

Training in Extreme Environments - The Need for Rehydration

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The capacity for exercise performance is reduced when the environmental conditions are less than optimal, but extremes of environmental temperature or barometric pressure are often encountered in situations where hard exercise has to be performed. This presentation will focus on the problems associated with dehydration and with optimisation of fluid intake to maximise exercise performance, since these are the problems most often encountered during training and competition.

The main causes of fatigue in prolonged exercise are normally depletion of the body's energy stores or by disturbances of temperature regulation and fluid balance. The importance of dehydration is clearly demonstrated by the reduced capacity to perform exercise in the heat and by the relatively high incidence of heat illness encountered during major competitions held in hot climates: athletes, however, commonly ignore the need to replace fluids lost during exercise. The need for rehydration is more often recognised by endurance athletes, but dehydration also has an adverse effect on high-intensity short-duration exercise.

Fluid ingestion during exercise and during the recovery period has the twin aims of providing a source of carbohydrate fuel to supplement the body's limited stores and of supplying water and electrolytes to replace the losses incurred by sweating. Increasing the carbohydrate content of drinks will increase the amount of fuel which can be supplied, but will tend to decrease the rate at which water can be made available; where provision of water is the first priority, the carbohydrate content of drinks will be low, thus restricting the rate at which substrate is provided. The composition of drinks to be taken will thus be influenced by the relative importance of the need to supply fuel and water; this in turn depends on the intensity and duration of the exercise task, on the ambient temperature and humidity, and on the physiological and biochemical characteristics of the individual athlete.

Carbohydrate ingested during exercise appears to be readily available as a fuel for the working muscles, at least when the exercise intensity does not exceed 70-75% of maximum oxygen uptake. Carbohydrate-containing solutions appear to be more effective in improving performance than plain water, and solutions of glucose, sucrose and glucose polymers all produce similar results.

Water and electrolytes are lost from the body in sweat; although the composition of sweat is rather variable, it is invariably hypotonic with respect to plasma. The normal result of sweat loss is thus to increase the plasma concentration of all the major electrolytes. Sweat rate is determined primarily by the metabolic rate and the environmental temperature and humidity, but varies greatly between individuals exercising under the same conditions. The sweat rate may exceed the maximum rate of gastric emptying of ingested fluids; most athletes consume far

less fluid during exercise than they are capable of assimilating, and some degree of dehydration is commonly observed. Excessive replacement of sweat loss with plain water or fluids with a low sodium content may result in hyponatraemia, but this is uncommon and athletes should be encouraged to drink in excess of the need dictated by thirst.

Rehydration after exercise is particularly important in training where exercise may have to be repeated after a rather short interval. Sodium replacement is essential for post-exercise rehydration, and this may be the major benefit of the small amounts of sodium added to commercial sports drinks. The optimum frequency, volume and composition of drinks will vary widely depending on the intensity and duration of the exercise, the environmental conditions and the physiology of the individual, and it is thus difficult to make specific recommendations that will suit all sportsmen and women. The athlete must determine by trial and error the most suitable regimen, and should experiment in training to find a rehydration fluid which is both effective and palatable. The body cannot adapt to increase its tolerance to dehydration, but rather dehydration during training will have the effect of decreasing the training load that can be sustained and thus reduce the effectiveness of the training programme.