TRAINING NOTES

Cold Weather PT

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A military unit that is well-trained to conduct operations in extremely cold weather has a distinct advantage over the enemy in such an environment. When environmental extremes forced the Germans to discontinue operations during their invasion of Russia in 1941, the Russians were able to counterattack successfully. Two years earlier, in 1939, when blizzards were too severe even for the Russian troops, the Finns came ghosting out of the storms on their skis and overran the potentially stronger Russian forces.

Lack of acclimatization, fear of unknown extreme conditions, and cold injuries are all interrelated, and all can contribute to the incapacitation of a fighting force. In the United States Army alone during World War II, there were about 91,000 "lost time" cold injuries. There were more than 9,000 cases of cold injury among U.S. ground troops during the Korean War — more than 8,000 of them occurring in the winter of 1950-51 alone.

Acclimatization to the cold, in all its aspects, is particularly important to infantry units, because the effects of cold injury are selective and severe. In World War II, for example, 87 percent of the cold injuries occurred in infantry rifle companies, primarily during combat operations; only 15 percent of the casualties were ever returned to combat; the average period of hospitalization was 50 days; and the casualties, in most cases, were left with permanent residual damage.

VULNERABLE

Soldiers from warmer climates, with little personal experience in dealing with the cold, require intensive training and guidance if they are to function in severe cold. Other soldiers as well are especially susceptible to injury — untrained soldiers coming in from other units, for example, and those with medical histories of coronary disorders and upper respiratory or rheumatoid disease. Blacks and women are the most in danger of frostbite. (White, non-smoking males are the least vulnerable. Smoking clearly reduces the circulation of blood, and therefore heat, to the extremities.)

These and all other soldiers, therefore, need to participate in a well-planned physical conditioning program that is designed to acclimate them and give them some experience in dealing with the cold.

Granted, few physical training (PT) programs include conditions and environmental exposures that can compare to those of military units during wartime operations. But some distinct benefits can be realized from wintertime PT programs. Although winter weather at many stateside installations cannot be considered extreme, it does get cold enough to allow troops to learn what the physical effects of cold weather can be and what activities and precautions can counter those effects.

Accordingly, if troops are exposed to the cold daily for two or three weeks, they will become physically acclimated. Their skin will become drier and provide better insulation against cold. The circulatory heat input to the surface of their skin and to their extremities will also decrease less in response to cold. Thus, cold weather PT can allow them to retain their conditioning during the winter months. (In fact, for reasons that are still being studied, the conditioning benefits of cold weather training seem to ex-

ceed those of warm weather training.)

It should be noted that it is much easier to withstand cold temperatures than hot temperatures during vigorous physical activity and that it is possible, with intense activity, for a soldier to suffer heat injury even at temperatures below zero. (For this reason, rubber or plastic suits should never be used during winter running.) In fact, the Army probably has more heat exhaustion problems during peacetime operations in the Arctic than it has cold injuries. And in Arctic areas, outdoor activity is not completely stopped until the temperature reaches -70°F.

Soldiers who work hard seldom if ever have cold injuries. For obvious reasons, therefore, commanders should require vigorous activity of their troops when exposure temperatures reach -20°F or less. At rest, the average 154-pound man produces 90 kilocalories of heat per hour. During periods of strenuous physical effort, this same man can produce up to 700 kilocalories per hour. In other words, seven or eight times as much heat can be produced by increasing the level of physical activity.

Given this increased level of heat generation, and with proper precautions, it is reasonable to conduct PT at temperatures of -40°F or even below. Of course, commanders and trainers must have a basic understanding of the body's response to cold, and they must realize that cold injury can be prevented in only the following ways: By increasing heat production (through activity), by reducing heat loss (through insulation), or by some combination of the two.

The body's first line of defense against cold exposure is to shunt blood (which carries the heat) away from the surface areas, where it is lost, down into the deep body centers that are vital for life. The blood flow to the surface of the extremities — fingers and toes — is reduced the most. In fact, heat flow to the digits is reduced to one-tenth of normal, and the heat that is supplied can be lost rapidly. The small cylindrical shape of the digits results in a high surface-to-volume ratio and, consequently, a high heat loss rate. The ear tip, nose, and chin, while less vulnerable than the digits, also have a high surface-to-volume ratio.

The head is the only part of the body surface that maintains a good blood (heat) supply. For this reason, the head should be covered during cold weather PT so that heat circulated to it is not lost to the environment. The ears should definitely be covered, because they are more vulnerable than any other part of the head, and also because exposure can cause painful earaches in many people. The nose and the chin will generally not be frostbitten as long as a person is active, but many people are more comfortable running in cold weather if these areas are covered.

The respiratory tract is also affected by cold air, but the lungs do not really freeze as some people believe. This is a myth. Studies of air breathed in at -70°F have shown that, by the time it reaches the lungs, the air is warmed to well above the freezing level. The inhalation of cold air does, however, initially cause a degree of constriction of the air passages (and sometimes spasms, if the air is extremely cold).

Breathing in cold air can also cause another problem. All air holds some moisture, but warm air takes up more than cold air does. This means that if the air is warmed only upon entering the respiratory tract, it will steal moisture there, drying and damaging the lung tissues. (After vigorous work in extremely cold Arctic areas, for instance, soldiers frequently find themselves coughing up blood for an hour or so.)

This does not pose significant problems at the temperatures that are generally encountered at most stateside installations in the winter. Healthy people can run for up to two hours a day in temperatures of -40°F without adverse effects to their lungs. But cold weather running does result in the production of a more viscous mucus in the respiratory tract, and soldiers will find that if they cover their faces they can breathe considerably warmer, more humid air. A wool scarf over the mouth and nose works well for some. Those who wear glasses often use dust or dental masks, which do not cause fogging of the lenses as scarves sometimes do. Such masks should be provided for the troops to use at their own discretion.

A jogger's hands are probably more susceptible to frostbite than any

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other portion of his body. Mittens are more protective than gloves, although GI gloves with clean woolen inserts offer adequate protection for some. Protection can be significantly increased by wrapping the gloves with plastic bags to trap warm air near the hands. If mittens are desired and not available (or if they are too heavy), one or more pairs of old woolen socks can be used. Handcovers should always cover the wrists as well.

LAYERS

The upper body should be covered by three layers. The first should be a good absorbent insulator with long sleeves and possibly a turtleneck. The second could be a long-sleeved, hooded sweat shirt, a wool sweater, or the top of a set of long johns. The third layer should be the issued PT shirt. Natural fabrics (cotton and wool) provide the best insulation. In extremely cold and windy weather a windbreaker (the field jacket without liner) should be used as the third layer to reduce windchill. It will not let sweat evaporate readily, though, and soldiers should be careful not to become overheated and wet. Wet areas conduct heat away from the body more than 240 times as fast as air trapped in clothing does, and this predisposes a person to rapid cold injury. For this reason, soldiers who begin to sweat should immediately remove a layer of clothing.

As for the lower body, men should be aware that frostbite of the penis is not unknown. (In fact, an article in the January 20, 1977 issue of the *New England Journal of Medicine* describes this condition and its prevention.) Synthetic fabrics (polyester trousers or dacron/cotton boxer undershorts) are not adequate for cold weather jogging. Instead, male joggers should wear cotton knit underwear or twill running shorts and natural fiber pants or sweat pants.

A jogger's legs should be covered with at least two layers: fatigue, BDU, or sweat pants over long underwear or old pajamas. Many joggers find that one layer is enough because the muscles of their legs generate enough heat.

Because cold weather can tighten muscles and tendons, the rate of knee and ankle injuries can be expected to increase during winter months. It is particularly important for soldiers to do stretching exercises indoors and then to warm up completely before running. Contributing to the injury rate, although to a lesser extent, is the fact that running shoes lose much of their cushioning effect in cold weather. Soldiers should not be allowed to run in combat boots.

The feet, because of the motion of running and the friction against the running shoes, generate enough heat to be safe and warm as long as running is sustained. But if a runner stops to rest or walks long distances, his nylon running shoes and his feet will cool off quickly. Wool socks are warmer than cotton, and one pair is enough.

The clothing used for exercising in cold weather should never constrict circulation. Tight socks, shoes, underwear, sweaters, jackets, or trousers should be avoided. The clothing should also be clean. Socks, gloves, or other items that contain dirt, grease, or mineral salts from perspiration lose many of their insulating characteristics and give less protection against cold.

The rule for outdoor activity is "keep covered, keep dry, keep moving." Stragglers should be carefully controlled during winter runs. If movement cannot be sustained, the soldiers should be transported to a warm area immediately. In some individuals, if the skin is allowed to cool, skin temperatures will not rise with exercise alone. (Blacks, who have five or six times as many cold injuries as the other categories studied, seem particularly prone to this condition.) For this reason, a pre-run warm-up should begin immediately after the soldiers leave a warm area or, even better, both stretching and warm-up exercises should be done in a warm area such as a gymnasium.

Hot drinks can help. They dilate the peripheral blood vessels and thus increase the heat that is circulated to the extremities and the skin. Additionally, coffee (specifically the caffeine in it) apparently increases the rate of fat oxidation (yielding both heat and mechanical energy), thus conserving muscle glycogen (the usual source of energy). This seems to result in a significant increase in a person's ability to do sustained work such as running. (Unfortunately, if coffee is consumed *immediately* before running, its diuretic effect sometimes interferes with the run.)

After running, runners should cool down indoors; remaining outdoors in a possibly sweaty condition without sustained activity can lead to a rapid loss of body heat and, consequently, to rapid cold injury.

In planning for cold weather PT, commanders can get informative data from installation weather offices: the average minimum temperatures for each of the winter months, for example, and the average humidity and windspeed for the different seasons and for different times of day. Records of extremes are also generally kept on hand.

Commanders and trainers have to put a lot of care, planning, and leadership into their physical conditioning programs if they are to be successful. But these investments are always rewarded with superior troop performance.

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