When high temperatures affect the brain, even health- and safety-conscious people can get preventable, heat-related illnesses.

Hot Temperatures Can Short-Circuit Brain Function

If you are old enough, you may remember the 1987 Partnership for a Drug Free America ad that showed a raw egg being cracked into a frying pan with the slogan: "This is your brain. This is drugs. This is your brain on drugs." It left a lasting impression.

Now, with prolonged, record-breaking summer heat, Americans are saying it's hot enough to fry an egg on the sidewalk or the hood of a car. (The egg congealed when we tried this on a plus-100F°day.) These fried-egg analogies are a reminder of how vulnerable your brain can be to external forces.

Along with the heat waves rippling across the country, there is plenty of advice about how to prevent heat illness: drink cool water, limit direct sun exposure, cover up with a hat and loose clothing, wear sunscreen, avoid overexertion, take frequent breaks in a cool place, apply wet cloths to your skin, replace essential chemicals lost when sweating, get quality sleep, and so on.

However, even with this knowledge, heat exposure can short-circuit the best intentions.

Why Is the Brain Susceptible to Heat?

The brain is a complex organ comprised of about 60 percent fat and 40 percent water, protein, carbohydrates and salts. The brain controls mind and body functions, including temperature. It stores messages and relays them through the spine and across the body's central and peripheral nervous systems to the extremities.

Heat exposure affects blood flow and oxygen supply to the brain and can trigger an inflammatory response. This helps explain why some people don't react as quickly as they should when they start to feel overheated. They may feel sluggish, confused, dizzy or have a fainting episode. Even in mild cases of heat exposure, cognitive performance, attention and memory may be impaired.

Research shows that blood supplied to the brain is cooler than the brain itself, and that brain temperature rises more quickly and to a greater extent than blood in response to heat. This "intra-brain" heat production is believed to be a primary cause of functional brain hyperthermia.

Hyperthermia is an abnormally high temperature that occurs when the body reaches a point where it can no longer sweat and cool itself. Heat fatigue, heat syncope (dizziness after prolonged exposure), heat cramps, heat exhaustion and heat stroke are types of hyperthermia. Heat stroke is a life-threatening condition. Symptoms such as mental status changes (like confusion or combativeness), strong rapid pulse, lack of sweating, dry flushed skin, faintness, staggering or coma require an emergency medical response.

Contributing Factors

In addition to changes in the brain, factors that may contribute to heat illness include:

- Physical exertion in extreme temperatures
- Not allowing enough time to acclimatize
- Not drinking enough water (dehydration)
- Consuming alcohol or caffeinated beverages
- Lack of access to air conditioning or cooling stations
- Not taking frequent breaks to cool down
- Spending too much time in direct sun
- Not protecting skin from sun and glare exposure
- Working in confined spaces

People who work outdoors have higher risk for heat illness on high heat index days. The heat index is a combination of relative humidity and air temperature. For example, on a 90°F day with 70 percent humidity there is higher risk for sunstroke, muscle cramps and heat exhaustion. Full sun exposure can increase the heat index by up to 15°F and create extremely dangerous conditions.

The elderly, people who take certain types of medications or have chronic illnesses, pregnant women, people who are not used to heat and humidity, and those who live with poor socio-economic conditions are among populations with higher risk of heat illness.

Hydration Essential to Brain Health

Since water comprises a significant percentage of the brain, dehydration diminishes both physical and mental performance. Studies show that even mild dehydration (2 percent water loss by sweating) reduces cognitive ability and physical coordination. Since the body does not store water, fresh, daily resupplies are needed. Water is essential because it:

- Regulates blood flow and temperature
- Improves brain, kidney, liver and urinary functions
- Aids with digestion and elimination of toxins
- Increases energy levels and concentration
- Promotes weight loss/control
- Eases joint pain and headaches
- Improves sleep
- Replenishes skin and hair

Being smart about heat illness starts with following prevention measures and taking prompt action when there are signs and symptoms of impairment. Some simple practices, such as drinking water, covering up and limiting exposure during the hottest time of the day help save lives.

Heat Illness Prevention

To help prevent heat illness, follow the three primary rules: water, rest and shade. Watch for signs and symptoms. If you suspect that you or someone else has heat illness:

- *Move to a shady, air-conditioned or other cool place to rest.*
- *Remove personal protective equipment or heavy clothing, socks and boots.*
- *Take a shower, bathe or sponge off with cool water.*
- *Apply a cold, wet cloth to the wrists, neck, armpits and/or groin.*
- *Drink water, juice or a sports drink with electrolytes.*

Recommended Resources

Heat-related Illnesses: Response and Prevention, WorkCare Fact Sheet

Heat Safety Tool mobile app (OSHA and NIOSH) uses the heat index as a risk indicator

National Emphasis Program – Outdoor and Indoor Heat-Related Hazards, OSHA 2022

Simplifying Heat Stress Prevention, WorkCare blog by John Longphre, M.D., M.P.H.

Check out our Summer of Safety Campaign!