BEARING THE COLD—TIPS FOR COLD WEATHER EXERCISE

Regardless of season—and weather, tactical personnel need to maintain their fitness. Considering this, different climates bring with them different challenges. A working knowledge of the effects of cold weather on exercise will allow for the creation of strategies that can help safeguard against cold weather-related injuries and optimize exercise performance in this climate. This article will discuss the factors and effects of cold temperatures on exercise, the most common cold-related injuries along with strategies for prevention, and tips for optimizing exercise performance in the cold.

EFFECTS OF COLD TEMPERATURES ON EXERCISE

The body's ability to maintain warmth when exercising in the cold depends on the environmental medium, the amount of heat generated through physical activity, and the prevention of heat loss typically through the combined insulative capacity of the body and clothing. The environment can play a pivotal role in maintaining warmth. For example, heat loss occurs 3 – 5 times more quickly through water than air (4). This can be an important safety consideration when conducting workouts or training events that subjects an individual to wet conditions.

Muscle is the primary tissue responsible for heat production and the amount of heat produced is dependent upon the intensity of physical activity. Along with clothing, an individual's stature and body composition affects their ability to insulate and prevent heat losses. Heat loss is a factor of body surface area to mass ratio, meaning that a taller and leaner individual has a greater surface area to dissipate heat than a shorter and bulkier individual with the same body mass. There is also an increased insulative capacity in individuals that carry a greater amount of body fat (4).

The body undergoes many physiological changes when exposed to the cold. The most notable effects with regard to exercise in the cold relate to heart rate, muscle tone, and power production. The critical air temperature, the temperature at which the metabolic rate begins to increase to counteract heat loss, can occur at temperatures as high as 80 degrees Fahrenheit / 27 degrees Celsius (4). A prominent physiological change is peripheral vasoconstriction, which is the constriction of blood vessels in the extremities. When this change occurs, more blood remains in the core to defend against heat loss, thereby reducing the amount of blood flow into the limbs (4). Additionally, another byproduct of vasoconstriction is increased blood pressure, which may lead to a reduced heart rate and may be difficult for individuals to exercise at a specific heart rate (3). A greater effort is often necessary in the cold to match a heart rate that was easily attainable in more temperate conditions. Along with vasoconstriction, muscle tone also increases during cold exposure (3). Muscle tone relates to the partial contraction of the muscle while in a rested state. An increase in muscle tone allows for heat production and is also known as pre-shivering, as it relates to cold exposure. As muscle tone escalates when the body experiences more significant heat loss, shivering ensues, which causes the muscles to involuntarily contract to produce even more heat (3).

In addition, power output is decreased in cold environments and peak power occurs at a slower velocity than in temperate conditions (2,5). In practical terms, this means that speed-oriented tasks such as sprinting and jumping may be compromised, and movement velocity may need to be decreased to optimize any power-oriented tasks (4).

COLD-RELATED INJURIES

Some of the most prevalent injuries or ailments as a result of cold weather exercise include hypothermia, frostbite, and dyspnea. Hypothermia can be classified as mild, moderate, or severe and can be defined as having a core temperate below 95 degrees Fahrenheit / 35 degrees Celsius (7). Hypothermia is the most serious among these as death can occur in severe cases. Symptoms are highly variable, however they tend to begin with shivering, drowsiness or exhaustion, and slow and shallow breathing, and then progress to slurred speech, disorientation, and changes to cardiac rhythm in severe cases (7). A predisposition to hypothermia can occur whenever heat production is reduced or heat loss is accelerated. Training factors that can potentially lead to a decrease in heat production include decreasing physical activity, excessive fatigue, energy depletion, and lack of sleep. Wind, rain, wet clothing, fatigue, and low body fat account for the most common training factors that increase heat loss (2). Following a simple risk management plan, as shown in Table 1, may account for many of the controllable training factors mentioned above and reduce the incidence of cold stress or strain while exercising due to improper preparation.

Frostbite occurs when tissue temperatures fall below 32 degrees Fahrenheit / 0 degrees Celsius (3). It is most common in exposed skin such as on the nose, ears, cheeks, and wrists, but can also occur in commonly unexposed surfaces of the hands and feet. Initial symptoms of frostbite include numbness in the affected area, with pain often occurring during rewarming. Extreme cold, wetness, and wind chill are the most common environmental predisposing factors for frostbite. Wind can negate skin warming in spite of an increasing core temperature if the skin is exposed, so efforts should be taken to cover any exposed skin areas. Winter clothing and appropriate equipment can also help to safeguard

against frostbite. While most temperatures may be relatively safe for adequately prepared healthy individuals, it is recommended to avoid outside activity when temperatures are below -18 degrees Fahrenheit / -28 degrees Celsius, as this is generally when an increased susceptibility to hypothermia and frostbite occurs (2).

Difficult or labored breathing, known as dyspnea, is another common cold-related condition. The onset of dyspnea is generally the result of bronchospasms, which is the sudden constriction of the muscles in the walls of the bronchioles (3). Cold air is often very dry, and it is the dryness of the air more so than the cold that affects breathing (3,6). Asthma sufferers are more likely to experience bronchospasms (6). Physicians often prescribe beta2-agonists such as albuterol that can be taken 15 min prior to exercise for best results (6).

OPTIMIZING EXERCISE PERFORMANCE IN THE COLD

Optimal exercise performance in the cold requires proper evaluation of the environment, adequate nutrition, appropriate clothing, and good judgment. Exercise intensity and clothing work in conjunction to sustain core temperature. The intensity of exercise governs the amount of metabolic heat produced, so having a plan in advance for the content of a training session makes it possible to make an optimal clothing selection. Low-intensity exercise (performed at 30% or less of VO_2max) may not produce enough heat to match heat losses in a cold and wet environment (5). However, when exercise is undertaken in a relatively dry environment, standard outdoor clothing can help to offset any lethal drop in core temperature for 5 – 6 hours (5). Moderate and sustained exercise (performed at 70% of VO_2max), may produce enough heat to maintain core temperature in temperatures as low as 14 degrees Fahrenheit / -10 degrees Celsius in shorts and short-sleeved shirts for as long as 90 min (5). Cold weather may have the most deleterious effect on high-intensity exercise (performed above 70% of VO_2max) (2,5). Dynamic performance and power output can be impaired in cyclical and jumping tasks. If required to perform bursts of high-intensity activity in a training session it is suggested that appropriate clothing is worn or low-intensity activity be maintained between explosive bouts to produce enough metabolic heat to preserve muscle temperature (4). Intermittent activity training sessions or practices present the greatest challenge when selecting clothing. The danger of intermittent activity comes from overdressing, which can make the skin damp from excessive sweating, or underdressing, which leaves an individual inadequately prepared for periods of inactivity. The best strategy may be to layer clothing so that the amount of insulation can be quickly adjusted based on activity level.

A three-layer system of clothing is the preference of many outdoor exercise enthusiasts (2). It is recommended that the first layer of clothing should have wicking properties to draw moisture away from the skin and keep them dry throughout the exercise session. Popular materials for the first layer are polypropylene, polyester, or wool. The second layer of clothing should provide the most insulation to retain heat. The third and outermost layer should act as a weather barrier to block wind, rain, and snow. It is also recommended that shoelaces and equipment straps like gloves or backpacks are not pulled too tightly as circulation to the extremities is already reduced in the cold.

Athletes can expend up to 10 – 40% more energy during cold weather exercise from added weight from clothing and equipment, environmental obstacles, and shivering (2). Carbohydrates are important in the sustainment of exercise performance in the cold; however, the need for additional carbohydrate intake is generally met when ensuring caloric intake is sufficient. Dehydration does not necessarily subject an individual to a greater susceptibility to cold-related injuries in all instances; however, dehydration can still occur in cold temperatures and fluid intake is still a very important factor to consider. The same general hydration guidelines offered in hot conditions can apply to exercise in the cold, such as entering a training session well hydrated, maintaining hydration throughout, and replacing fluids lost during and following the workout. It is important to note that thirst may be less noticeable in cold weather if skin temperatures fall compared to hot weather. In addition, an increase in urination from cold exposure, known as cold-induced diuresis, can occur, which may lead to additional fluid loss (2).

CONCLUSION

Knowing the risks of cold weather training is only half of the battle. Making good judgments on clothing selection based on exercise intensity and environmental conditions, and maintaining adequate food and fluid consumption are the applied components that will lead to effective training in cold conditions. It is important to be familiar with a proper risk management strategy to help guide decision-making that can enhance safety and exercise performance.

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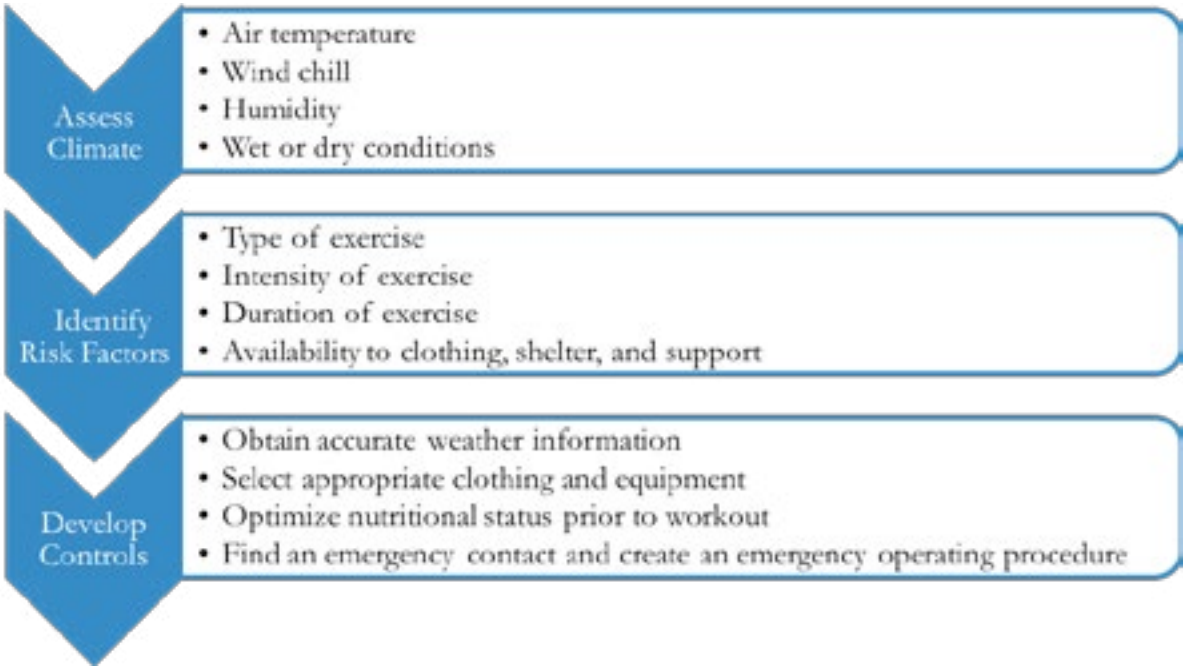
TABLE 1. RISK MANAGEMENT PLAN



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