. At 16:13 hours, Park Rangers were informed a hiker had fallen from a northern cliff face of Angels Landing referred to as Scouts Lookout. The fall point was just prior to a first set of chains installed by the National Park Service to assist hikers navigate difficult sections of the trail. SAR teams were immediately dispatched to an area below the trail where they found human remains spread throughout the vegetation. The search team did not initially locate a body but at 18:45 hours the team utilized binoculars to establish a possible fall line from the upper part of the trail. This enabled the team to locate the victim on a ledge not visible to the search team below. The team confirmed it as a fatal fall. Park Rangers on scene were able to package the victim before dark but extrication of the body was delayed due to night conditions.

At the point of her fall the victim had hiked over 3.2 km and gained 305 m in elevation. In addition, the victim had passed a total of seven informational signs describing the difficulty of the hike and the potential dangers on the trail. Investigators learned the victim had completed another hike earlier in the day, had no pre-existing health issues, and was not suicidal. Three witnesses to the fall stated the victim had been seated and dangling her legs over the cliff edge. They further stated the victim intended to finish the trail but fell from the cliff as she rose to a standing position. The weather was clear, dry, and windy with occasional wind gusts between 29–47 km/h at the point of the fall. The incident report stated it was unclear whether a sudden gust of wind, possible vertigo, or tripping contributed to the fall. The extrication of the body required a Grade 5 class climb (difficult, with sustained climbing, high commitment, and few bivouac sites) and a rescue craft to ferry the remains of the body across the Virgin River. Final SAR costs were not reported.

Case Report 3

At 14:25 hours, Zion National Park Dispatch was alerted that a 64-year old male from California had suffered a ground level fall on the switchbacks section of the Angels Landing Trail. The park responded with a four-person litter and personnel with ALS (Advanced Life Support) capabilities. Upon arriving on scene the victim had approximately 0.11 liters of blood spilled on the ground around his head and no palpable carotid pulse. The hiker was otherwise unresponsive and not breathing. Witnesses to the event stated they saw the victim making multiple stops to rest. During one stop the hiker leaned against a rock wall and collapsed. The hiker hit his head on a rock as he collapsed. A German physician and emergency room nurse witnessed the ground level fall and performed CPR on the dead hiker for 25 minutes. A wheel litter was used to evacuate the victim's body from the trail. Further investigation found the hiker had quadruple bypass heart surgery a year prior and had recently stopped taking his prescriptions due to their high cost and his lack of health insurance. Prior to the hike the victim expressed interest in seeing if he could still hike post-surgery and if the elevation gain on the trail would impact him. The final cause of death was deemed sudden cardiac arrest with the victim expiring in the field.

Case Report 4

At 16:55 hours, Park Dispatch was alerted to a hiker falling from Angels Landing. The reporting party stated the body was in a supine position with a twisted neck and leg but could not confirm if the hiker was deceased. Park Rangers arriving on scene found a young female body close to the entrance of Refrigerator Canyon with injuries incompatible with life. Investigating Rangers determined the victim fell 207 m from the Angels Landing Trail. Family members at the scene identified the victim as a 13-year old female from nearby Colorado City, Arizona. At the time of the fall the victim had been hiking with 12 members of her family but had fallen far behind on the trail.

The victim was wearing sandals and a prairie dress extending to her ankles; a style of dress commonly worn by polygamous groups in Utah. Witnesses who spoke with the victim prior to her fall stated she was alone and had wandered off trail and onto a sandstone ledge. The victim told another hiker she was trying to find an alternate route to the top of Angels Landing. However, the victim did not appear sure of her footing and was leaning against a rock in a nervous manner. None of the family members realized the youth had fallen behind the main family group during their hike. Tracks matching the sandal tread worn by the victim were identified at the point of the fall just off the trail from a second set of chains. These tracks led 6 m to a steep sandstone ledge. A sizeable disturbance in the sand at the cliff edge suggested the victim had slipped on the sandstone. The teenage victim was described as happy and adventurous with no existing health problems.

Case Report 5

At 11:55 hours, Zion National Park Dispatch received multiple reports of a hiker falling from Angels Landing Trail. The victim, a 53-year old male from Missouri, was part of a large hiking group of 30 people gathered in the national park for a wedding scheduled the next day. Park Rangers searching the base of the trail for any signs of a body described the area as steep and densely covered by trees and shrubs. When eventually located, the body was 46 m below the base of Angels Landing. The point of impact was greater than one meter in diameter and approximately 0.2 m deep.

The exact point of fall from the trail was not identified so no estimate of a fall height was calculated. However, several witnesses to the incident described the victim as an aggressive hiker wanting to be noticed by charging ahead of his hiking group. Family members were concerned the hiker was not showing proper respect for the trail and could become dehydrated, tired, and dizzy from his hiking pace. At the time of his fall, the victim was near the edge of the trail jumping from a large rock to a smaller rock when he lost his balance. During the fall the victim hit a lower ledge and cartwheeled several times before making impact with the ground. A local family member leading the hike reported warning everyone about the dangers of the steep, rocky, and exposed trail prior to starting the hike. The leader also pointed out warning signs situated at the trailhead.

Case Report 6

At 08:22 hours a Park Volunteer reported finding a deceased body in an area known as Refrigerator Canyon. Hikers descending from Angels Landing first saw the body and informed the Park Volunteer. Park Rangers responding to the incident concurred finding an adult male with major blunt force trauma to his head, torso, and extremities. Blood spatter from the body was also

identified on a sandstone wall near the body. No identification was found on the body but rental car keys helped identify the victim as a 45-year old male from Florida who had been in Las Vegas watching a rugby tournament. Interviews with the family of the victim confirmed the family was aware the victim would be hiking solo and described him as an experienced and cautious hiker. The victim had been taking anti-depressant medication for eight years but was not suicidal. The vertical fall distance from the trail was approximately 192 m. As the victim was hiking solo and there were no witnesses to the fall, no specific cause of the fall was reported. Nonetheless, other hikers reported patches of ice on the trail that day. A sign posted at the trailhead warned of a strenuous climb, a narrow trail with cliff exposures, a hazardous trail during thunderstorms and darkness, and a conditions conducive to having ice and snow on the trail.

Case Report 7

At 08:24 hours, Zion National Park Dispatch was notified a 40-year old female had fallen 293 m from the Angels Landing Trail. With assistance from a search helicopter, the body of the victim was located at the base of the north face in technical terrain. The difficult nature of the terrain required 10 individuals to lower the body 15 m over a cliff band and complete a lengthy litter carryout down steep terrain and across a shallow river crossing. The victim was hiking with several family members and using hiking poles to assist her trek. She was also wearing new walking shoes purchased several days prior to the hike. The victim had complained the toe box of her new shoes made her feet look large.

The victim did not consume alcohol the night prior to the hike and was only taking medication for cholesterol. The family hiked at a slow pace and stayed together while ascending 305 m in elevation. At the time of the incident, the victim was walking off-trail dangerously close to the edge of the cliff. Her route was characterized by low lying brush, uneven footing, and loose sand and rock. The victim stumbled as she climbed over the uneven rock, lost her footing, and started to free fall off the cliff. Witnesses stated the victim was talking at the time she stumbled and was not giving her foot placement full attention. The victim was reported to have an uneven gait; the result of childhood skating incident. Investigators determined the most plausible explanation for the fall lies with the loose terrain and physical factors such as fatigue and her uneven gait. No search and rescue costs were reported.

Discussion

Prior research examining the emergency medical and search and rescue workload for Zion National Park identified 30 cardiac incidents over a 5-year period requiring advanced lifesaving services, 456 first aid incidents, and 10 visitor fatalities park-wide.[11] The same study found that over a 3-year period, canyoneering and day hiking were the subject activity in 50% and 33% of all search and rescue operations carried out in the park.[11] Fatigue, falls, errors in judgement, and insufficient equipment and experience were the major factors contributing to the search and rescue incidents.

The prior study reported only park-wide data and did not report on specific attractions and high profile trails such as Angels Landing Trail. Thus, the present study allows for the first examination of the factors contributing to hiking fatalities on Angels Landing Trail. Environmental factors such as trail conditions and elevation along with human factors such as unsafe hiker behavior and pre-existing health conditions were identified as contributing to at least one fatality. Hiking in backcountry wilderness areas such as Zion National Park is often falsely perceived as safe and less challenging despite existing research identifying hiking as a high incident activity.[3,16-20] Moreover, despite the lack of denominator data reporting the total number of hikers on the trail making the calculation of incident rates impossible, a trail such as Angels Landing is clearly challenging with potentially fatal consequences.

Similar to the errors in judgment identified in the emergency and search and rescue workload study, in the present study unsafe hiking behavior was identified as a factor contributing to the death of hikers in five of the seven cases. In the wilderness recreation literature, unsafe hiking behavior is generally considered when the hiker displays a lack of situational awareness and does not understand or perceive the potential consequences of their actions.[2,21,22] Such a situation arises in both experienced and inexperienced hikers and can include a range of situations such as a hiker overestimating their abilities, ignoring warning signs, and choosing to hike solo.[2,23,24] Neither the unsupervised Boy Scout (Case Report 1) attempting to climb to a ledge beyond his reach and the 13-year hiker separated from her family (Case Report 4) understood the potential consequences of their actions. Likewise, the adult hikers in Case Reports 2 and 5 ignored warning signs and chose to sit and dangle their legs over the edge of the trail. Choosing to hike in an aggressive manner and jump from rock to rock indicates an overestimation of abilities and an overall lack of situational awareness.

The distracted and off-trail behavior of the hiker in Case Report 7 also indicates a lack of situational awareness.

Along with unsafe hiking behavior, pre-existing health conditions are known to exacerbate hiking injuries and contribute to hiking fatalities.[3,24-27] For example, sudden cardiac death (SCD) incidents are known to occur in Zion National Park.[11] Outside of the national park, SCD incidents are responsible for 30% of mountain hiking fatalities and are very common at lower altitudes.[28,29] SCD is almost always associated with vigorous exercise within one hour prior to the SCD incident.[28] The victim in Case Report 3 is an example of an SCD which has an increased probability provided the victim had by-pass heart surgery one year prior and had stopped taking his prescriptions. The victim had clearly exerted himself and made frequent stops to rest. Likewise, an uneven gait is known to contribute to falls in older adults and to be a factor in hiking incidents.[27,30-33] Along with being distracted and hiking on loose terrain, uneven footing resulting from a pre-existing and almost lifelong uneven gait contributed to the falling death of the victim in Case Report 7.

It is impossible to overlook the role the social and physical environment played in the seven case reports. While not directly linked by investigators, whether the hiker was solo or part of a larger group was mentioned by witnesses in each incident report. Large groups were described by witnesses as creating crowded hiking conditions and large group behavior such as the social pressure placed on the Boy Scout and the teenager forgotten by her family undoubtedly contributed to the death of the young victims. Moreover, without question the physical environmental aspects of Angels Landing contributed to each death. It is clear from the case reports that in all but one incident, falling from height was the final causal factor resulting in death. Out of the five cases where the fall site was known to investigators, the fall heights ranged from 192 to 293 m.

Conclusion

This study describes the characteristics and factors contributing to seven hiking deaths on the Angels Landing Trail in Zion National Park, Utah, USA. Unsafe hiking behavior played a major role in the death of five of the seven hikers, pre-existing health conditions contributed to two fatalities, and environmental factors such as the physical and social environment contributed to each fatality. Since the opening of the Angels Landing Trail in 1926, the National Park Service has attempted to improve hiking safety on the trail. In the 1950s and 1960s the trail was partially reconstructed and some guard rails were added. In 2010, Zion National Park undertook major safety improvements on the trail by installing 60 new posts and 55 meters of chains to assist hikers on steep and narrow sections of the trail. The re-chiseling of some dry stonework steps was also completed.

Despite the improvements and attention given to Angels Landing trail, fatal incidents continued to occur. In April 2022, Zion National Park instituted a permit system for the Angels Landing Trail. Distances on the trail were metered to avoid crowding and visitors wanting to hike the trail were required to apply for hiking permits via an online lottery system at recreation.gov. Hiking permits are spread at varied times throughout the day and Park Rangers conduct regular patrols checking for permits. While designed to prevent overcrowding, the permit system also intends to improve the hiking experience and increase the safety of the hike. One death has occurred since the start of the permit system but details about the fatal incident are presently unavailable. This suggests further research monitoring Angels Landing Trail conditions and investigating the factors contributing to further deaths is warranted. This will allow for a comparison of factors contributing to hiking deaths before and after the institution of the permit system. Such a comparison could ultimately inform prevention strategies for similar hiking trails. Likewise, future research would do well to acquire appropriate denominator data to better understand the number of trail users hiking Angels Landing. This would also allow for the calculation of injury rates by the number of participants as well as their exposure hours on the trail.

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