Contemporary Issue

HEALTH AND PERFORMANCE OF MILITARY PERSONNEL IN COLD CLIMATIC ENVIRONMENT OF THE WESTERN HIMALAYAS

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Abstract

Indian Armed Forces are constrained to deploy a large number of troops in the western Himalayas in the interest of national security and territorial integrity. The region represents extremely rugged, arid and cold climatic conditions. The altitude ranges from 8000 to 23000 feet with winter temperatures ranging from -35°C to - 55°C in some regions. Low environmental humidity, hypo-baric hypoxia and high solar ultra-violet radiation with its attendant problems further compound the hardships faced by the troops in these climatic conditions. The role of the Armed Forces medical personnel is extremely challenging, as they have to ensure maintenance of health and physical fitness of the troops to ensure optimal performance during peace and during operations. These considerations include nutrition, physical fitness programmes suitable for the terrain and climatic conditions, protection against cold and hypoxia induced health problems, clothing and shelter taking into consideration the ergonomic factors, human waste disposal and prompt medical attention and evacuation in case of illness. An overview of the effects of cold hypoxic environment on health and performance of Indian troops, measures employed by the Armed Forces to maintain health of troops including psychological factors and the incidence of various cold induced health problems during peace time compared to operational period over the last 10 years is presented in this paper.

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Introduction

Man is essentially a tropical animal in that he lacks the natural adaptation to cold in the form of a thick layer of fur or significant subcutaneous fat insulation [1]. The major physiological protection of man against low environmental temperature is either prevention of heat loss through skin by vasoconstriction or by raising metabolic production of heat, either by shivering or by non-shivering thermogenesis [2]. These mechanisms are usually effective in maintaining body temperature during nude exposure to moderately low temperature (15°C to 28°C). Nude exposure to temperatures below these is invariably uncomfortable and body temperature starts falling on exposure to near zero or sub-zero temperatures. The only protection against such temperature is clothing or warm shelter [3]. Most authorities agree that there is no natural acclimatization for man against cold [4]. However, responses of those individuals, who are born and brought up in naturally cold environment differ from those belonging to tropical or subtropical climates, when exposed to cold [5] but all men require protective clothing, shelters or artificial sources of warmth when exposed to near zero or sub zero temperatures [6].

India is constrained to deploy a large number of troops in the western Himalayas due to reasons of national security and territorial integrity. Barring a few hill tribes, most of these soldiers are lowlanders, born and brought up in tropical and subtropical conditions. They are exposed to harsh weather conditions like very low temperature, hypobaric hypoxia, extreme aridity, high degree of solar ultra violet radiation and strong winds in the western Himalayas. Besides, the terrain is extremely difficult and hostile, leading to several physical and psychological stresses. The job of the Armed Forces medical personnel is extremely challenging in that they have to ensure health and operational fitness of troops against hostile natural forces of such magnitude. Their major concerns are nutrition, physical fitness programmes suitable for the terrain and climatic conditions, protection against cold and hypoxia induced health problems, clothing and shelter taking into consideration the ergonomic factors, human waste disposal and prompt medical attention and evacuation in case of illness.

Environmental characteristics

The main environmental parameters, characterizing western Himalayas are extremely low temperatures

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during winter months, which may be as low as -60°C at places, very low humidity round the year, average remaining below 25% and high winds touching 120 knots in certain sectors, thereby imposing dangerous wind chill effect.

Acclimatization

The Indian Armed Forces have evolved a satisfactory acclimatization schedule for hypobaric hypoxia of high altitude but no acclimatization against cold has been possible till date. There have been some attempts in the past by Indian defence scientists to induce some degree of cold tolerance in individuals by deliberate 4 hour nude exposure to temperature of 10°C for a period of 20 days [7]. Also, there have been attempts to identify individuals with poor cold tolerance by measuring their Cold Induced Vasodilator (CIVD) response [8]. It was hypothesized that individuals showing poor CIVD were more susceptible to cold induced injuries. These studies have not found wide acceptance and practical use in the Armed Forces. Armed Forces are not employing any cold acclimatization schedule today, and protective clothing and shelters are the only practical means of combating cold during winter months.

Cold Protective Clothing

The Armed Forces personnel are issued with two types of extreme climate protective clothing. The first version is issued to troops deployed in areas where temperatures do not fall below -20°C and are not perpetually snowbound. This ensemble consists of woollen inner underpants, woollen shirt, serge pants, woollen jersey, and anorak style parka with hood, woollen socks, snow boots, mittens and impermeable gloves. The total weight of the ensemble is about 6.5 Kg. It has an average insulation value of about 3.5 Clo and can offer adequate protection up to -15°C in a resting man up to a wind velocity of 5 knots. Physical activity enhances the protective value of the ensemble. The drawbacks are added weight leading to increased metabolic demands on physical activity, and bulky nature of the clothing hindering natural range, rate and style of movements. The design of the outer gloves is unsatisfactory for fine movements of digits. The second type of ensemble is issued to troops exposed to perpetually snowbound areas and temperatures below -20°C . The constituents are similar to the first ensemble; with the addition of glare protective goggles and insulated (down) trousers. The insulation value is more than 5 Clo. The material of boots is lighter and design of snow gloves allows better dexterity of movement. The overall weight of ensemble is about 7 Kg.

The cost of the second ensemble is several times the cost of the first type of ensemble. The bulky design, however, poses the same problems in the movements as the first design. During weapon operations, in both type of clothing, the outer gloves have to be taken off with only mittens protecting the hands. This enhances the risk of cold induced injuries on fingers and hands.

Physical Work Capacity

Hypobaric hypoxia of high altitude reduces the maximum physical work capacity of the individual, depending on the altitude [9,10]. The reduction has been roughly estimated to be 70% of sea level values at 10,000 feet and 50% at 18,000 feet in individuals not acclimatized. 2 months acclimatization leads to increase in work capacity to about 87% of sea level values at 10,000 feet and 68-70% at 18,000 feet [9]. Maximum heart rate is reached at a lower work rate and perceived muscle fatigue is also reported at a lower work rate compared to sea level [11]. Hypoxia is also reported to reduce cold tolerance by increasing shivering threshold, possibly due to hypoxia induced vaso-dilatation [12]. Cold exposure, on the other hand reduces physical work capacity further, as part of available oxygen is diverted for metabolic (non-shivering) thermogenesis, and is not available for physical work [13]. In snow bound areas, extra effort is required even to walk on snow. It has been estimated that energy expenditure is three times while walking on snow compared to walking on ground surface [14]. It has also been estimated that the rate of climb goes on reducing with altitude, compared to similar rates at sea level, even in physically fit and experienced mountaineers [15]. From this, it is clear, that hypoxia and cold combine to pose a serious limitation on physical performance of troops in these terrains. The Armed Forces have to ensure maintenance of maximum possible operational physical efficiency under these conditions. Clearly, rigorous physical training schedules of sea level cannot be employed in this region. However, it has been shown that rigorous physical conditioning of troops prior to induction to high altitude results in better physical performance at high altitude [16] also; previously conditioned troops find it easier to maintain an optimal operational fitness even with a moderate level of training. The Armed Forces are following a schedule at which a 6-8 weeks rigorous pre-induction training is followed by another 6-8 weeks conditioning at a battle school situated at a moderate altitude (6500 feet). Following induction to high altitude, physical maintenance programme is carried out which includes marches, moderate aerobic and strength training exercises, games and gradient

climbing at moderate pace. This schedule has yielded good results without any adverse effects on troops. This was evident during the recent Kargil operations, where Indian troops showed a high degree of operational fitness in evicting the enemy intrusion.

Nutrition

The total caloric requirement based on metabolic needs and physical requirements of job is estimated to be about 4800 to 5000 Calories/day [17]. This is due to increased metabolic demand due to cold exposure, as well as high metabolic cost of physical activity, even routine ones like walking, owing to steep gradients and soft snow. Other factors to be taken into consideration are hypoxia induced anorexia and change in taste preferences [18]. Fat absorption is lower at high altitude [17]. All these problems frequently resulted in the past in weight loss and loss of physical conditioning. These problems were compounded by frequent non-availability of fresh food, vegetables etc. Over dependence on tinned food often resulted in monotony and sometimes in deficiency of essential nutritional ingredients like vitamin C. Armed Forces have made a serious attempt to rectify these problems. Now the ration scales have been rationalized in a manner so as to cut down on fat content of diet to less than 15% of total calories, provide more carbohydrates in the diet, ensure vitamin supplements, provide adequate protein supplement commensurate with physical requirements, try to supply fresh rations as often as possible and to introduce variety to avoid monotony. These measures have yielded very encouraging results.

Psychological Health

Isolation, monotonous terrain, constant threat from environment and enemy and lack of communication are some of the major factors leading to psychological stresses in troops. Besides, exposure to hypoxia has been shown to bring about certain minor reduction in cognitive ability and short-term memory recall, which have been shown to be completely reversible on return to lower altitude within a few weeks [19]. Major results of psychological stresses have manifested as aberrations of interpersonal relations, tendency of alcoholism, reactive depression and avoidance of responsibility in a smaller number of troops. The main preventive strategy employed by the Armed Forces includes encouraging healthy group interaction, communication between troops and commanders, availing recreational facilities whenever available, limited tenure in such areas, providing frequent communication with family members, including satellite phone facili-

ties, and giving a humorous twist to temporary effects of hypoxia to allay anxiety concerning them.

Hygiene and Waste Disposal

Although extreme cold, lack of sufficient amount of water and lack of proper sanitary facilities, make it an uphill task to maintain personal hygiene, the troops are encouraged and educated to maintain all possible degree of personal cleanliness, take a bath whenever possible and change clothes frequently. They are also required to keep their surroundings and living quarters as clean as possible. Washing at least intimate articles of clothing as frequently as possible is encouraged. These measures have yielded good results, and non-radiation skin disease incidence amongst these troops is even lower than corresponding population in other parts of the country.

Human waste disposal is a big problem in snow-bound cold regions. The major problem is that ground is frequently not accessible through deep snow, and the trench is dug in the snow only. Very cold temperatures prevent biodegradation of waste. Other waste is also disposed off by burying in the snow and does not undergo biodegradation. During operations, "Cat's Hygiene" has to be employed by the troops in which each man digs a small hole in the snow before relieving himself into it and then covering the excreta with snow. All the refuse comes out during the snow melt season and creates an awful nuisance as well as poses a serious health hazard. Use of portable chemical closets is under consideration of the Armed Forces to overcome this problem.

Medical Facilities and Chain of Evacuation

The troops are provided with a multi-level medical cover. Each forward post has at least one trained paramedical person with first aid equipment and facilities. Besides, some combatant troops are also trained in providing first aid and carrying out evacuation, called the Battle Field Nursing Assistants (BFNA). A group of posts are covered by a medical aid post, on which a medical officer is available with preliminary treatment facilities. The next line of evacuation is to an Advanced Dressing Station (ADS), which can be reached within 6-8 hours from any post in favourable weather. From ADS, next line of evacuation is to a Field Ambulance, where middle level treatment facilities are available including physician, surgeon, X-ray and pathology lab. Cases can be evacuated from Field Ambulance to a well-equipped field hospital or more advanced hospitals, as the case may be. Rapid evacuation by helicopter is available, but in adverse weather conditions, it has to be undertaken on foot or by mule

where only mountain tracks are available, or by mechanical transport, where motorable tracks are provided.

Cold Induced Medical Problems

The major cold induced problems from the western Himalayas sector include chilblains, frostbite and hypothermia. The following table presents the average incidence of these problems per thousand troops for the last ten years. As a low intensity conflict (LICO) has continued over the last 18 years in this region, as well as full-scale operation during this period, incidence of these problems in peace, during LICO and during operations is compared.

TABLE 1
4 monthly incidence (per thousand) of cold induced problems in Military Personnel in the Western Himalayas*

Illness	PEACE	LICO	Ops
All cases including battle casualties	34.4	78.53	38.88
Frost bite	3.14 (9.13%)	5.34 (6.7%)	1.52 (3.91%)
Chilblains	1.96 (5.69%)	2.11 (2.6%)	0.94 (2.41%)
Hypothermia	0.27 (0.78%)	1.02 (1.2%)	—
All cold induced cases	5.37 (15%)	8.47 (10.7%)	2.46 (6.3%)

*Values in brackets represent percentage of total cases

These figures clearly bring about that the total number of illnesses is the maximum during LICO. The difference in incidence of total illnesses during peace and a full-scale operation was minor. What is significant is that proportion of cold injuries as a percentage of total injuries is maximum in areas of the sector not engaged in direct battle or LICO. Cold injury percentage is the lowest during operations, but probably is due to the fact that these operations were essentially carried out during summer months. Lower incidence of cold injuries during LICO compared to peace area is probably due to better protective clothing provided to troops in LICO area of operation. However, 15% of total illnesses in peace areas of deployment in this sector represents a very high percentage and requires immediate measures. Some of the measures being undertaken are:

- Intensive health education amongst troops, including man to man training and instructional pamphlets, giving precautionary measures against cold induced injuries.
- Better protective clothing and shelters.
- Prompt medical attention to all cold injuries, saving life and limb.
- Research into better modalities of prevention and treatment of cold injuries.

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