Care and Maintenance of Our Most Dangerous Weapon

LTC (RETIRED) CHARLES D. HENRY

The most dangerous weapon on the battlefield is the individual warfighter. With or without a specific weapon system, there is nothing more potentially dangerous than a fit, trained, motivated, and focused warfighter in action. To create, shape, and enhance the individual into a warfighter, we start with the generic Mark 1, Mod 0 human being. We must understand our innate capabilities and limitations to attain and sustain optimal performance and not to waste such a prize finished asset.

There are many factors that influence warfighters' physiology and performance. The human body is very adaptive, but it has definite limits and can only adapt so far on its own. It is behavior — what we know and do — that allows us to survive and act in all environments. With all the possible interactions in any environmental change, our answer to the question of our survival and success is always "it depends." This is where we, as warfighter leaders, earn our pay by evaluating the changes and directing and supporting the necessary behaviors and actions to help preserve the physical and emotional potential of individual warfighters.

We must remember that human beings are not machines. We sometimes need "warm-up" or "start-up" times to adapt and fully engage our physical potentials, and we do have some vulnerabilities. Sometimes we need time to recover from efforts, to recharge our batteries or let our body's systems come back into balance for optimal performance. Sometimes we need to change the pace of our operations to maintain that optimal performance. To attain and then sustain optimum physical performance in our warfighters, we must be aware of how our bodies work and where any vulnerabilities might exist.

The following is an outline of "rule of thumb" knowledge and guidance for warfighters and their leaders. It is hoped this understanding of our bodies' innate capabilities and limits will enable warfighters to always safely succeed in their tasks.

We Always Sweat

Humans are the most prolific sweaters in the entire animal kingdom. At all times we are losing water in part because water evaporation is the best way for us to lose heat, and this is something we must do as warm-bodied animals. In a neutral thermal environment, obvious sweating does not occur except where ventilation is restricted around the feet, groin, waist band, neck band, and armpits; and this evaporation accounts for only 15-25 percent of our total heat loss. Of the total, slightly more than half is the result of evaporation from the respiratory tract as we breathe, with the remainder coming from the water that passively diffuses through the skin and evaporates. Except when in the cold, we always produce excess waste heat that we must lose to remain healthy. In the cold, we are not well equipped by nature

Photo by PVT Lawrence Broadnax

A Soldier with the 25th Infantry Division's Lightning Academy pulls security for his team during an exercise as part of the Jungle Operations Training Course at Schofield Barracks, HI, on 18 June 2020.

to prevent the crippling continuous heat loss that threatens our lives. We must supplement our physical capabilities with behavioral actions to sustain and support ourselves. Understanding the nature of these threats helps us refine our behaviors to best sustain warfighters.

Envelopes of Performance — Temperature and Humidity

The temperature range of our indefinite living environment with adequate food, shelter, rest, and water is 40-95 degrees Fahrenheit (F). However, we must always remember that it is the intensity of our physical work that creates the heat that incapacitates and sometimes kills us. We can create fatal heatstroke at as low as 76 degrees. As it is the combination of intensive activity and behavior that creates these harmful conditions, we must remember that the British Army has reported heat injury and illness in trainees at 50 degrees. One of the worst cases reportedly occurred when overdressed Norwegian marathoners, who had been misinformed about weather conditions, suffered heat illnesses and injuries at 32 degrees.

As increasing humidity slows down our protective evaporation, our internal heat burden can grow with any physical activity or labor that can create heat faster than the body can lose it when the relative humidity is more than 50 percent. The effects of humidity on our work capacity apparently depend on the intensity of the work we are doing by creating the heat load we generate internally.

Photo by SGT Lauren Harrah

Soldiers from the 3rd Infantry Division conduct a dismounted water crossing during joint training at Zagan Training Area, Poland, on 24 August 2016.

In the low range of humidity, prolonged exposure to 10-15 percent humidity threatens eye and skin damage as well as faster dehydration that threatens our whole body.

Time Needed for Adaptation to Heat

The research of Lawrence Armstrong, Ph.D., has revealed the following facts for heat acclimatization:

- A minimum of three days is required for our initial adaptations to heat to take place to create the foundation of our new basic physical stability. To act aggressively before this time is simply begging for rapid exhaustive failure.

- A minimum of 10 days under best conditions is required for all our physical adaptations to heat to become complete, while 14 days is normally expected in stable heat conditions.

We cannot speed up these processes by forcing water and electrolytes, as these only create chemical imbalances that our body has to take additional time to sort out. The U.S. military treats approximately 100 cases of hyponatremia (low body salt) each year as troops drink too much water and then collapse into convulsions and nervous dysfunction. So far, at least two Army deaths from this cause have been reported.

Adaptation to Cold

The challenge of cold is to behaviorally adapt to the threat of continuous excessive heat loss as the temperature drops below 40 degrees. Can we insulate and feed ourselves well enough to prevent our decline because of the continuous degradation caused by the cold? If the cold is moderate enough and stable, there are indications that a plateau of adaptation can be attained in approximately two to four weeks as compared to the two weeks generally needed to adapt to a hot environment. Whenever and however those adaptations occur, both are absolutely dependent on the continuous maintenance of the new supportive behaviors. We must remember that while we can protect ourselves from excess heat with just shade, water, and rest, protection from cold requires additional food, water, warm shelter, insulating clothing, and the ability to stay dry.

The Dangers of Being Wet

Water conducts heat away from the body 25 times faster than air. According to Technical Bulletin (TB) 508, *Prevention and Management of Cold-Weather Injuries*, “Wading in streams or working in the rain substantially increases a Soldier’s susceptibility to hypothermia because water has a high thermal conductivity." The TB states that the core temperature cooling rate depends on both water temperature and the immersion depth. TB 508 also states: "Soldiers who have low body fat and a high surface-area-to-mass ratio are more susceptible to faster cooling rates. Also, Soldiers who have not eaten in over 24 hours are more susceptible, as are those who are fatigued because of physical exhaustion or sustained operations."

The Dangers of Wind Chill

Wind increases our rate of heat and moisture loss. NATO employs the wind chill temperature index (WCTI) to determine environmental cold stress. The WCTI integrates wind speed and air temperature to provide an estimate of the cooling power of the environment and the associated risk of peripheral cold injury. The wind chill temperature is the equivalent still air (i.e., no wind) temperature at which heat loss through bare skin would be the same as under windy conditions. Note that warfighters riding in open vehicles or exposed to propeller/rotor-generated wind can be subject to dangerous wind chill, even when natural winds are low. Ambient dry bulb and contact surface temperatures (exposed skin) are used to determine the risk of frostbite. There is no risk of frostbite when the ambient air temperature is above 0 degrees Celsius (32 degrees F) even though the WCTI may be below freezing due to strong winds. Wet skin will not freeze if the air temperature is above 32 degrees F, but wet skin below this temperature will freeze faster than dry skin. Temperatures, wind chill, and risk of cold injury increase at high altitudes as air temperature is about 3.6 degrees F lower with every 0.3 kilometers (1,000 feet) above the site at which temperature was measured.

Water and Caloric Needs

Depending on the environmental temperature, three to eight days without water will kill a human.

A minimum average of 2.5 liters of water per day is needed to sustain inactive humans.

A fit, acclimatized human can sweat up to three liters per hour but can absorb no more than 1.3 liters per hour which means that rest, food, and water breaks are absolutely required to allow the body to rehydrate.

With increasing dehydration, all the benefits of fitness and acclimatization for physical performance and protection are lost. A fit but dehydrated warfighter is no more capable than an unfit, unacclimatized adolescent.

Without food, inactive humans take four to six weeks to die; having to be active shortens this time.

Without eating, no one can fully rehydrate as the body cannot fully absorb water without solid food.

When we start shivering to create extra warmth for our body in the cold, we start burning extra fuel and then need extra food to replace these energy reserves as we start to burn ourselves out.

In the cold, warfighters need 25-50 percent additional food per day to survive and work. That's generally the daily equivalent of four standard meals, ready to eat (MREs) if nothing else is available.

A National Guard Soldier from Bravo Company, 1st Battalion, 297th Infantry Regiment, provides cover fire with his team during Arctic Eagle 2018 outside of Fort Greely, AK, on 2 March 2018.

Photo by SPC Michael Risinger

The daily caloric requirement record that I know of is warfighters consuming an estimated 7,400 calories per day cross-country skiing with 45-kilogram packs in the Arctic. This was possible only because they had hours of warm, protected rest and plenty of food each day helping their bodies to recover from the daily efforts. This effort was limited to three days and 51 kilometers.

The current Greenland Sledge Patrol member depends on the consumption of 7,000 calories per day and 5,000 calories per dog per day for their two-to-five-month patrols. This is currently the greatest endurance effort that I know of.

It is no coincidence that military training programs around the world that minimize food, water, and rest as part of tests of stamina and performance usually curtail the program after five to six days as thereafter exhaustive failure, injury, and death occur.

Effect of Altitude

Operations in the mountains present three possible hazards: the diminishing oxygen with altitude, the frequent cold, and an often wet environment.

Above 4,900 feet the air gets thin enough to begin to diminish the oxygen we need for energy.

Our maximal oxygen uptake begins to decrease significantly above an altitude of 1,600 meters (5,249 feet). The altitude limitations in total body oxygen transport begin to appear above 2,000 meters (6,562 feet). For every 1,000 meters (3,281 feet) above that the maximum oxygen available to our body drops by approximately 8-11 percent.

It takes approximately two weeks to adapt to the changes associated with the hypobaric conditions at 2,268 meters (7,500 feet). Every 610 meters (2,000 feet) above that requires an additional week of acclimatization to altitude.

What Starts Failing First

Our brain is the most vulnerable component in our body. It is the first of our systems to begin failing under the environmental stresses of heat, cold, and fatigue. As we fatigue, we become distracted and slower to see and think. Our accident rates climb as the temperature either climbs or lowers to extremes. Continuing physical and mental toughness is absolutely required for warfighters to continue to perform. Training, discipline, experience, and mind/body toughness can counteract much of the effects of stress, but these must be combined with continuous clear-headed planning and adequate supporting resources. A failure of the leadership to protect their ability to continually think and act clearly can quickly lead to chaos and mission failure. All experienced warfighters can remember missions and exercises that drifted and whimpered to an end rather than surged across the finish line as the wear and tear of the effort wore down the chain of command.

Summary

What I have tried to present are nine sets of factual rules of thumb to describe with general accuracy the boundaries of normal human health and performance for warfighters who are almost always pushing the human performance envelop in pursuit of their mission in often stressful environments. Each human being is unique, so it is always a mistake for leaders to assume that everyone in a unit will react to the environment in the same manner and be able to withstand the applied stress for the same duration. Leaders must always watch the whole unit for signs of someone failing, as this can act as a barometer of stress for the whole unit.

Understanding how we can be physically challenged by and then respond to the environment allows us to fully apply the knowledge of how we should behave in that particular environment that we have accumulated with experience. That tested knowledge of how to behave is found in our professional warfighter publications listed in the references below.

Virtually every day we approach some of our normal healthy limits, but we are protected by our unconscious behaviors (stop working when tired, take a drink when thirsty, and eat when we are hungry). As warfighters, our missions and tasks often take us beyond those safe limits — sometimes very far beyond. We become rightfully proud of our learned abilities to “suck it up” — to endure. But we must be aware of the price we are potentially paying and the rate at which we pay it. If we can understand what may be threatening to tear us down, we may then be able to prevent, wherever possible, the likely exhaustive failure, injury, and death. When we reach our objectives, we want and need to be able to stand tall, ready, capable, and alert without also being exhausted, stumbling, distracted, and vulnerable.

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LTC (Retired) Charles D. Henry’s career has allowed him to earn both the Expert Infantryman Badge and the Expert Field Medical Badge. His service included operations in the Andes, the Alaska Range, the Huachucas, the Rockies, and the Sierras — all over 5,000 feet. He was inducted into the “Below 50 Club” at the Northern Warfare Training Center for training in the field at temperatures measured below -50 F. His service included winter operations in Korea, Alaska, Europe and the Eastern and Northern United States. He also experienced operations in South and Central America and the Southwestern and Southeastern United States. He has earned a master’s degree in Physiology.