

# Medical Displan Victoria: Guidelines for prevention of heat injury

by Dr Rodney Fawcett, Area Medical Coordinator, Kilo Region

**T**o maintain the body's general health and well-being it is important for the body temperature to be kept at 37°C. This maintenance of a fixed internal environment is of significance as many of the body's internal biochemical processes have critical chemical systems that perform best at this temperature. The ability of the body to gain or lose heat to maintain this constant temperature of 37°C is ultimately vital to sustaining life.

In conditions such as fighting summer bushfires the main issue is one of ensuring the body is able to

maintain a reasonable heat loss in normally hot conditions. This is achieved mainly by evaporation (sweating), while small amounts of heat can be lost by the mechanisms of radiation (direct heat transfer from a warm body to a cooler environment) and convection (movement of air over the body, as when using a fan). This latter process can also aid sweating. Once environmental temperatures exceed 37°C, the only method of body heat loss is by sweating, which can be aided by increasing airflow over the body.

Heat loss is not the only factor to consider, as the work done by the body's

own internal metabolic processes creates additional heat. At rest the body generates about 100 watts from internal heat and activity, but processes involving physical exertion, such as firefighting, can increase this heat production to at least 1000 watts, depending upon the level of exercise. The production of sweat involves the loss of body fluid and salts. Under normal circumstances at 20°C, a person at rest loses 2 litres of body water per 24 hours. This loss goes up with increasing heat or workload. At

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For an adult		
Approximate volume of water lost (litres)	Body weight lost (%)	Symptoms caused by dehydration
0	0	
		Thirst, slowing down, weariness, nausea, emotional instability.
3	5	Stumbling, headache, increase in body temperature, pulse rate and respiratory rate. Dizziness, indistinct speech, increasing weakness, mental confusion.
6	10	Delirium, swollen tongue, circulatory insufficiency, marked haemoconcentration and decreased blood volume, failing renal function.
9	15	Inability to swallow, painful urination, cracked skin, cessation of urine formation.
12	20	Limit of survivability?

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10 litres per 24 hours. But, these figures do not take into account workload.

As the body heats up, heat loss is required to keep the core temperature at 37°C. Blood vessels in the skin open up (vasodilation) so that heat can be conveyed from the core to the surface to allow for heat loss primarily by evaporation of sweat. As body water is lost through this process, symptoms of heat injury can develop if cooling is inadequate and the fluid lost is not replaced. (The table on page 23 gives an indication of symptoms as they relate to fluid loss and dehydration.)

In addition to body water loss, sweating also involves salt loss, but as the body acclimatises to heat, which takes 10–14 days, this loss is reduced and sweat becomes less salty. In unacclimatised individuals in very hot conditions, up to 25 grams of salt can be lost in a 24-hour period.

This guideline has only explained the consequences of heat stress in terms of body water and salt loss coupled with the requirement to maintain a constant core body

temperature. Heat stress affects many other, more complex body systems, but by having an understanding of the basics, heat stress may be prevented.

## The keys to heat injury prevention

- *Acclimatisation*—a reasonable level of physical fitness with an ongoing exercise program can best achieve this, especially when preparing for warmer months following the colder seasons.
- *Rest cycle*—there needs to be a reasonable work–rest cycle to reduce the impact of a build up of the body's metabolic heat produced by the work. A rest every half hour in hot conditions is considered prudent. In extreme conditions less time at 'work' would be advisable.
- *Adequate water replacement*—opportunity to replace lost body water during rest cycles is a must. Frequent drinking must be encouraged.
- *Adequate salt intake*—The normal diet needs a little more than usual added salt. Note: salt tablets are not easily absorbed and are of limited value. Electrolyte replacement fluids can be used, but after acclimatisation sweat is diluted, thus half strength is more appropriate.

- *Early symptoms of heat stress or dehydration need to be detected*—if these occur, move to a shaded area, remove clothing to cool the body down, fan the body, give fluids as tolerated (water or half strength electrolyte replacement fluids). Do not douse in cold water or ice as this causes constriction of the skin blood vessels (once skin temperature has dropped below 28.4°C) and actually increases heat retention in the body core, even though the skin feels cold and shivering may occur. Seek first aid or medical assistance as soon as possible.

## References

Ernsting & King, *Aviation Medicine*, 2nd ed., Cambridge University Press  
Pearn et al 1996, *The Science of First Aid*, 1st ed., St John Ambulance Australia.

*Dr Rodney Fawcett, MSc(Occ Med), MBBS, BMedSci, DipAvMed, FAFPHM, AFCHSE, MRACMA, is Manager of the Clinical Resource Unit, The Geelong Hospital, and a District Medical Officer for St. John Ambulance Victoria.*