

Autonomic and Thermoregulatory Effects in Adults with Spinal Cord Injury During Cold Environmental Exposure

Implications for polar and extreme environments: a scoping review



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Background

Spinal cord injury (SCI) is known to:

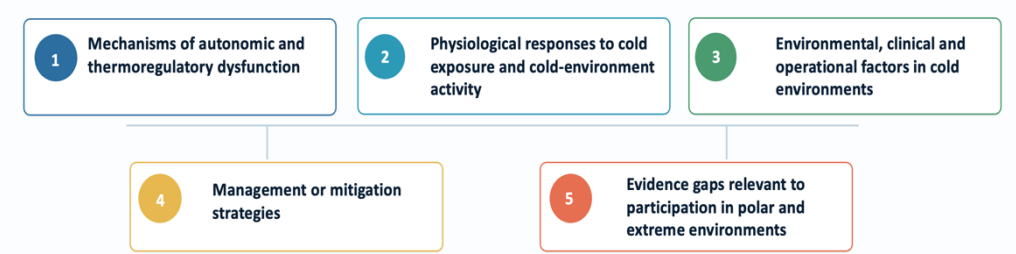
- Disrupt autonomic pathways
- Impact thermoregulation and cardiovascular control⁴
- Impair vasoconstriction, shivering and sweating⁴
- Alter thermal sensation

Research on SCI thermoregulation primarily focuses on exercise in temperate or hot environments. Physiological responses to environmental cold exposure remain poorly understood. This review brings together evidence describing autonomic and thermoregulatory responses to cold exposure in adults with SCI. The advent of more adventurous adaptive expeditions and winter sport involvement for SCI individuals, has highlighted the growing need to support safe participation for this demographic. Therefore, a synthesis of the current evidence may improve clinical risk assessment, inform future guidance, and identify priorities for research in expedition and extreme medicine.

Aims

To map and synthesise evidence on physiological, autonomic and thermoregulatory responses in adults with SCI during cold environmental exposure and explore implications for polar and extreme environments.

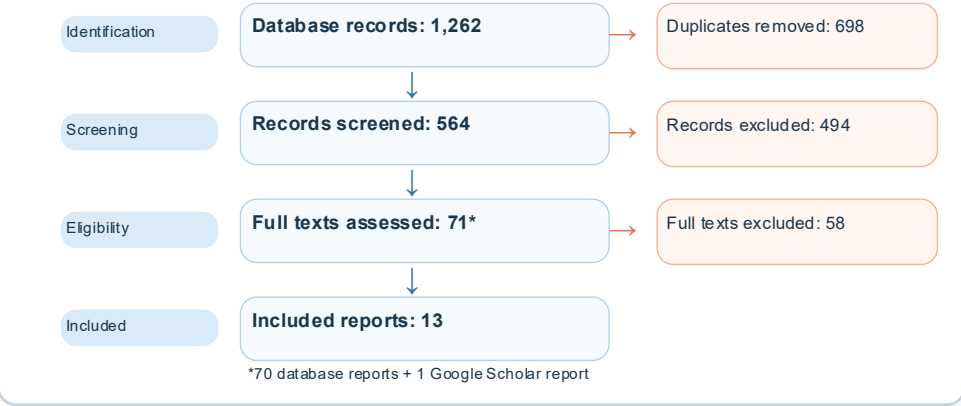
Review Questions



Methods

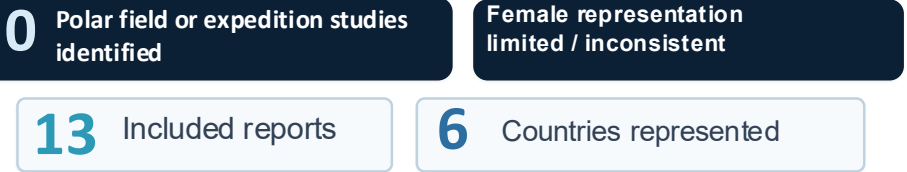
- PPiE informed review: people with SCI and stakeholders in expedition medicine, Paralympic physiotherapy and adaptive polar exploration.
- Scoping review with PRISMA-ScR reportings.
 - MEDLINE, Embase, CINAHL, SPORTDiscus: 23 April 2026. Google Scholar: 7 July 2026.
 - Title/abstract and full-text screening against eligibility criteria.
 - Data extracted on study design, SCI characteristics, cold exposure, outcomes, findings and evidence gaps.
 - Descriptive numerical summary and narrative synthesis.

PRISMA-ScR Flow

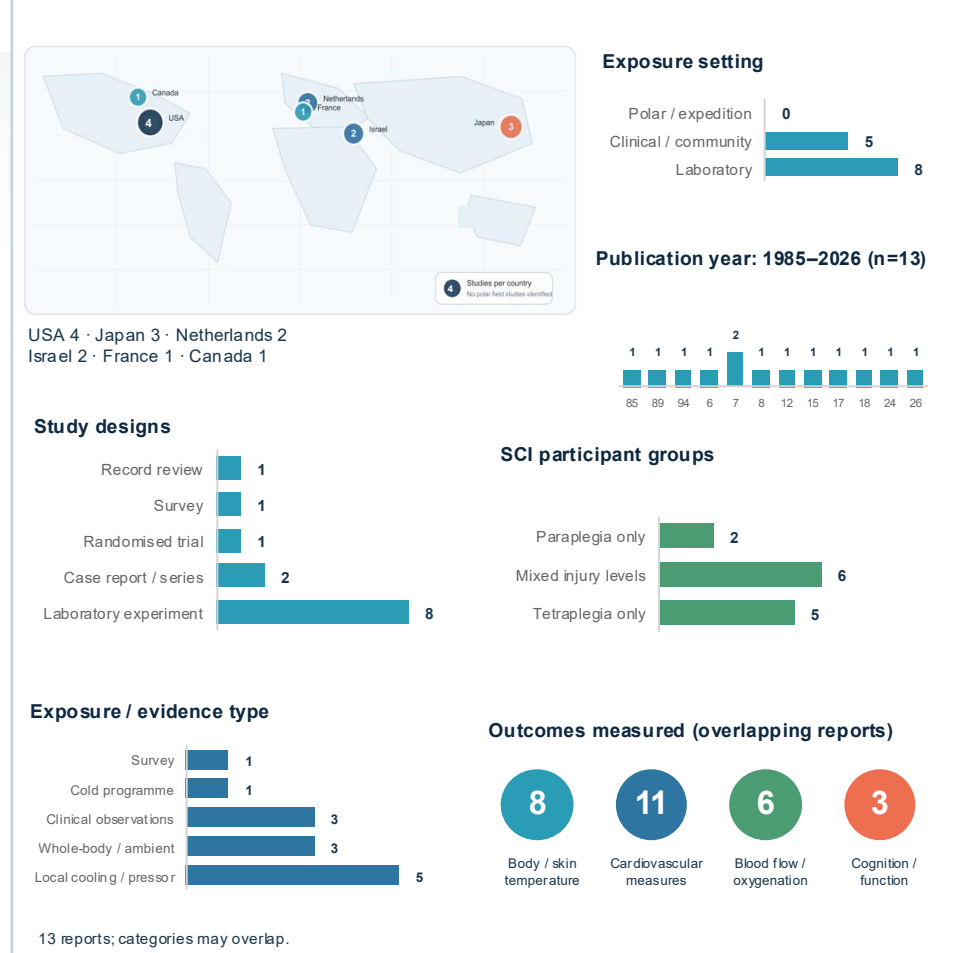


Results Overview

Evidence is dominated largely by controlled physiological studies. Direct evidence from polar expedition settings was not identified.



Results – Descriptive Statistics



Limitations

- Small, heterogeneous evidence base; many small samples
- Most experimental cold exposures were brief and controlled
- Limited female representation; variable SCI reporting
- No prolonged polar or expedition exposure studies
- Single reviewer; no formal critical appraisal

Cold Exposure Findings for SCI



Conclusion

- SCI can alter autonomic and thermoregulatory responses to cold.
- Findings are relevant to adaptive winter sport and extreme medicine.
- Small laboratory studies limit application to real-world exposure.
- The key gap is direct evidence from prolonged outdoor or polar cold exposure.

Focus For Future Research:

- Prioritise field studies of prolonged cold exposure.
- Investigate adaptive polar expeditions and winter sports.
- Standardise reporting of injury characteristics, exposure and outcomes.
- Use larger cohorts and link physiological responses with everyday function and participation.

Selected References

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3. Fujita Y et al. Observations of cold-induced vasodilation in persons with spinal cord injuries. *Spinal Cord.* 2024;62:170–177.
4. Handrakis JP et al. Thermoregulation in persons with spinal cord injury: case series on use of the autonomic standards. *Spinal Cord Ser Cases.* 2017;3:17086.
5. Tricco AC et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and explanation. *Ann Intern Med.* 2018;169:467–473.
6. van der Scheer JW et al. A comparison of static and dynamic cerebral autoregulation during mild whole-body cold stress in individuals with and without cervical spinal cord injury: a pilot study. *Spinal Cord.* 2018;56:469–477.

Full reference list available on request