Hand movements made by patients in response to a request to "show me where your pain is and tell me what it feels like"

Diagnosis	Clenched fist to centre of chest	Flat hand to centre of chest	Palms drawn laterally from centre of chest	Others
Cardiac (n=138)	19	64	27	28
Non-cardiac (n=21)	4	4	2	11
Uncertain (n=44)	3	13	7	21

me where your pain is and tell me what it feels like." The admitting doctor recorded the response on an illustrated form, choosing from three designated responses (clenched fist to the centre of the sternum; flat hand to the centre of the sternum; both flat hands drawn from the centre of the chest outwards) or describing some other action and drawing it on the form. The forms were collated and stored for at least one year after admission to allow time for any investigations such as exercise electrocardiography, cardiac perfusion scanning, coronary angiography, and upper gastrointestinal endoscopy to be completed. The forms were kept by an independent observer while the case notes were examined without knowledge of each patient's chest pain response. Each case was classified as cardiac, non-cardiac, or uncertain. When all the notes had been examined the final clinical classification for each was matched to the original chest pain response.

The notes of 203 consecutive patients admitted during a six month period in 1992-3 were examined. The cause of the chest pain was considered to be cardiac in 138 (68%), non-cardiac in 21, and uncertain in 44 (most of these patients had coexisting cardiac ischaemia and gastro-oesophageal disease). Of the patients with cardiac pain, 110 (80%) used the designated hand movements to describe their pain, but only 33 (51%) of those with non-cardiac or pain of uncertain origin did so ($\chi^2=17{\cdot}8$, $P<0{\cdot}01$). Only 19 (14%) patients with cardiac pain displayed the true Levine's sign compared with 64 (46%) who placed the flat of the hand on their chest while describing their pain and 27 (20%) who drew both hands outwards (table).

Although the sensitivity of the designated hand movements for cardiac pain was high (80%), the specificity was low (49%). This gave a positive predictive value of 77% and a negative predictive value of 53%.

Comment

This study has shown that if patients admitted to a coronary care unit illustrate the nature of their chest pain by placing a clenched fist or a flat hand on the sternum, or by drawing both palms laterally across their chest, there is a 77% chance that their pain is due to cardiac ischaemia. If they do not use these signs there is an even chance that their pain is non-ischaemic. These signs are not discriminatory, but a positive response lends support to a diagnosis of cardiac ischaemia.

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1 Braunwald E. The history. In: Braunwald E, ed. *Heart disease.* Philadelphia: Saunders, 1992:1-13.

Frostbite of the face and ears: epidemiological study of risk factors in Finnish conscripts

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Abstract

***Objective*—To determine the incidence of and the risk factors for local cold injuries of the face and ears in peacetime military service.**

***Design*—Prospective, controlled epidemiological study using a questionnaire.**

***Setting*—Finnish defence forces, 1976-89.**

***Subjects*—913 young male conscripts with local frostbite of the head that needed medical attention and 2478 uninjured control conscripts.**

***Main outcome measures*—Type of activity, clothing, and other risk factors at the time of cold injury. Odds ratios were used to calculate risk. Controls were handled as one group.**

***Results*—The mean annual incidence of frostbite was 1·8 per 1000 conscripts. Frostbite of the ear was most common (533 conscripts (58%)), followed by frostbite of the nose (197 (22%)) and of the cheeks and other regions of the face (183 (20%)). Most conscripts (803 (88%)) had mild or superficial frostbite. Risk factors included not wearing a hat with earflaps (odds ratio 18·5 for frostbite of the ear); not wearing a scarf (odds ratio 2·1 and 3·8 for frostbite of the ear and cheeks respectively); using protective ointments (odds ratio 3·3, 4·5, and 5·6 for frostbite of the cheeks, ear, and nose respectively); being extremely sensitive to cold and having hands and feet that sweat profusely (odds ratio 3·5 for frostbite of the nose); and being transported in the open or in open vehicles under windy conditions (odds ratio 2·2 for frostbite of the cheek).**

***Conclusions*—Wearing warm clothing, including a scarf and a hat with earflaps, helps to prevent frostbite. Each person's sensitivity to cold may also be important. The routine use of protective ointments should not be recommended.**

Introduction

Local cold injuries are a common problem of military operations and training in wintertime, especially during land manoeuvres.[1,2] Feet and hands are most prone to cold injuries, but the unprotected areas of the head—ears, nose, and cheeks—are also vulnerable to cold.[3]

In addition to the ambient temperature, other factors influence the risk of developing frostbite of the face and ears. The wind (windchill effect) greatly affects heat loss from the skin by convection.[4,5] Preventive behaviour and protective clothing diminish the risk.[6,7] Protective ointments are traditionally used,[8] but their role is controversial.[9]

Exposure to cold is part of outdoor training for the Finnish defence forces in winter, both at garrisons and during manoeuvres. We evaluated the incidence of and risk factors for frostbite of the face and ear in Finnish conscripts during military service.

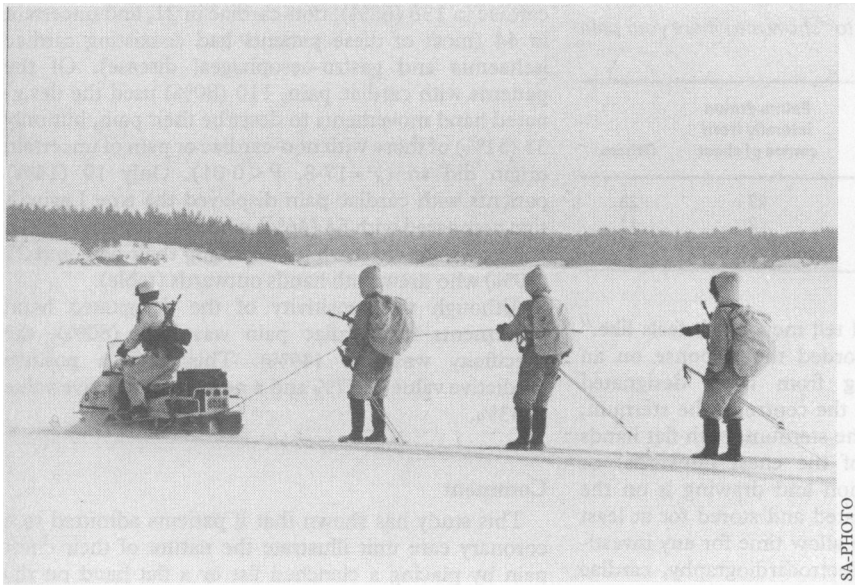


Fig 1—*Typical high risk conditions for developing frostbite of the face: soldiers in tow on a motor sleigh*

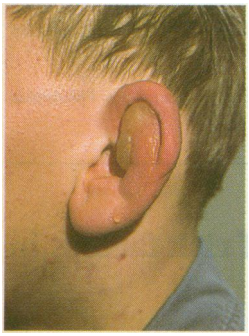


Fig 2—*Grade II bullous frostbite of the upper part of auricle*

Subjects and methods

In Finland all healthy men are required to serve in the army for 8-11 months in peacetime. Each year 25 000-35 000 male conscripts (mean age 19 years) are trained. After an exceptionally hard winter in 1976 the Medical Section of the Finnish Defence Staff started systematically collecting data on all cold injuries that needed medical examination.[10] Information on weather, type of activity, and other conditions at the time of the injury, as well as the medical facts, were given by local medical officers. Information on clothing, shoes, use of protective ointments, fatigue, previous cold injuries, sensitivity to cold and the degree of sweating at the extremities, smoking, earlier indoor work, and so on was given by the injured man. When possible, two conscripts who had not developed frostbite were randomly selected from the same squads as the injured soldiers to act as controls. Valid controls could not always be found as the injured man was sometimes alone when he was frostbitten.

Table 1—*Anatomical distribution of frostbite of head according to activity in 913 Finnish conscripts. Values are numbers of conscripts*

	Site of frostbite			
	Ears	Nose	Other part of face	Head (total)
Garrison service	259	108	101	468
On duty	207	107	100	414
Off duty	52	1	1	54
Land manoeuvres	61	70	65	196
Lasting ≥3 days	30	48	43	121
Lasting ≤2 days	31	22	22	75
On leave	213	19	17	249
Total	533	197	183	913

Table 2—*Independent risk factors for developing frostbite of face and ears. Values are odds ratios (SE)*

	Site of frostbite		
	Ears	Nose	Other part of face
Not wearing a hat with ear flaps	18·5 (0·14)	—	—
Applying protective ointment	4·5 (0·41)	5·6 (0·17)	3·3 (0·71)
Not wearing scarf	2·1 (0·14)	—	3·8 (0·18)
Hands and feet that sweat easily	—	3·5 (0·2)	—
Travelling in open vehicle	—	—	2·2 (0·24)

The severity of frostbite can be assessed only in warm surroundings and some time after the injury—from several hours up to two days after the typical physical signs of early frostbite (local blanching of the skin with clear demarcation from unaffected skin). In grade I frostbite the skin is reddish and oedematous, in grade II frostbite it starts to blister and form bullae, and in grade III frostbite local necrosis of the dermis develops over 1-2 weeks.[11]

BMDP software was used for the statistical analysis. Univariate analysis was used to determine which variables had an effect, the proportions in injured and control groups being compared by using a χ^2 test. Thereafter a logistic stepwise regression model was used to avoid unnecessary multiple colinearity. In the final analysis a fixed module was used, with calculation of the odds ratio to measure the degree of risk. All tests were two sided, and all controls were handled as one group.

The risk factors evaluated were:

- The type of activity at the time of being frostbitten—land manoeuvres for up to two days or for three or more days, on duty at garrison, off duty at garrison, on leave
- The degree of physical activity at the time of injury—physically active outside, waiting on site, being transported (fig 1), other
- Fatigue
- Physical condition—the result of a 12 minute running test
- Wearing of scarves
- Wearing of earflaps
- Application of protective ointments
- Smoking—whether a smoker before the frostbite
- Working outdoors as a civilian
- Sensitivity of hands and feet to cold
- Profuse sweating of hands and feet.

Results

During 1976-89 a total of 2054 men reported frostbite, 913 (44%) of them having frostbite of the face or ears (head). A total of 2478 non-injured conscripts acted as controls. The annual number of cases of frostbite of the head ranged from 17 to 234 (13% to 64% of all cold injuries), being highest during the coldest winters. The mean annual incidence of such cases was 1·8 per 1000 conscripts (95% confidence interval 1·3 to 2·3 per 1000).

Frostbite mainly affected the ears (533 conscripts (58%)), then the nose (201 (22%)) and other regions of the face, mostly the cheeks (183 (20%)). Most cases were mild (grade I; 803/913 (88%)). In the coldest winters, and especially during army exercises, up to a third of cold injuries were grade II (fig 2). Noses were most prone to second grade injuries. Grade III frostbite occurred only sporadically.

Table 1 shows the prevalence of frostbite during different types of activity. Most frostbite of the ear and face occurred when soldiers were serving at a garrison (while on guard, practising shooting, handling weapons, participating in outdoor sports, etc) and while they were on leave. Only 196 of the 913 conscripts (21%) developed frostbite during land manoeuvres. Frostbite of the ear occurred more often on leave than on exercises (213/533 (40%) *v* 61/533 (11%)). Frostbite of the ear was the most common cold injury in conscripts on leave (prevalence 89% (213/249)).

Table 2 shows the major risk factors for frostbite of the face and ear. It shows how important earflaps are in protecting the ears. Using a scarf protects both ears and cheeks surprisingly well. When we analysed the risks during land manoeuvres separately, increased sensitivity to cold (odds ratio for developing frostbite of the

nose 3·4 when fingers have increased sensitivity to cold and 3·5 when toes have increased sensitivity to cold) and working indoors as a civilian (1·9 for frostbite of the cheek) became additional risk factors.

The use of protective ointments increased the risk of developing frostbite of the head threefold to sixfold. In the whole sample of 2054 conscripts with frostbite, 345 (17%) had used them. Of the 913 conscripts with frostbite of the head, 143 (16%) had used them. Most patients with grade II frostbite had used emollients (98/109; 90%).

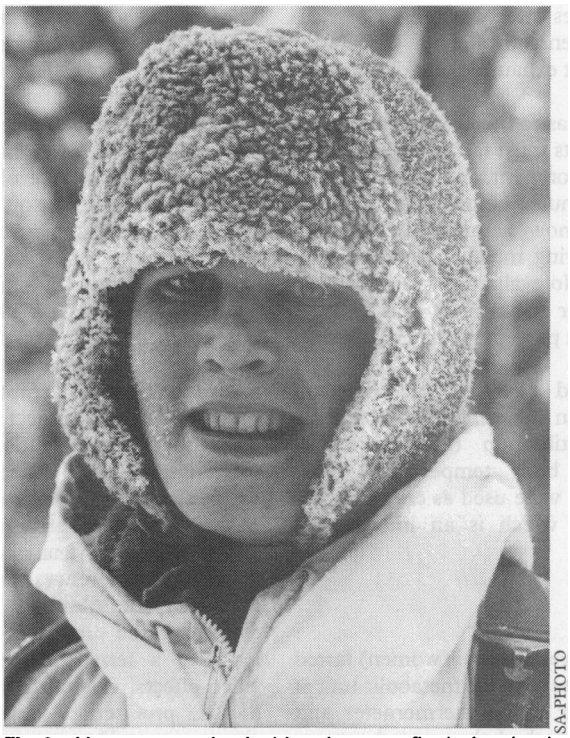
The data on weather conditions were insufficient to analyse the chilling effect of the wind on the development of frostbite. Neither smoking nor tiredness correlated with frostbite of the face or ear.

Discussion

We studied over 900 largely mild cases of frostbite of the face and ears. We sought to differentiate risk factors as independent variables, and our results show the importance of protective clothing, especially earflaps and scarves. The effect of the type of activity on cold injuries can also be explained mostly by the different clothing worn. During manoeuvres every soldier wears a combat suit with appropriate winter cap (fig 3), the clothing differing only in minor details such as type of underwear and socks, etc. On or off duty at a garrison soldiers wear either combat suits or light uniforms. On leave most men wear civilian clothes and often seem not to wear hats with earflaps.

The increased risk of frostbite with the use of protective ointments was unexpected but consistent for all grades of frostbite of the face and ear. Thus the quality of ointments used was not registered. The use of emollients may give a false feeling of safety, and the skin is therefore left unprotected. The preliminary results of tests in a cold chamber support this possibility.[9]

Conscripts, and also their leaders, should be educated about how to prevent cold injuries[7 12 13]: appropriate clothing should be worn on leave as well as on duty. Frostbite of the face and ears can develop insidiously. The first symptoms of frostbite are a localised sense of coldness, followed by local stinging and tenderness. Then the affected part becomes numb. At this stage the skin to an observer looks blanched, with sharp demarcation from the normal surrounding tissues. However, the affected person at this time cannot see the blanching and is unaware of the injury. Thus soldiers need to be taught the early signs and symptoms of frostbite.



SA-PHOTO

Fig 3—*Young conscript in his winter outfit during land manoeuvre at -32°C. Notice the frozen villus hairs on cheeks*

Key messages

- The first physical sign of a frostbite in cold is local blanching of the skin; detecting frostbite at this stage may need help from other people
- Wearing protective clothing, especially a scarf and a warm cap with earflaps, is the best way of preventing frostbite of the ears and cheeks
- Differences in clothing explained most of the increased risk of developing frostbite when conscripts were stationed in their garrison or on leave rather than on manoeuvres
- Emollients applied to the face and ears were a considerable risk factor for developing frostbite, which is contradictory to their presumed protective effect

CONCLUSION

Cold injuries to the ears and face are mainly caused by not wearing appropriate clothing. Wearing a scarf and a warm cap with earflaps reduces most of the risk. The unexpected risk connected with the use of protective ointments indicates that the routine use of protective ointments cannot be recommended.

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Conflict of interest: None.

1 Hamlet M. An overview of medically related problems in the cold environment. *Mil Med* 1987;152:393-6.
2 Hanson H, Goldman R. Cold injury in man: a review of its etiology and discussion of its prediction. *Mil Med* 1969;134:1307-16.
3 Lindholm H, Koskenvuo K, Sarna S, Friberg O. *Frostbites of conscripts in 1976-1989.* (In Finnish.) Helsinki: Scientific Committee of National Defence, 1993. (Report A 1993/1.)
4 Siple PA, Passel CF. Measurements of dry atmospheric cooling in subfreezing temperatures. *Proceedings of the American Philosophical Society* 1945;89: 177-99.
5 Wilson O, Goldman R. Role of air temperature and wind in the time necessary for a finger to freeze. *J Appl Physiol* 1970;29:658-64.
6 Steinman A. Adverse effects of heat and cold on military operations: history and current solutions. *Milit Med* 1987;152:389-92.
7 Vaughn P. Local cold injury—menace to military operations: a review. *Mil Med* 1980;145:305-11.
8 Dick HJ. Prevention of cold injury on exercises with the allied military force (land) in north Norway. *Medical Corps International* 1989;4:41-7.
9 Lehmuskallio E, Rintamdki H, Anttonen H. The protective effect of facial ointments in acute cold exposure. In: Jemec GBE, ed. *Proceedings of the third congress of the European Academy of Dermatology and Venereology.* Copenhagen: Kandrup, 1993:10.
10 Koskenvuo K, Karvonen M, Korvenkontio M. The frostbites of conscripts in early winter 1976. (In Finnish.) *Annales Medicinae Militaris Fenniae* 1977;52:9-13.
11 Koskenvuo K. Prevention of frostbites. (In Finnish.) *Annales Medicinae Militaris Fenniae* 1976;51:59-62.
12 Fritz R, Perrin D. Cold exposure injuries: prevention and treatment. *Clin Sports Med* 1989;8:111-28
13 Tervahauta R, Hassi J, Anttonen H, Vuori E, Lehmuskallio E. Maintaining military performance in cold environment. In: Koskenvuo K, ed. *Field surgery and medicine.* Hdmeenlinna: Medical Section of the Finnish Defence Staff, Karisto Oy, 1993:461-70. (In Finnish; English version in preparation.)