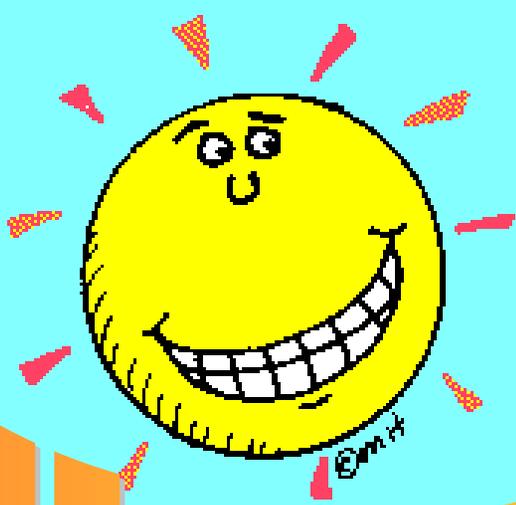


Heat Stress



Valeria Penarrieta
EHS 201



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Valeria Penarrieta
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Manifestations of Heat Stress

- Heat Fatigue
- Heat Rashes
- Heat Cramps
- Heat Collapse
- Heat Exhaustion
- Heat Stroke





Heat Fatigue

A factor that predisposes an individual to heat fatigue is lack of acclimatization. The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.

Heat Rashes

The most common problem in hot work environment, prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.





Heat Cramps

These are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating and lack of water replenishment. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.



Heat Collapse

In heat collapse, the brain does not receive enough oxygen because blood pools in the extremities. As a result, the exposed individual may lose consciousness. This reaction is similar to that of heat exhaustion and does not affect the body's heat balance. However, the onset of heat collapse is rapid and unpredictable. To prevent heat collapse, the worker should gradually become acclimatized to the hot environment.



Heat Exhaustion

Signs and symptoms: headache, nausea, vertigo, weakness, thirst, and giddiness.

Fortunately, this condition responds readily to prompt treatment. Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, a medical emergency.



Heat Stroke

Medical Emergency! This occurs when the body's system of temperature regulation fails and body temperature rises to critical levels.

Primary signs and symptoms of heat stroke: confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature (106°F).

If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of work load and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

Regardless of the worker's protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.



Occupational Environments and Activities at Risk

Environments:

- * iron and steel foundries
- * nonferrous foundries
- * brick-firing and ceramic plants
- * glass products facilities
- * rubber products factories
- * electrical utilities (particularly boiler rooms)
- * Bakeries
- * Confectioneries
- * commercial kitchens
- * Laundries
- * food canneries
- * chemical plants
- * mining sites
- * Smelters
- * steam tunnels.

Occupational Activities

construction

Refining

asbestos removal

hazardous waste site activities,

those that require workers to wear semipermeable or impermeable protective clothing



Individual Susceptibility

Physical Factors:

- Age
- Degree of acclimatization
- Medical conditions such as hypertension
- Weight
- Metabolism
- Type of clothing worn
- Degree of physical fitness
- Use of alcohol or drugs
- Prior heat injury

Environmental Factors:

- Ambient temperature
- Air movement
- Relative Humidity
- Radiant heat
- Conduction

It is difficult to predict just who will be affected and when, because individual susceptibility varies!



Regulations

There are none!!!

However...



Regulations

There ARE enforceable Recommendations under provisions of Section 5 of the OSH Act or the "**General Duty Clause**" which states that each employer:

“shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees”



Regulations (cont.)

The American Conference of Governmental Industrial Hygienists (1992) states that workers should not be permitted to work when their deep body temperature exceeds 38°C (100.4°F).

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

Work/rest regimen	----- Work Load* -----		
	Light	Moderate	Heavy
Continuous work	30.0°C (86°F)	26.7°C (80°F)	25.0°C (77°F)
75% Work, 25% rest, each hour	30.6°C (87°F)	28.0°C (82°F)	25.9°C (78°F)
50% Work, 50% rest, each hour	31.4°C (89°F)	29.4°C (85°F)	27.9°C (82°F)
25% Work, 75% rest, each hour	32.2°C (90°F)	31.1°C (88°F)	30.0°C (86°F)

*Values are in °C and °F, WBGT.

These TLV's are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4° F). They are also based on the assumption that the WBGT of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average should be used (consult the ACGIH *1992-1993 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* (1992)).

These TLV's apply to physically fit and acclimatized individuals wearing light summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLV's in this table must be reduced by the corrections.

Source: ACGIH 1992.



Sampling Methods

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1. **BODY TEMPERATURE MEASUREMENTS.** Although instruments are available to estimate deep body temperature by measuring the temperature in the ear canal or on the skin, these instruments are not sufficiently reliable to use in compliance evaluations.
 2. **ENVIRONMENTAL MEASUREMENTS.** Environmental heat measurements should be made at, or as close as possible to, the specific work area where the worker is exposed. When a worker is not continuously exposed in a single hot area but moves between two or more areas having different levels of environmental heat, or when the environmental heat varies substantially at a single hot area, environmental heat exposures should be measured for each area and for each level of environmental heat to which employees are exposed.



Control: Engineering Controls



- **General ventilation** is used to dilute hot air with cooler air (generally cooler air that is brought in from the outside). This technique clearly works better in cooler climates than in hot ones. A permanently installed ventilation system usually handles large areas or entire buildings. Portable or local exhaust systems may be more effective or practical in smaller areas.



- **Air treatment/air cooling** differs from ventilation because it reduces the temperature of the air by removing heat (and sometimes humidity) from the air.



- **Air conditioning** is a method of air cooling, but it is expensive to install and operate. An alternative to air conditioning is the use of chillers to circulate cool water through heat exchangers over which air from the ventilation system is then passed; chillers are more efficient in cooler climates or in dry climates where evaporative cooling can be used.



- **Local air cooling** can be effective in reducing air temperature in specific areas. Two methods have been used successfully in industrial settings. One type, cool rooms, can be used to enclose a specific workplace or to offer a recovery area near hot jobs. The second type is a portable blower with built-in air chiller. The main advantage of a blower, aside from portability, is minimal set-up time.





Control: Engineering Control (cont.)



- **Convection:** Increase the air flow using fans in the work area (as long as the air temperature is less than the worker's skin temperature). Changes in air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation. .
- **Insulation:** methods include insulating the hot surface that generates the heat.
- **Shields:** Can be used to reduce radiant heat, i.e. heat coming from hot surfaces within the worker's line of sight. Surfaces that exceed 35°C (95°F) are sources of infrared radiation that can add to the worker's heat load. Having cooler surfaces surrounding the worker assists in cooling because the worker's body radiates heat toward them.



Control: Acclimatization

The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimatization. After a period of acclimatization, the same activity will produce fewer cardiovascular demands. The worker will sweat more efficiently (causing better evaporative cooling), and thus will more easily be able to maintain normal body temperatures.

A properly designed and applied acclimatization program decreases the risk of heat-related illnesses. Such a program basically involves exposing employees to work in a hot environment for progressively longer periods. NIOSH (1986) says that...

	Day 1	Day 2	Day 3	Day 4
Previously Exposed	50%	60%	80%	100%
Newly Exposed	20% on Day 1, and a 20% increase in exposure each additional day			



Control: Administrative and Work Practices

Training is the key to good work practices. Unless all employees understand the reasons for using new, or changing old, work practices, the chances of such a program succeeding are greatly reduced.

• NIOSH (1986) states that a good heat stress training program should include at least the following components:

- Knowledge of the hazards of heat stress;
- Recognition of predisposing factors, danger signs, and symptoms;
- Awareness of first-aid procedures for, and the potential health effects of, heat stroke;
- Employee responsibilities in avoiding heat stress;
- Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;
- Use of protective clothing and equipment; and
- Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

Hot jobs should be scheduled for the cooler part of the day, and routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.



Control: Fluid Replacement

Cool (50°-60°F) water or any cool liquid (except alcoholic beverages) should be made available to workers to encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids should be placed close to the work area.

Summary

- Manifestations: heat fatigue, heat rashes, heat cramps, heat collapse, heat exhaustion, heat stroke
- Susceptibility: individual susceptibility varies and depend on physical and environmental factors
- Regulations: OSHA General Duty Clause
ACGIH-no working when temperature exceeds 100.4°F
- Identification and control: engineering controls, acclimatization, administrative and work practice, Heat stress training program, fluid replacement

The End

