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Impact of weather on sports and sport injuries

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Abstract

The performance of participants can be reduced or improved, and some sporting world records are invalid if set under certain weather conditions. While outdoor sports are most affected, those played indoors can still be changed by adverse or helpful weather conditions. One of the most obvious weather impacts on winter athletes is tightness. Winter athletes must take extra precaution while warming up to make sure they do not incur any muscle damage. While any exercise outdoors in any climate can pose an asthma risk to even the most seasoned athletes, it's the cold, dry area that increases the risk during the winter months. For many people with regular asthma, just stepping outside in frigid temperatures is enough to cause coughing, wheezing, and chest tightness. Most injuries occur during hot and humid conditions, cold weather conditions, and wet and rainy conditions. The injury may not be direct but caused by a weakening of the body due to the extreme weather conditions.

Keywords: Weather, tightness, muscle damage, climate, extreme weather conditions

Introduction

Sports have become an important part of our lives. Taking part in physical activity and sport is a major element in our health agenda. The benefits of physical activity to both the body and the mind have been acknowledged by health experts and hence have become an important part of a healthy life. People take part in various sports activities for health, fitness, stress-busting, or just for pure fun and socializing. While some are very serious about their sports activities, others engage in them casually. The increased awareness of the health benefits of physical activity has made sports activity a part of our daily life. Regular exercise and sports activity must be undertaken taking into consideration the current health status of the personal and sticking to certain patterns and prescriptions without overdoing it to avoid injuries and sickness.

The cold slows down all of your body's chemical processes, including your nervous system's ability to generate a muscle contraction. While physical activity in the cold requires more nutrients, exercising in a cold climate will not necessarily cause a person to burn more calories than in a temperate climate. Temperature is a physical quantity that expresses hotness and cold. It is the manifestation of thermal energy, present in all matter, which is the source of the occurrence of heat, a flow of energy, when a body is in contact with another that, is colder. Some outdoor sports are canceled because of heavy precipitation. Some are deemed too dangerous to play when the ground is damp because of the danger of injury to a player through slipping. Some sports are canceled because of precipitation. Some are deemed too dangerous to play when the ground is damp because of the danger of injury to a player through slipping (Baseball, Cricket, Golf, and Tennis etc.). Some sports cannot be played if insufficient visibility as it can make them dangerous or can be disadvantageous to a competitor. Cricket test matches often finish when the umpire decides that the light level is too low and the timing of this can sometimes be controversial. The difficulties of playing in bad light conditions are also disputed. Some events are called off when there is heavy fog. High heat and humidity lead to two problems in the exercising body: 1) increased core body temperature and 2) dehydration. Athletes can lose as much as 2 to 8% of their body weight during high-intensity exercise, and the rate of fluid absorption from the gut just can't keep up with that rate of loss. Exercising regularly and engaging in sports is one activity people try to pursue without any break or discontinuity. But, sometimes this is not possible due to changing weather conditions.

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Weather conditions can change and make it inconvenient and sometimes impossible to pursue sports activities. Extreme heat or cold or wet conditions may hamper physical activity. They may disturb not just outdoor but also affect indoor activities. Weather is an unpredictable and constantly changing phenomenon. Sudden changes in weather affect many human activities. Sports activities are highly influenced and are dependent on weather conditions. Various sports events at various levels – local, state, national, and international – are held in various parts of the world. The energy, planning, and other resources that are put into organizing these sporting events are on a massive scale than earlier. Every person, thing, event, and position is meticulously detailed. All this will be wasted if the weather conditions change suddenly and drastically. The events may be canceled, postponed, or delayed. Certain sports are held in certain regions due to the compatibility of climatic conditions to the sport.

People all around the world participate in various sports according to the climate of the region. There are certain sports relative to particular regions. Skiing and Snowboarding are popular in cold regions with snow and ice. In warmer regions, other sports like running, football, cricket, tennis, etc are played. Different weather conditions have an influence on the sport as well as the players. The players may be injured or their health affected due to the weather. The result of the sport may also be impacted due to the weather discouraging the players. Sports activities during extreme weather conditions may result in various degrees of injuries.

Effects of hot weather on sports

Hot weather can affect the performance of players significantly. Dehydration is a loss of fluids and salts from the body. Many players suffer from dehydration due to long periods of activity even when the weather is not too hot. Even in moderately warm weather conditions, continuous movement on the field can cause the body to lose fluids and salts through perspiration and exhalation of air due to high rates of respiration. Extreme heat can increase body temperature and loss of fluids. This leads to dizziness, fatigue, and cramps. Heat stress, from exertion or hot environments, places athletes at risk for illnesses such as heat stroke, heat exhaustion, or heat cramps. (King, 2004).

Heat stroke

A condition that occurs when the body becomes unable to control its temperature, and can cause death or permanent disability.

Symptoms

- High body temperature (103°F or higher), Hot, red, dry, or damp skin, Fast, strong pulse
- Headach, Dizziness, Nausea, Confusion, Losing consciousness (passing out)

First AID

- Request immediate medical assistance., Move the worker to a cool, shaded area.
- Remove excess clothing and apply cool water to their body.

Heat exhaustion: The body's response to an excessive loss of water and salt, usually through sweating.

Symptoms

- Heavy sweating, Cold, pale, and clammy skin, Fast, weak pulse, Nausea or vomiting
- Muscle cramps, Tiredness or weakness.

First AID

- Move to a cool place, Loosen your clothes
- Put cool, wet clothes on your body or take a cool bath, Sip water

Heat cramps

Affect workers who sweat a lot during strenuous activity. Sweating depletes the body's salt and moisture levels.

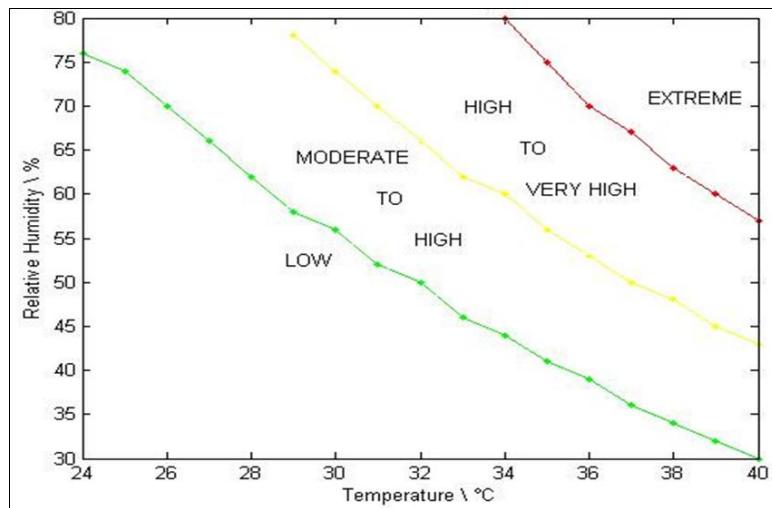
Symptoms

Muscle cramps, pain, or spasms in the abdomen, arms or legs

First AID

- Stop physical activity and move to a cool place
- Drink water or a sports drink
- Wait for cramps to go away before you do any more physical activity.

Prolonged loss of fluids may result in a gradual decrease in the volume of blood circulating. This leads to thickening of the blood and increases the heart rate to provide sufficient blood flow to the muscles and vital organs. Thus blood flow to the skin is drastically reduced resulting in a decrease in sweating and dissipation of heat from the skin. The core body temperature rises to lead to heat stress or collapse and even death. Even a 2% decrease in body weight through water loss can cause detrimental effects, with reports of up to a 20% decrease in performance (Dehydration & Sports Performance Sportsinjuryclinic.net 2019). A fluid loss exceeding 3-5% bodyweight impairs reaction time, judgment, concentration, and decision making – vital elements in all sports. Among boxers, dehydration can lead to brain injury. The reduction of glycogen in the body will also affect the brain and the thought capacity. The reflexes are affected and the player is not able to react immediately on the field. The player will be injured due to a fall or collision with another player or being hit by a ball. Muscles use fluids and electrolytes to function well. Depletion of body fluids and salt due to dehydration can result in frequent and intense muscle pain. Potassium and Sodium are the most important electrolytes for muscles. They are the ones that are mostly lost during excessive sweating. Dehydration can result in lowering muscle endurance increasing the risk for sprains and strains. Several studies highlighted in the National Athletic Trainers Association bulletin confirmed that 3-4 percent dehydration lowers muscle endurance, which increases the risk for strains and sprains. According to the NATA, athletes participating in high-intensity sports like tennis cross country and soccer for extended periods should consider adding electrolytes to their beverages (Strains and Sprains" April 06, 2017, *dripdrophydration*, pbc.)

**Fig 1:** Risk of heat illness for sportsmen

Hypernatremia or sodium depletion in the blood is observed in events lasting over 8 hours. It can be fatal and is caused by water intoxication or consumption of only large amounts of water or liquids with little or no sodium. Drinking plain water may cause bloating, stimulate urine output, and suppress thirst. Thus, it might actually do more harm by excreting the salts in the body. CHO-electrolyte drinks are replacing water as they have sodium to quicken fluid absorption and CHO to provide fuel. Endurance cyclists and marathon runners can perform better if they consume CHO-electrolyte in place of water. CHO-electrolyte drinks are useful when athletes do not have enough time to refurbish glycogen stores in their bodies; for example, athletes participating in the Tour de France, major tennis tournaments, and two-day mountain marathons. In major endurance sports like marathons and triathlons, collapse is quite common. This occurs with an increase in race distance, temperature, and humidity. Most athletes who collapse do after the finish line. This is usually caused by the pooling of blood in the dilated vessels of skin in limbs which have been moving incessantly and the muscle pumping activity has stopped suddenly. This is also called Postural Hypotension (Heat Exhaustion or Syncope). In the 2012 London Marathon, a 30-year woman died within sight of the finish line, making news headlines. At a hot Chicago marathon in 2007, a man died amidst accusations of the danger of running in the heat – his death was attributed first to dehydration and heatstroke, later to an existing heart condition. Even elite athletes are not immune – Ryan Shay during an Olympic qualifying marathon in New York, and Fabrice Muamba during a Premier League match. It's a recurring event, often, but not always linked to high temperatures. Collapse is perhaps the most dramatic of all medical problems affecting athletes. Though collapse can be seen in any athletic event requiring maximal exertion, it is most common in endurance events, such as marathons and triathlons. The incidence seems to increase as the race distance, temperature, and humidity increase (O'Conner *et al.*, 2003)^[1].

A wide swath of research has linked dehydration to muscle injuries, and this happens because muscles use fluids and electrolytes to function properly during exercise. So when an athlete is dehydrated, and the body's supply of fluids and electrolytes is depleted, an athlete can experience more frequent and intense muscle pain. Some of the most important electrolytes for muscles are sodium and potassium, and incidentally, both are also the most likely to be lost through

sweat during intense exercise. Many studies have examined the link between electrolyte depletion and muscle endurance, and the general consensus is that dehydration wreaks havoc on muscle function. According to the NATA, athletes participating in high-intensity sports like tennis cross country and soccer for extended periods should consider adding electrolytes to their beverages. And during the first hot practices of the season, athletes should be adding electrolytes to their water, as well.

Participating in physical activity and sport is a well-established element of the public health agenda that has received increasing attention in recent years (Malina and Little, 2008). In fact, as physical activity benefits to mind and body have long been acknowledged by health professionals, regular participation in physical activity has become an important component of a healthy lifestyle. Appropriate and sufficient regular physical activity plays a significant part in enhancing and maintaining health. Depending upon the metabolic rate, environmental conditions, and clothing worn, exercise can induce significant elevations in the body (core and skin) temperatures. Body temperature elevations elicit heat loss responses of increased skin blood flow and increased sweat secretion (Sawka and Young, 2005) Sawka, Wenger and Pandolf, 1996. Humans encounter thermal (heat & cold) stress from climatic conditions, insulation worn and body heat production. Alterations in body temperatures (skin, muscle & core) above and below “normal” levels can degrade exercise performance and cause thermal injury.

Current or recent illness increases the challenge of participating in physical activity safely in the heat because of the potential negative residual effects on hydration status and regulation of body temperature. This is especially true for illnesses that involve gastrointestinal distress (e.g., vomiting, and diarrhea) and/or fever. (Inbar, Morris, Epstein, and Gass, 2004). Performing in hot and cold environments places a heavy burden on the mechanisms that are designed to regulate body temperature. Heat exchange between the skin and the environment is governed by biophysical properties dictated by the surrounding temperature, humidity, and air motion, sky, and ground radiation, and clothing (Gagge and Gonzalez, 1996)^[6].

In temperate and cooler environments, the high capacity for dry heat loss (radiation and convection) reduces evaporative cooling requirements, so sweat losses are relatively small. The wearing of heavy or impermeable clothing, such as a football uniform, greatly increases the heat stress and evaporative

cooling requirements while exercising in temperate to hot environments. (McCullough and Kenney, 2003). Exercise during windy or rainy conditions or water immersion poses several unique challenges to the body's ability to maintain normal body temperature. The transfer of body heat in the water maybe 70 times greater than in air. Heat stress, from exertion or hot environments, places athletes at risk for illnesses such as heat stroke, heat exhaustion, or heat cramps (King, 2004).

All heat-related illnesses are completely preventable if the athlete uses caution when exercising in a heated environment. An athlete can only perform at an optimal level when dehydration and hyperthermia are minimized by the ingestion of ample volumes of fluid during exercise and by commonsense precautions in keeping cool (Murray, 1995)^[12]. In a heated environment, it is essential that the athlete continually replaces lost fluids by drinking large quantities of water heat stress, from exertion or hot environments, which places athletes at risk for illnesses such as heat stroke, heat exhaustion, or heat cramps. The occurrence of these injuries depends on the combination of 2 factors: low air or water temperatures (or both) and the influence of wind on the body's ability to maintain a norm thermic core temperature, due to localized exposure of the extremities to cold air or surfaces.

Effects of cold weather on sports

Dew plays an important part in the later part of a day-night game. Dew is often seen during the evenings in games played in the subcontinent, making the outfield wet. A wet ball is difficult to bowl with because it's not easy to get a proper grip on it. Also, the ball tends to skid off the wicket when it bounces, making it easy for batsmen to score off them.

Cold injuries are classified into three broad categories

1. Decreased core temperature (Hypothermia)
2. Freezing-tissue injuries of the extremities
3. Non-freezing injuries of the extremities

Hypothermia

Hypothermia is a serious concern for athletes in cold temperatures. Hypothermia usually occurs when it's very cold outside, but it can also strike when temperatures are merely cool and an athlete gets wet or sweaty and then becomes chilled.

Hypothermia: Mild. Rectal temperature 33°–35 °C

1. **Signs/symptoms:** shivering, hungry, lethargic, confused, poor coordination, slurred speech, ataxia.
2. **Treatment:** insulate the athlete with dry clothing, continue mild exercise, and administer warm liquids.

b. Hypothermia: Moderate. Rectal temperature 30°–33 °C

1. **Signs/symptoms:** semi-conscious, confused, irrational, disoriented, muscle stiffness, slow, irregular pulse.
2. **Treatment:** exogenous heat via a warm shower, warm water bottles, body contact, inhale warm, moist air; warm liquids; the athletes should be handled with care due to myocardial irritability.

c. Hypothermia: Severe. Rectal temperature below 30 °C

1. Signs/symptoms: unconscious, pupils dilated, faint or absent heartbeat.

Freezing-tissue injuries of the extremities

Frostbite is the term that is used to describe tissue damage from direct freezing of the skin. Skin exposed directly to a cold environment can freeze when external temperatures reach just below 32°F. Vasoconstriction in the skin will become so effective that blood flow to the extremities may cease, causing the tissues to die from a lack of oxygen and nutrients. This is known as frostbite. Frosting, the mildest form of cold injury to the skin, is a precursor to frostbite. It can occur with exposure of the skin to very cold temperatures, often in combination with windy conditions. It can also occur from skin contact with cold surfaces (e.g. metal, equipment, liquid). With frosting, only the superficial skin is frozen; the tissues are not permanently damaged.

Symptoms

- At first, cold skin and a prickling feeling, Numbness, Red, white, bluish-white or grayish-yellow skin
- Hard or waxy-looking skin
- Clumsiness due to joint and muscle stiffness
- Blistering after rewarming, in severe cases

First AID

- Rule out the presence of hypothermia by evaluating observable signs and symptoms and measuring core temperature.
- To re-warm, the affected tissue should be immersed in a warm water bath. Water temperature should be monitored and maintained. The water will need to be gently circulated, and the area should be immersed for 15 to 30 minutes.
- Remove any constrictive clothing and submerge the entire affected area.
- Thawing is complete when the tissue is pliable and color and sensation have returned.
- Athletes should avoid using alcohol and nicotine.(Biem, Koehncke, Classen and Dosman,2003).

Non-freezing injuries of the extremities

A chilblain, also known as pernio, is an injury associated with extended exposure (1–5 hours) to cold, wet conditions. Chilblain is an exaggerated or uncharacteristic inflammatory response to cold exposure. Prolonged constrictions of the skin blood vessels result in hypoxemia and vessel wall inflammation; edema in the dermis may also be present. Alpine sports, mountaineering, hiking, endurance sports, and team sports in which footwear and clothing remain wet for prolonged periods due to water exposure or sweating.

Symptoms

- Red or cyanotic lesions swelling, Increased Temperature
- Tenderness, Itching, numbness, burning or tingling
- Skin necrosis, Skin sloughing.

First AID

- Remove wet or constrictive clothing, wash and dry the area gently, elevate the area, and cover with warm, loose, dry clothing or blankets.
- Do not disturb blisters, apply friction massage, apply creams or lotions, use high levels of heat, or allow weight bearing on the affected area.
- During treatment, continually monitor the affected area for return of circulation and sensation. (Inbar, Morris, Epstein and Gass, 2004).

When spending time outdoors in winter, the body adapts to the cold and dry ambient air by trying to retain heat. In an attempt to maintain core temperature, the amount of warm blood the body sends to the arms and legs is decreased in order to reduce the amount of body heat lost to the cold air. By decreasing the amount of blood to the extremities, more warm blood stays in the core region of the body. This eventually leads to the kidneys producing more urine. When this cold-induced increase in urine production occurs, over time it can lead to dehydration. The body also is more prone to dehydration because breathing cold, dry air results in fluid loss through evaporation. Outdoor winter workouts are a great way to take in small doses of sunlight. The sunlight can help to improve mood and help with vitamin D intake exposure to the cold causes an initial reduction in skin temperature followed by a drop in core body temperature. In order to defend against a damaging decline in body temperature and the onset of hypothermia, the body reduces blood flow to the skin and generates its own heat through shivering.

Redistribution of blood flow is one of the primary defense mechanisms in the face of cold exposure. However, in the extremities, this mechanism causes a loss of dexterity in the fingers and toes. Increasing muscle temperature, through the use of a warm-up, is vital for improving muscle function. Depending on snow conditions, these dangers can range from broken limbs to head injuries. Without the proper preparations, training and pro-activeness, winter sporting activities can even be deadly. These two sports and their industry are heavily dependent upon weather conditions, as air temperatures can make or break the sports season. The most ideal conditions for skiing, snowboarding and snow-making are below 30 degrees, but the colder the better. When temperatures get too high, the snow can turn to slush, making it harder for active skiers and snowboarders to control their turning movements.

As colder weather approaches over the next few months, you may already be anticipating (and dreading) that stubborn ache or pain from a pre-existing sports injury. The one that reverts to feeling like it did seconds after it happened, but only around this time of year when a cold front is bearing down on your area. The broken ankle suffered during a football game or the torn ligament in your knee that never seemed to fully feel itself; sometimes they come back to haunt you.

Conclusions

This study clearly shows that most of the outdoor sports activities and in particular endurance sports are strongly influenced by the variation of meteorological parameters. In effect, the evaluation of bio climatological conditions and of thermal comfort in endurance sports particularly in road cycling has fundamental importance not only for proper planning of the training program and the nutritional plan but also for a better evaluation of the race strategy. Despite these observations, the influence of meteorological and environmental conditions is often disregarded in the outdoor sports performance assessment among the meteorological variables that strongly influence the sporting activity the most important are temperature, wind, precipitation, fog, atmospheric pressure, and relative humidity.

Participation in physical activity and sport can be beneficial to athletes and participants but can be lead to adverse health consequences when activities are done during harsh weather. So, it could be concluded that weather conditions should be considered when planning any training programmes for sports

and physical activity so as to reduce heat illness and cold injuries.

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