

# Cold-related illnesses in military service and the role of protective clothing

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## Abstract

Despite being one of the oldest threats to life and limbs, cold exposure and consequent disorders are no less important in modern military practice as they were during classical times. Indeed, the desire of clothing providers to over-sell incremental improvements in protection may built them unrealistic expectations. This paper encompasses the principal local conditions that results from cold exposure, and adequate protective clothing is also described

## INTRODUCTION

Cold-related illnesses result from the limited capacity of homeothermic humans to cope with cold exposure. The law of conservation of energy requires that, when heat loss exceeds heat production, there is net loss of heat, reflected by a fall in tissue temperature.

Physiological responses to whole body cold exposure include peripheral vasoconstriction, resulting in increased insulation, and increased metabolic rate, particularly shivering. If the whole body is well protected but only a small portion of the periphery is cooled, then local vasoconstriction may be cyclically relieved by waves of cold-induced vasodilation (1-2).

Cold endangers the body's heat balance and requires behavioural action to control heat losses. Protective clothing (PPC) is the natural and post common measure for this purpose. Clothing for cold protection may be bulky and heavy, affecting performance and increasing muscular strain and work load.

## FROSTBITE

The prevalence of frostbite is uncertain, and in the past military accounted for the majority cases. Freezing injuries occur below 0°C in dry conditions, and can be exacerbated by wet tissues, wind chill and altitude.

The prevalence of cold injury increases with falling temperature, and there was no link found between smoking and frostbite. Previous cold injury is a significant risk factor

(4)!

A number of factors increase the risk of developing frostbite, including individual's clothing, consumption of drugs and alcohol. Physiological factors such as hypoxia, high altitude and dehydration increase the risk of frostbite (2). Mechanical factors affect the risk of developing frostbite such as wet, tight or inadequate clothing, contact with a conducting material and immobility, and exposure to high winds (2-3).

Classification of frostbite is shown in Table 1.

## Figure 1

Table 1. Classification of frostbite

Stage I pre-freezing- before ice crystals forms 3-10°C
Stage II freeze-thaw - tissue temperature is below 0°C
Stage III vascular stage results in coagulation, plasma leakage
Stage IV late ischemic phase-thrombosis, ischaemia, gangraene

Modified from Imrey<sup>2</sup>

In frostbite the skin may become white and blanched in appearance and tissues feel woody to patient.

Prevention and treatment of frostbite is shown in Table 2.

**Figure 2**

Prevention and treatment of frostbite Table 2. (2, 5)

Protect from further cold injury, put on dry gloves/socks, adjust boots
Do not deliberately thaw part until it can be rapidly rewarmed in a water bath
Give aspirin 300mg daily to facilitate circulation
Give oxygen above 4,000m
Hypothermia should be first treated by slow rewarming with insulation
Hydration with warm fluids drink
Frostbitten part should be rapidly rewarmed by immersion in warm water(40-42°C)
Strong painkillers may be needed by injection
Frostbitten part must not be used, the patient will have to be carried
Damaged part should be loosely bandaged with dry protective dressings
Suspicion of infection need antibiotics
Check the patient is up to date with tetanus cover
<b>Hospital treatment:</b> rewarming, imaging (duplex, angiography, MRA), minor surgery, hyperbaric oxygen treatment, sympathectomy, vasodilators (iloprost), amputation

## PROTECTIVE CLOTHING

The exchanges between the environment and the human body depend on various factors, namely the clothing thermal characteristics and the clothing fit. The thermal insulation provided by clothing is thus affected by the activity and the environmental conditions. The measurement of clothing insulation should therefore be carried out under reference conditions. In the case of measurements with thermal manikins, the test specifications are referred in different standards. Such measurements are defined in terms of the

heat loss and the mean skin temperature of the manikin and the environmental conditions within the test chamber (operative temperature, difference between air and mean radiant temperatures, relative humidity and air velocity)(6-7).

## CONCLUSION

This paper has examined the effects, prevention and treatment possibility of cold injury.

Protective clothing serves the purpose of eliminating or reducing the effects of environmental stress factors. Protection against physical agents in most cases implies the use of special fabrics and various treatments of the fabrics, rendering them highly impermeable to water vapour. An adequate protection therefore is often obtained only at the expense of considerable restrictions on body heat balance.

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