Maximising Olympic Distance Triathlon Performance
A Sports Medicine Perspective

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Health Aspects of the Triathlon

It is well established that regular endurance exercise involving large muscle groups can produce many physical and psychological effects. Swimming, biking and running are often mentioned as examples of acquiring fitness for health [1 - 2].

Health-related physical fitness includes improvements in:

1. Cardio-respiratory endurance (linked directly to a reduced risk of cardiovascular disease).
2. Body composition (obesity is a well known risk factor).
3. Muscular strength, endurance and flexibility (eg. low back pain is often associated with fitness deficiencies and muscular imbalance in the lower back region).

In view of the relationship between health and exercise it makes sense that health-related fitness is relevant to all in today's industrialised society. The triathlon is a unique sport in that it encompasses all health related variables and therefore can be used as a prime example of health-related fitness. This is especially the case with respect to the short distance events (up to and including standard distance). In the longer distance events (½ Ironman and Ironman) the health advantages are possibly out-weighed by the stress created by prolonged exposure to environmental factors, combined with extreme fatigue.

The triathlon is an endurance activity which uses nearly all the muscles of the human body. Cardio-respiratory endurance is developed as well as strength and endurance in all muscle groups. Apart from the health-related quality of the triathlon, it is also fun and an achievable activity for many as most people can swim, bike and run. There are no complicated skill involved, as is the case in many team sports.

Just to finish a triathlon gives tremendous satisfaction and therefore also contributes to psychological development and self confidence.

Prevention

The individual triathlete will be more interested in preventing illness and injury than treating existing symptoms. The threat of over-training and injury is one of the limiting factors on how hard the triathlete can train. Months of careful preparation can be severely disrupted by injury or illness.

Training for triathlons means exposure to stress, both physical and mental, and it is likely most triathletes will have their training interrupted at least once a year through illness or injuries. Serious triathletes know that the harder they work, the fitter they become. At the same time, they are more likely to encounter ailments that destroy their fitness. The key for them is to find the right balance.

Educating triathletes about the value of closely monitoring signals from the body can greatly assist in preventing problems. Overwork - too much, too fast, too soon - is still the main cause of

problems and injuries related to training [3 - 4].

Taking a detailed and specific sports history can give us an insight into the athlete's training habits, short and long - term goals and the equipment used. This information will form the basis on which to advise athletes when treating injuries or when dealing with potential problems.

Injuries

It has already been mentioned that many injuries are caused by errors in training. High mileage and intensity without allowing for a suitable recovery, and a sudden increase in training volume are the main culprits. Other causes are errors in technique, inflexibility of muscles, unyielding running surfaces and structural abnormalities (table I).

Surveys of triathletes show that the majority of their injuries are running related [5]. This is no surprise given the considerable stress on legs caused by pounding on the road, and most injuries, therefore, affect the lower extremities, especially the knee, lower leg and foot.

Common running related injuries are iliotibial band syndrome, stress fractures, compartment syndrome, tibial periostitis, Achilles tendinitis and plantar fasciitis [6].

In the treatment of those injuries, attention needs to be paid to the causes of the injuries listed in table I. Many minor injuries can be helped by proper footwear, possibly including orthotics, and by paying attention to technique. For established injuries, anti - inflammatory medication, physiotherapy, acupuncture and, as a last resort, cortisone injections, might be required. Stress fractures are one of the few injuries which require complete rest from running (for approximately six to eight weeks). Often, however, triathletes will still be able to swim and bike in this period.

Table I. Causes of overuse injuries:

Errors in training	'Too much, too fast, too soon' is a frequent cause of injury.
Errors in Technique	Toe running, for example, can lead to many lower leg ailments.
Faulty Equipment	Worn shoes, oversized bike etc.
Inflexibility of muscles	The main cause of 'swimmers shoulder' (supraspinatus endinitis). Muscle inflexibility also plays a major role in many running injuries.
Running Surfaces	Concrete and asphalt are hard on the legs.
Structural abnormalities	Pees planus (flat feet), pes cavus (high arched feet), rear foot valgum and varus, genu valgum (bow legs) and genu valgus (knock knees) can all contribute to running and cycling injuries.

Common cycling - related injuries, except for those sustained in crashes, are located in the knee, lower back and neck [7]. Chronic sprains and strains of the ligaments supporting the knees, together with patellofemoral dysfunction, are often caused by pushing too hard in high gears, excessive hill climbing, or a faulty placement of the feet on the pedals.

Back pain is a frequently encountered complaint in triathletes and cyclists. Most cases can be helped by adjusting body position on the bike, either by changing the seat position or the handle bar reach. If those measures fail or if there are neurological symptoms present, further investigations are necessary to exclude an underlying organic cause.

A whole new condition following the introduction of aerodynamic handlebars is the '*aeroneck*' [8]. This is neck pain and stiffness caused by sitting for long periods with the shoulders hunched, the arms tucked underneath the upper body and accompanying hyperextension of the neck. This unnatural position puts tremendous strain on the cervico-thoracic junction. Time will tell what the long term effects will be on this part of the spine. It looks at the moment as though conditioning improves the symptoms, at least in the short term. A forward seat position combined with widening of the elbow pads is still the most effective strategy for treatment and prevention.

Swimmer's shoulder (supraspinatus tendinitis) is one of the few injuries related to swimming. Swimmer's shoulder is a good example of an 'overuse' injury, where the repetitive movement is the main cause of the ailment. When the arm rotates - approximately 1500 times in a 3000m freestyle workout - the supraspinatus tendon can rub against the tip of the acromion, eventually resulting in tendinitis. There is a direct relationship between inflexibility of the shoulder and supraspinatus tendinitis [9]. The condition can be difficult to treat. Symptoms sometimes respond to an upper arm strap, icing after a work out, different stretching exercises and the avoidance of hand paddles (In more persistent cases, physiotherapy, anti - inflammatory medication, acupuncture or, as a last resort, cortisone injections can be tried.

Injuries always need to be distinguished from the normal aches and pains which are part of training. These are usually not severe enough to interfere with training. They appear early in the training session and improve as the session progresses. Alternatively, they can crop up at the end of a hard training session with quick recovery on cessation of training.

Overtraining

Overtraining, or staleness, is a combination of persistent physical and mental fatigue with a decline in training and racing performance. This is caused by too much training and/or not enough recovery. Outside stress (family, work, relationships) can also be a contributing factor, as well as not allowing enough recovery time during and following illness. The most common symptoms of overtraining which can accompany a decline in performance are loss of interest, insomnia, irritability, depression, loss of appetite and weight fluctuations, fatigue, increased muscle soreness, illness (frequent colds, sore throats, headaches, stomach ailments) and persistent increase (ten beats or more) in the resting pulse rate. It is thought that these symptoms are related to a dysfunction of the autonomic nervous system [4].

The precise mechanism involved in the development of staleness has yet to be established. One theory is that an increase in training does not allow glycogen stores to reload fully between training sessions, resulting in chronic glycogen depletion [10]. The answer to this is to increase the amount of carbohydrate in the diet. Dietary assessment of the overtrained athlete by a qualified dietitian or nutritionist is strongly recommended to check on carbohydrate intake and also to check on other possible nutritional deficiencies.

Nutritional deficiencies (eg. iron deficiency) and viral infections (eg. glandular fever) can mimic the symptoms of overtraining. The treatment for overtraining consists of decreasing the frequency, duration and intensity of training sessions for as long as it takes for the symptoms to disappear. Some athletes need to have a complete break from the sport to rekindle the desire to perform. Recently Intermittent Hypoxic Training (a method of altitude simulation) has shown promising results as a treatment for excessive fatigue and over training [11].

At present no sensitive or specific tests are available to prevent or diagnose overtraining [4].

The diagnosis is based on the medical history and clinical presentation. The best way for an athlete to monitor signs of overtraining is to monitor subjective well being [14]. In addition, it is worthwhile to record resting pulse rate and weight on a daily basis during periods of intense training. This is best done early in the morning, just after waking.

The fatigue associated with overtraining is only one of a range of symptoms and should not be confused with the tiredness which accompanies a solid build up towards a race.

Dehydration and Heat Illness

Dehydration is a well known condition associated with endurance events, especially in a hot environment. Heat illness (heat stroke, heat exhaustion, heat syndrome, hyperthermia) usually occurs in combination with dehydration. Although it is more common in long distance events it can also occur in standard distance events held in hot conditions. [12]

Thirst occurs when the body loses approximately 1% body weight. When athletes lose more than 2 to 3% of their body weight through perspiration, their performance will start to decline. When 5% of the body weight is lost, most athletes will show obvious signs of dehydration and heat illness. Dehydration levels of 7% or more are extremely dangerous.

Proper hydration before and during the event is the main means of preventing dehydration and heat illness. The risk of heat illness is significantly increased by high temperatures, high humidity, bright sunlight and lack of wind, all of which are factors on which the body's ability to lose heat depends. Excessive sweating or possibly cessation of sweating, headache, nausea and vomiting, vertigo, and goose pimples are all early symptoms of heat injury.

The early stages of heat illness can sometimes be overcome by slowing down and taking fluids frequently. Advanced symptoms include impairment of consciousness with initial confusion, disorientation, and ultimately collapse. This stage requires urgent medical attention. The diagnosis is confirmed by taking a rectal temperature.

Treatment consists of cooling the athlete (using ice packs) along with hydration through intravenous fluids. Observation of vital signs and symptoms is essential.

If heat illness is not treated properly, serious complications can occur, such as renal failure, arrhythmia, coma and death. Research has shown that in well trained and acclimatised athletes, the heat dissipating mechanism becomes more efficient and, therefore, adequate conditioning, together with acclimatisation and paying attention to hydration, form the key to prevention. Some athletes can cope better with heat than others because of differences in heat generation and heat dissipation. Glycerol loading has been used to prevent dehydration but research has shown conflicting results and significant side effects can affect any potential benefits [13].

Hyponatraemia (water intoxication)

Hyponatraemia is now considered one of the more serious problems associated with endurance exercise. It has been reported to occur in athletes after long endurance events such as ultra - marathons and the Ironman Triathlon [18]. Although it may be asymptomatic, hyponatraemia has been associated with signs and symptoms such as altered mental status, seizures and pulmonary oedema. The most likely cause of hypotranaemia is a combination of loss of salt through sweat and retention of high volumes of hypotonic fluids that have been ingested. Sweat loss can be as great as 2.8*l* per hour.

The water intoxicated athlete is well hydrated and has a normal temperature (in contrast to the athlete with heat illness). Often the symptoms do no occur until a few hours after the athlete has finished the event. The delayed onset of symptoms may be due, in part, to continued hypotonic fluid ingestion following the race and increased absorption of hypotonic fluids from the gastrointestinal tract after the athlete has stopped running.

Treatment of hyponatraemia is primarily supportive and includes infusion of normal saline. The risk can be reduced by planning a replacement scheme that includes a combination of water and glucose electrolyte solutions.

References

1. Shephared RJ, What is the optimal type of physical activity to enhance health? Br J. Sports Med 1997; 31: 277-284
2. Hellemans J. Prescribing exercise in general practice. New Zealand Medical Journal 957: 98 (790) 1985
3. Kuipers H , Training and overtraining: an introduction Med. Sc. Sp.Ex 1998; 1137-1139
4. Kuipers H, Keizer HA. Overtraining in elite athletes. Review and directions for the future. Sports Medicine 79: 6, 1988
5. Maynard M, et al. Injuries amongst competitive triathletes. The New Zealand Journal of Sports Medicine 2: March 1988
6. James SL, Bates BT. Injuries to runners. American Journal of Sportsmedicine 40: 6, 1978
7. Mellion M.B. Common Cycling Injuries, Management and Prevention. Sports Medicine 11 (1):52-70, 1991
8. Hellemans J. Personal observation, January 1988
9. Greipp IF. Swimmers shoulder: the influence of flexibility and weight training. The Physician and Sportsmedicine 92: 13 (8), 1985
10. Costill DL, et al. Effects of repeated days of intensified training on muscle glycogen and swimming performance. Medicine an Science

in Sports and Exercise 249: 20 (4). 1989
11. Kolchinskaya, A Z. Hypoxia and Load Hypoxia: Destructive and Constructive effects. Hypoxia Med Journal 3/93
12. O'Toole M, Douglas P, Laird H L, Hiller D B. Fluid and Electrolyte status in Athletes Recovering Medical Care at an Ultra distance Triathlon. Clin J Sp med 5:116-122 1995.
13. Inder W J, Swanney P M, Donald R A, Pritchett T C R, Hellemans J. The effect of Glycerol and Desmopression on Exercise Performance and Hydration in Triathletes. Med Sci Sports Ex Sept 1998
14. Noakes TD, et al. Water intoxication: a possible complication during endurance exercise. Medicine and Science in Sports and Exercise 370: 17, 1985