

Health challenges on research and cruise ship expeditions to Antarctica

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Review article

Abstract

Antarctica is one of the last great wilderness areas on Earth. Early Antarctic expeditions during the Heroic Age of Antarctic discovery (1895–1922) returned reports of frostbite, scurvy, snow blindness, and death. Today, over 50,000 people travel to the Antarctic each year via research expeditions, commercial cruise ships (tourism), and research cruises. This study reviewed the existing research reporting the health challenges encountered during modern day travel to Antarctica. The results identified a transition from the Heroic Age when death was common to a contemporary time when death is an uncommon event. The review identified musculoskeletal and soft tissue injuries resulting from moving equipment and supplies to be the most common health challenge encountered by long-term land expeditions. Digestive issues such as constipation and dyspepsia were also common in during the coldest months. For tourist oriented commercial cruise ships, motion sickness resulting from rough seas was most prominent. Specifically, the small nature of the cruise ships made them prone to rough seas in Drakes Passage. During scientific cruises where research is primarily conducted aboard the ship, dermatological conditions (viral, fungal, bacterial) such as dry skin, dry lips, eczema are the most common health challenge. Musculoskeletal and soft tissue injuries are also common given the physical challenge associated with strenuous research.

Keywords

- Antarctica
- expedition
- cruise ship
- injury
- illness
- death

Contribution

- A – the preparation of the research project
- B – the assembly of data for the research undertaken
- C – the conducting of statistical analysis
- D – interpretation of results
- E – manuscript preparation
- F – literature review

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Introduction

The Antarctic region is a highly sensitive environment recognized as the most cold, windy, dry, and highest continent in the world.¹⁻³ Known for its abundant wildlife, a near pristine environment with high scenic value, Antarctica is one of the last great wilderness areas on Earth.⁴ Historically, travel to the Antarctic began when Fabian von Bellingshausen became the first person to spot land south of the Antarctic Circle in 1820. One year later, John Davis was the first explorer to land on the continent. Further expeditions were completed in the early 1900s with the first documented tourists arriving as part of an Argentine expedition in 1933.⁷ Today, the number of research expeditions to the Antarctic has increased and commercial travel has reached the point where tourism oriented commercial cruise ships offer the opportunity to set foot on the Antarctic for hiking and viewing wildlife.⁶ While human activity in Antarctica falls under the governance of the Antarctic Treaty System, the day to day operations of research expedition and tourist activity is not regulated.

The first reported health challenges associated with Antarctic travel come from 18 documented Antarctic expeditions during the Heroic Age of Antarctic travel (1895–1922).^{8,9} Frostbite, scurvy, and snow blindness were the most commonly described medical challenges during these expeditions.^{8,9} However, other case reports involved smoke blindness, chilblains, dental conditions, swollen legs and feet, dry and cracked skin, and incidents of metal sticking to bare flesh.^{3,8,9} In contrast, contemporary travel to Antarctica is described as physiologically and psychologically challenging.¹⁰ Some studies from extended research expeditions suggest injury trauma is the most common incident resulting in minor, severe, and fatal incidents³ Others have suggested dermatologic and orthopedic problems to be most challenging.^{3,10} However, regardless of the claims, research reporting medical challenges associated with Antarctic travel are few and limited.⁵ Thus, the risk of injury, illness, and even death when traveling to the Antarctic is largely unknown.

With increasing levels of Antarctic tourism, in recent years many concerns have been expressed about the impact these boats and accompanying tourists are having on the natural environment.¹¹ Similar concerns have been raised about the health of an increasing number of travelers to the continent. Given these concerns and the lack of comprehensive knowledge about the risk of injury and illness during travel to Antarctica, the aim of this study is to review existing research reporting health challenges during travel to the Antarctic.

Material and methods

A systematic literature review of all English-language articles was conducted using PubMed, Scopus, EMbase, and Scholar Google for the years 1900–2022. The search strategy involved searching the terms ‘Antarctica, Expedition, Tourism, Cruise, Injury, Illness, Fatality, Death, and Health.’ Articles were chosen for inclusion based on their relevance to the Antarctica and the medical issues they addressed. Articles and case study findings were organized based on their epidemiology, etiology, and purpose of travel.

Travel to Antarctica

Antarctica is more than 1000 km away from the nearest neighboring continent. Visitors to Antarctica typically arrive by sea or by flight. It is common for travelers to fly to Ushuaia, Argentina and then board an Antarctic Cruise. Travel on such commercial cruise ships generally takes two days to reach the Antarctic. Other Antarctic cruises coming from locations such as Australia take approximately 21 days to arrive. While there are no regularly scheduled flights to the Antarctica, charter flights fly two hours from Punta Arenas in Chile to King George Island in the South Shetlands. From there it is an additional 10 hour flight to the Antarctic. The flight season to Antarctica is short with flights only occurring from December to February.

Research expeditions

Travel to the Antarctic can generally be categorized into two groups based on their travel motive. The first group are those taking part in long-term scientific expeditions to Antarctica. The second group are tourists participating in short-term commercial expeditions (11–21 days) to the Antarctic.

Two studies from India and Japan highlight injury and illness trends for research expeditions. Japan has had ongoing research activities in the Antarctic since 1956 while India has had an ongoing Antarctic scientific research program since 1981.^{13–15} The Japanese data is the most comprehensive covering 59 research expeditions between 1956–2016 and reporting 6,837 medical cases.¹³ The Japanese research expeditions last for a period of 14 months and averaged 4 medical reports per person. Table 1 reports the cumulative top ten leading injury and disease challenges reported over all 59 expeditions. Digestive system issues such as diarrhea, dyspepsia, and constipation accounted for 10% of all

medical cases. This was followed by injury trauma and contusions both at 8%, lower back and frostbite injuries at 6%, and dental crowns dislocations due to the cold and altitude at 5%. Respiratory conditions, dermatitis (contact and eczema), periodontitis, and headaches were the remaining common medical reports. There was only one death due to a blizzard reported in the Japanese data, and two cases of lumbar anesthesia use for appendectomies. Three trauma injury cases were the result of snowmobile crashes.

Table 1. Leading diseases and injuries reported on 59 Japanese research expeditions to the Antarctic, 1956–2016

Condition	Total number	Percent of total medical cases
Digestive system (diarrhea, dyspepsia, constipation)	682	10
Injury / trauma	567	8
Contused wounds / distortion	567	8
Lumbago / disk hernia	390	6
Frostbite	387	6
Dental crown dislocation	313	5
Respiratory system	279	4
Dermatitis	225	3
Periodontitis	178	3
Headache	150	2

In contrast to the Japanese study, the Indian expedition spends between 12–15 months in the Antarctic where the expedition team is both inducted by air and sea.¹⁴ The study reported on only one expedition with 26 team members aged 27–59 year old. The Indian expedition was taken care of by two medical officers who reported a total of 93 medical incidents; an average of 3.6 reports per expedition member. Table 2 displays the most common medical problems encountered by the expedition. Abrasions, bruises, and soft tissue infections accounted for 16% of all medical reports as was musculoskeletal / lower back pain. Digestive problems such as dyspepsia and constipation accounted for 11%, oral ulcers accounted for 9%, and dry eye conditions accounted for 9%. Muscle cramps, fungal infections, general malaise, and dermatitis account

for the rest of the most common medical cases. The Indian study suggested that the higher number of musculoskeletal and lower back report and the higher number of abrasions and bruises were the result of moving supplies. It also noted that constipation was most prevalent during the month of July, the coldest month in the Antarctica. Of interest was the lack of frostbite or other cold injuries. The study attributed this to the high quality of clothing supplied the expedition members and the excellent heating arrangements in their facilities.¹⁴

Table 2. Most common medical problems encountered during the 27th Indian Scientific Expedition to Antarctica

Condition	Total number	Percent of total medical cases
Abrasions, bruises, soft tissue injury	15	16
Musculoskeletal / lower back	15	16
Digestive / Dyspepsia / Constipation	10	11
Oral ulcers	8	9
Dry eye	7	9
Muscular cramps	4	4
Fungal infections	4	4
General malaise	4	4
Dermatitis	3	3

Two additional studies of Antarctic expeditions reported on the Australian Antarctic Expedition of 1977–1985 and the British Antarctic Survey from 1986–1995.^{16,17} However, both studies are focused on reporting injury incidents only and report nothing of any illness. The British Antarctic Study reported a total of 3683 injury incidents over a 10-year period resulting in 2.19 injury reports per expedition member.¹⁷ Exactly 66% of all injuries happened on Antarctic bases while the rest were reported from support ships at sea.¹⁷ The data reported a high number of cold injuries such as frostbite (95% of cold injuries), hypothermia (3%), and trench foot (2%).¹⁸ Only 47% of land injuries and 46% of injuries on the ship were classified as work related.¹⁷ The rest were recreational injuries incurred while snowmobiling and skiing.^{19,20} In the Australian

Antarctic injury report, between 179 to 496 expedition members were either based on land or at sea over the nine years.¹⁶ The total number of reported injuries were 1,301 making for an incident rate of 1053.4 per 1000 persons per year.¹⁶ Injury rates were higher at the land base than on ship and minor soft tissue injuries and minor fractures and joint injuries were the most common incidents.¹⁶ The activities resulting in injuries were not reported but alcohol was a contributing factor in 13.4% of ship-based injuries and 6.7% of injuries at the land base.¹⁶

Commercial cruise ship expeditions

With the increasing popularity of the cruise tourism industry and the expansion of the industry into new markets such as the Antarctic, researchers have raised concerns about passenger and crew safety.²¹ Antarctic cruise expeditions began to increase to large levels around 1992 and reached the level of 56,000 tourists expecting to set foot on the continent for hiking tours and wildlife watching opportunities in 2017–2018.^{6,22} While there are number of case studies reporting singular cardiac events, falls while disembarking from inflatable boats, frostbite while kite skiing across the Antarctic, and encounters with penguins, giant petrels, and other birds, there are only two studies documenting the health challenges encountered on commercial Antarctic cruises.^{23–26} The first documented injury and illness patterns on a former Soviet Union flagged ice breaker converted to an Antarctic cruise ship; the second study reported injury and illness patterns on four different cruise ships in 2010 and 2011.^{6,27}

The former Soviet Union ice breaker converted into an Antarctic cruise ship made 11 Antarctic voyages in 2004–2005. Cruise ships sailing to the Antarctic tend to be smaller cruise ships carrying approximately 100–150 passengers. During these 11 voyages, the ship carried 1057 total passengers from 30 different countries with voyages lasting 10 days.⁶ Table 3 documents the injury and illness complaints documented during the voyages. Motion sickness (42%), infectious illnesses (17%), and injury trauma (15%) were the most documented complaints. While the study did not state the factors contributing to the high number of motion sickness incidents, each voyage cruised 600 miles through the notoriously rough seas of the Drake Passage on their way from Ushuaia, Argentina, to the Antarctic. Given

the small size of the vessel in the rough seas, motion sickness complaints can be expected. The study did not mention any specific illness, the nature of any injury, or list any contributing factors to the injuries. However, the study noted the absence of any cold injuries and incidents related to wildlife. It pointed to the heated ship and warm showers available after on-land excursions as the reason for the absence of cold injuries. Likewise, the absence of wildlife-related incidents was credited to expedition staff keeping tourists a safe distance from penguins, seals, and whales.⁶

Table 3. Most common medical complaints involving passengers aboard Antarctic cruise ships, 2004–2005

Condition	Total number	Percent of total medical cases
Motion sickness	96	42
Infectious	39	17
Injury / trauma	34	15
Musculoskeletal	16	7
Neuro / Psych	15	6
Gastrointestinal	14	6

The second study documented injury and illness patterns among 2366 passengers on 26 voyages aboard four Antarctic cruise ships between 2010–2011.²⁷ The Antarctic cruises averaged 14 days and reported 680 patient consults. However, 150 of the consultations were for motion sickness prophylaxis prior to the ships sailing through the Drake Passage. Table 4 displays the most common injury and illness complaints from the remaining active medical complaints. As in the previous study, motion sickness was again the most common complaint (27%). Pharyngitis and upper respiratory complaints including bronchitis and pneumonia accounted for 23% of all complaints while injuries accounted for 14%. The nature of injuries were simple contusions, lacerations, and sprains. Out of the 74 documented injuries, 66% occurred while the passenger was on ship and 34% occurring during land-based excursions. Table 5 reports five major events reported during the 26 cruises. One incident involved a fatality while the other four required medical evacuation from the ship.

Table 4. Most common active medical complaints from four expedition cruise ships making 26 Antarctic voyages during 2010–2011

Condition	Total number	Percent of total medical cases
Motion sickness	142	27
Pharyngitis / upper respiratory	122	23
Injury / trauma	74	14
Pre-existing condition	32	6
Gastrointestinal	21	4

Table 5. Severe health incidents occurring during Antarctic cruise ship expeditions

Incident	Description
Cardiopulmonary arrest	71-year old male suffered cardiopulmonary arrest while walking on shore. Fatal.
Myocardial infarction	60-year old male presented on-ship with substernal chest pain and suffered an inferior wall myocardial infarction. Emergency evacuation from the ship. Stenting of his right coronary artery.
Tendon disruption	46-year old male slid down a hill and suffered a quadriceps tendon disruption. Evacuation from ship.
Hip fracture	76-year old male sustained a hip fracture from a fall on the deck of the ship. Evacuation from ship.
Hip fracture	Elderly female passenger suffered a hip fracture after a fall in her cabin. The cruise ship was crossing the Drake Passage. Evacuation from ship.

Scientific cruises

Even though travel to the Antarctic is generally categorized into land-based scientific expeditions and commercial cruise ships, recent research has shed light on research-oriented scientific cruises. Such cruises typically involve long sea voyages where the scientific research is primarily conducted on the ship. Few, if any, land excursions are made and almost all passengers on the cruises are scientists.

A 2020 study of scientific cruises documented the health challenges on six scientific cruises between 2004–2019. Each cruise set sail from New Zealand and traveled to the Antarctic via the Southern Ocean.²² Each cruise carried 40–45 people (244 people in total) for a duration of 6–7 weeks at sea. Table 6 documents 196 clinical presentations made on the six cruises. Dermatological conditions (viral, bacterial, and fungal) such as dry skin, eczema, skin fissures, burns, and dry lips were by far the most common presentation on the cruises (31%).

Table 6. Most common clinical presentations from six New Zealand to Antarctic research cruises, 2004–2019

Condition	Total number	Percent of total medical cases
Dermatological	60	31
Musculoskeletal / soft tissue	37	19
General malaise	22	11
Motion sickness	20	10
Lacerations / abrasions	9	5
Respiratory	7	4
Gynecological / genitourinary	6	3
Gastrointestinal	4	2
Oral / dental	3	2

Most of these resulted from the cold, low-humidity, and ultraviolet radiation the scientists were exposed to.²² Musculoskeletal and soft tissue problems such as ankle sprains, rotator cuff injuries, contusions, and thoracic and lumbar pain were the second most reported problems (19%). These were primarily attributed to the nature of the scientific work with various equipment from the ship.²² General malaise (11%) was attributed to pre-motion sickness as people adjusted to the motion of the ship and the physical and mental demands of their research. The same motion resulted in fall injuries and people losing their balance.²² Compared to other sea-based cruises, the lower prominence of motion-sickness on the scientific cruises was attributed to the fact most passengers were marine scientists and experienced in sea conditions.

Conclusion

This review reports injury and illness trends on scientific expeditions, tourist-oriented cruise ships, and scientific cruises expeditions to Antarctica. Compared to the early Heroic Age of Antarctic expeditions (1895–1922) when frostbite, scurvy, snow blindness, and death was common, contemporary travel expeditions have transitioned to a time where deaths are uncommon and human activity on the continent has increased. Moreover, instead of facing the challenges of frostbite and scurvy, long-term land-based expeditions now face musculoskeletal and soft tissue injuries related to moving equipment and supplies. Digestive problems such as constipation and dyspepsia are also a health challenge during the coldest months. Commercial cruise ships traveling to the Antarctic primarily encounter challenges such as motion sickness due to the rough seas of the Drake Passage and the small nature of the cruise ships carrying less than 200 tourists. Frostbite is only a minor concern on cruise ships due to an easy retreat to a warm ship with hot showers and food. The emerging data on Scientific Cruises where most research is conducted aboard the ship identifies dermatological conditions such as dry skin, eczema, and dry lips as the major health challenge. Much of this is attributed to working in a cold, low humidity environment with exposure to ultraviolet radiation. Musculoskeletal and soft tissue injuries are also a challenge on scientific cruises due to the nature of the research being conducted. Motion sickness, while still present, is less common on scientific cruises as many of the scientists are experienced at sea. With the number of research and cruise expeditions to Antarctica increasing, concerns over health challenges and human impacts on the Antarctic will continue to be raised. It is hoped that with time more accurate and more numerous studies reporting on health challenges in the Antarctic will emerge.

References

- [1] Alekseev I, Abakumov E. The content and distribution of trace elements and polycyclic aromatic hydrocarbons in soils of Maritime Antarctica. *Environ Monit Assess.* 2020;192(11):670. doi: 10.1007/s10661-020-08618-2.
- [2] Alekseev I, Abakumov E. Content of trace elements in soils of Eastern Antarctica: Variability across landscapes. *Arch Environ Contam Toxicol.* 2021;80(2):368-388. doi: 10.1007/s00244-021-00808-4.
- [3] Taylor D, Gormly PJ. Emergency medicine in Antarctica. *Emerg Med.* 1997;9(3):237-245. doi: 10.1111/j.1442-2026.1997.tb00394.x.
- [4] Curry CH, McCarthy JS, Darragh HM, et al. Could tourist boots act as vectors for disease transmission in Antarctica? *J Travel Med.* 2002;9(4):190-193. doi: 10.2310/7060.2002.24058.
- [5] Dahl, E. Medical cruise challenges in Antarctica. *J Travel Med.* 2014;21(4):223-224. doi: 10.1111/jtm.12118.
- [6] Bledsoe GH, Brill JD, Zak D, Guohua L. Injury and illness aboard an Antarctic cruise ship. *Wilderness Environ Med.* 2007;18(1):36-40. doi: 10.1580/06-weme-or-029r.1.
- [7] Procriv P. Health aspects of Antarctic tourism. *J Travel Med.* 1998;5(4):210-212. doi: 10.1111/j.1708-8305.1998.tb00509.x.
- [8] Guly HR. Frostbite and other cold injuries in the heroic age of Antarctic exploration. *Wilderness Environ Med.* 2012;23(4):365-370. doi: 10.1016/j.wem.2012.05.006.
- [9] Guly HR. Snow blindness and other eye problems during the heroic age of Antarctic exploration. *Wilderness Environ Med.* 2012;23(4):77-82. doi: 10.1016/j.wem.2012.05.006.
- [10] Pattarini JM, Scarborough JR, Sombito VL, Parazyński SE. Primary care in extreme environments: Medical clinic utilization at Antarctic stations, 2013–2014. *Wilderness Environ Med.* 2016;27(1):69-77. doi: 10.1016/j.wem.2015.11.010.
- [11] Tejedó P, Benayas J, Cajiao D, Leung Y-F, Filippo D De, Liggett D. What are the real environmental impacts of Antarctic tourism? Unveiling their importance through a comprehensive meta-analysis. *J Environ Manage.* 2022;308:1-16. doi: 10.1016/j.jenvman.2022.114634.
- [12] Curry CH, McCarthy JS, Darragh HM, Wake RA, Todhunter R, Terris J. Could tourist boots act as vectors for disease transmission in Antarctica? *J Travel Med.* 2002;9(4):190-193. doi: 10.2310/7060.2002.24058.
- [13] Ikeda A, Ohno G, Otani S, Watanabe K, Imura S. Disease and injury statistics of Japanese Antarctic research expeditions during the wintering period: Evaluation of 6837 cases in the 1st–56th parties: Antarctic health report in 1956–2016. *Int J Circumpolar Health.* 2019;78(1):1-8. doi: 10.1080/22423982.2019.1611327.
- [14] Bhatia A, Pal R. Morbidity pattern of the 27th Indian Scientific Expedition to Antarctica. *Wilderness Environ Med.* 2012;23(3):231-238. doi: 10.1016/j.wem.2012.04.003.
- [15] Bhatia A, Malhotra P, Agarwal AK. Reasons for medical consultation among members of the Indian Scientific Expeditions to Antarctica. *Int J Circumpolar Health.* 2013;72:1-3. doi: 10.3402/ijch.v72i0.20175.
- [16] Lugg D, Gormly P, King H. Accidents on Australian Antarctic expeditions 1977–1985. *Polar Record.* 1987;23(147):720-725. doi: 10.1017/S0032247400008457.

- [17] Cattermole TJ. The incidence of injury with the British Antarctic Survey, 1986–1995. *Int J Circumpolar Health*. 2001;60(1):72-81. doi: 10.1080/22423982.2001.12112999.
- [18] Cattermole TJ. The epidemiology of cold injury in Antarctica. *Aviation Space Environ Med*. 1999;70(2):135-140.
- [19] Cattermole TJ. Snowmobile injuries in Antarctica, 1989–1996. *Int J Circumpolar Health*. 1997;56(4):152-158.
- [20] Cattermole TJ. The epidemiology of skiing injuries in Antarctica. *Injury*. 1999;30(7):491-495. doi: 10.1016/s0020-1383(99)00139-4.
- [21] Heggie TW, Heggie TM. Death at sea: Passenger and crew mortality on cruise ships. *Int J Travel Med Glob Health*. 2020;8(4):146-151. doi: 10.34172/IJTMGH.2020.25.
- [22] Visser JT. Patterns of illness and injury on Antarctic research cruises, 2004–2019: A descriptive analysis. *J Travel Med*. 2020;27(6):1-6. doi: 10.1093/jtm/taaa111.
- [23] Merefield DC, Beckham J. Cardiac arrest in Antarctica: A successful outcome. *J Travel Med*. 2016;23(3):taw015. doi: 10.1093/jtm/taw015.
- [24] Lamberth, PG. Death in Antarctica. *Med J Aust*. 2001;175(11-12):583-584. doi: 10.5694/j.1326-5377.2001.tb143734.x.
- [25] Russell KW, Imray CH, McIntosh SE, et al. Kit skier's toe: An unusual case of frostbite. *Wilderness Environ Med*. 2013;24(2):136-140. doi: 10.1016/j.wem.2012.11.013.
- [26] Bovard RS. Injuries to avian researchers at Palmer Station, Antarctica from penguins, giant petrels, and skuas. *Wilderness Environ Med*. 2000;11(2):94-98. doi: 10.1580/1080-6032(2000)011[0094:itarap]2.3.co;2.
- [27] Schutz L, Zak D, Holmes JF. Patterns of passenger injury and illness on expedition cruise ships to Antarctica. *J Travel Med*. 2014;21(4):228-234. doi: 10.1111/jtm.12126.