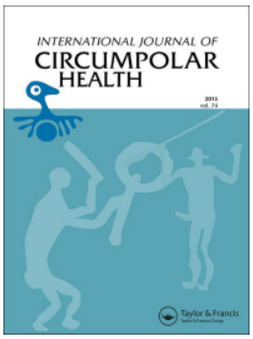

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ARCTIC MILITARY CONFERENCE IN COLD WEATHER MEDICINE

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Introduction: Training is more important than technology (for performance in the cold)

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ABSTRACT

After more than 50 years of studying soldiers in the cold, we are well past the phase of defining the unique problems; the research requirements are known but the solutions have been slow in coming. This requires iterative testing of proposed lab-based solutions with soldiers in the real environment. Representing a renewed effort to produce and implement solutions to human biomedical challenges in Arctic operations, this journal supplement highlights presentations from a three-day NATO Human Factors and Medicine panel-sponsored symposium in Washington DC in October 2022. While technology can certainly aid soldiers in extreme environments, it is ultimately training that is the most important factor for ensuring optimal performance and survival. By investing in the development of specialized Arctic forces training and implementing new solutions to protect their health and performance, we can ensure success in the coldest and harshest of environments.

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Military personnel; performance; predictive physiological models; cold-wet; manual dexterity; cold injury prevention; treatment in the cold; research requirements

> Perhaps no other environment is as immediately unforgiving as the extreme cold, and the best equipment is useless in the hands of cold-unprepared soldiers.
>
> NATO HFM 349 symposium organising committee

After more than 50 years of studying soldiers in the cold, we are well past the phase of defining the unique problems. The biomedical requirements are largely known, but the solutions have been slow in coming. Indeed, the *International Journal of Circumpolar Health* has published seminal reports on the limits of human cold tolerance [1–6]. In recent years, military research in the cold has been hampered by at least three factors: (1) a long period of high priority focus on hot dry environments in southwest Asia, (2) the relatively small number of individuals involved in Arctic operations, easily forgotten against priorities for the main force, and (3) the research community itself has not clearly communicated what has been learned and it has not proactively demonstrated how findings might be transitioned to benefit the Arctic soldier.

The Arctic has recently become a higher priority focus, especially because global warming is opening shipping lanes and increasing access to minerals in the Arctic. While a massive Army presence has not been envisioned in future Arctic conflicts, there is a need for trained and equipped "Arctic specialised forces" who should perhaps be regarded the same way we invest in other highly trained special operations forces. Nearly every failure in cold weather training reemphasises the importance of proper preparation and individual and team proficiency.

Military researchers develop new options and courses of action for military decision makers. This requires iteratively testing proposed lab-based solutions with soldiers in the real environment. All this research and development is accelerated through cooperative research and information exchanges between nations working on the same problems. One mechanism to organise and evaluate current research is through NATO research task groups and workshops. This journal supplement highlights presentations from a recent symposium on this topic organised by the NATO Human Factors and Medicine (HFM) panel. The three-day NATO HFM panel-sponsored symposium in Washington DC in October 2022 represented a renewed

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Figure 1. Word cloud on biomedical research priorities for soldiers in cold environments. The word cloud is formed by input from the audience of the NATO HFM-349 symposium during a Mentimeter interactive session.

effort to produce and implement solutions to human biomedical challenges in Arctic operations. The presented works cover a wide range of the challenge-spectrum that is encountered in extreme cold environments (see Figure 1).

For instance, traditional practices and experience of the Nordic countries have already shown the way for effective performance in the cold. This begins with teaching soldiers to "be comfortably cold" and to understand when it is time to act.

Being in a cold environment for a short period of time is a whole other beast than prolonged stay, with other challenges to performance, safety, and well-being. For instance, still lacking is a solution to wet/sweat management to prevent moisture accumulation in clothing, gloves, and boots. The innovation may be hampered by incomplete understanding of the biophysical interactions in the human-clothing-activity-environment system, preventing accurate predictive modelling of work/rest cycles, and cold injury and performance consequences of cold-wet conditions.

Better predictive models that account for other contextual and personal variability are critical to mission planning (including proper protective clothing), mission management (including probabilities of survival until rescue) and prediction of the health and performance status of opponents.

Protection of manual dexterity in extreme cold is a recurring theme in military biomedical research since at least the 1950s. Although the problem is still not solved, there is a much better understanding of the influence of torso and face protection on neural mechanisms of manual vasoconstriction, and further exploration of techniques ranging from biofeedback and dietary flavonoids to active warming systems in the glove or forearm.

New solutions to treatment of cold injuries and to management of traumatic injuries in the cold have centred on promising treatment of freezing cold injury, especially with the dramatic benefits of prostacyclin drugs, and new concepts for thermal protection and safe evacuation of casualties in austere cold environments.

In summary, while technology can certainly aid soldiers in extreme cold environments, it is ultimately training that is the most important factor for ensuring optimal performance and survival; but neither can excel without the other. The research community must continue to prioritise studying the unique challenges of the Arctic and communicate their findings to military decision makers. By investing in the development of specialised Arctic forces training and implementing new solutions for cold injuries and manual dexterity, we can better equip our soldiers for success in the coldest and harshest of environments with technology and training.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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