Review Article

Tapering for triathlon competition

IÑIGO MUJIKA

USP Araba Sport Clinic, Vitoria-Gasteiz, Basque Country
Department of Physiology, Faculty of Medicine and Odontology, University of the Basque Country, Leioa, Basque Country

ABSTRACT

Mujika I. Tapering for triathlon competition. *J. Hum. Sport Exerc.* Vol. 6, No. 2, 2011. The taper is a phase of reduced training before major competitions. Training intensity should be maintained to retain or enhance training-induced adaptations during tapering, but reductions in other training variables should allow for sufficient recovery to optimize performance. Lowering training volume by about 41-60% induces positive physiological, psychological and performances adaptations in highly trained triathletes, but performance benefits could be attained with somewhat smaller or bigger volumes. A final increase of 20-30% of the training load during the last days before a race may be beneficial. High training frequencies (>80%) seem to be necessary to avoid detraining and "loss of feel" in highly trained triathletes. The optimal duration of the taper varies widely, and tapers lasting 4 to 28 days may be ideal for individual athletes. If a temporary increase of about 20% over the normal training load is planned during the month preceding the taper, the duration of the taper should be extended. Particular attention should be given during the taper to recovery strategies, which may help to induce parasympathetic reactivation and muscle fatigue reduction. Adequate hydration, nutrition and carbohydrate loading strategies are recommended to help triathletes perform at their best. Travel, heat and altitude are environmental factors that often need to be integrated within the taper plan, and the need for multiple peaking is another issue that needs to be addressed by coaches and triathletes. **Key words:** PERFORMANCE, ELITE, TRIATHLON

Corresponding author. USP Araba Sport Clinic. Paseo de la Biosfera s/n. ES–01013 Vitoria-Gasteiz. Spain.
E-mail: +inigo.mujika@usphospitales.com
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.4100/jhse.2011.62.06

INTRODUCTION

The most important goal for coaches and triathletes is to increase the competitive abilities of the athletes to maximal levels, and to design a well controlled training program to ensure that peak performance is attained at each point of a major triathlon competition. In triathlon, top performances are often associated with a taper, which is a marked reduction in the training load for a few days before the competition. The taper has been defined as “a progressive, nonlinear reduction of the training load during a variable period of time that is intended to reduce physiological and psychological stress of daily training and optimize sport performance” (Mujika & Padilla, 2003). The taper is thus of great importance to a triathlete’s performance and the outcome of the event.

MANAGING THE TRAINING LOAD DURING THE TAPER

The training load or training stimulus in triathlon is a combination of training intensity, volume and frequency (Wenger & Bell, 1986). This training load is markedly reduced during the taper to decreased accumulated fatigue, but reduced training should not be detrimental to training-induced adaptations. Triathletes and their coaches must determine the extent to which the training load can be reduced at the expense of the training components while retaining or improving adaptations. A meta-analysis conducted by Bosquet et al. (2007) established the scientific bases for successfully reducing training loads to achieve peak performances in competition. Most of the studies analyzed were conducted in swimming, cycling or running, but they are relevant for triathlon. Bosquet et al. assessed the effects of altering components of the taper on performance.

Intensity: The results indicated that the training load should not be reduced at the expense of training intensity during a taper.

Volume: Performance improvement during the taper was highly sensitive to the reduction in training volume. It was determined that maximal performance gains are obtained with a total reduction in training volume of 41–60% compared to pre-taper training

Frequency: Decreasing the number of weekly training sessions was not shown to improve performance. However, a decrease in training frequency interacts with other training variables, particularly training volume, making it difficult to isolate the precise effect of a reduction in training frequency on performance.

Pattern of the taper: Of the four taper patterns that have been described (linear, exponential with slow or fast decay of the training load, and step taper), Bosquet et al. (2007) could only address the effect of progressive versus step tapers on performance, the former being in general more effective than the latter. Recommendations based on the work of Banister et al. (1999) with triathletes suggest that a fast decay implying a lower training volume is more beneficial to cycling and running performance than a slow decay of the training load. Increasing the training load by 20 to 30% during the final three days of the taper my optimize performance (Thomas et al., 2009).

Duration of the taper: A taper duration of 8 to 14 days seems to represent the borderline between the positive influence of fatigue disappearance and the negative influence of detraining on performance, but performance improvements can also be expected after tapers lasting 1 to 4 weeks. There is great interindividual variability in the optimal taper duration (Mujika et al., 1996; Thomas & Busso, 2005). Mathematical modeling simulations suggest that training performed immediately before the taper influences its optimal duration (Thomas et al., 2008).

Specific taper for swimming, cycling and running: Training intensity should be maintained whatever the mode of locomotion. A 41–60% decrease in training volume is optimal in swimming, but the optimal decrease ranges between 21 and 60% in cycling and running. A 8–14 d taper seems optimal in cycling and running, but longer taper durations are suitable in swimming. Cyclists seem to respond particularly well to step tapers in which training frequency is reduced (Bosquet et al., 2007).

Training load before the taper: The optimal duration of the taper for a given athlete varies with training done before the taper. Greater training volume and/or intensity before the taper may increase performance gains, but would require a longer taper (Thomas and Busso, 2005; Coutts et al., 2007).

ENHANCING RECOVERY DURING THE TAPER

Achieving an appropriate balance between training stress and recovery is important to maximize performance in triathlon. The cumulative effects of training-induced fatigue must be reduced during the weeks immediately preceding competition, and a wide range of recovery modalities can be used as integral part of the taper to help optimize performance.

Reducing muscular fatigue: Delayed-onset muscle soreness (DOMS) may be detrimental to an ongoing training program for several days (Cheung et al., 2003). Modalities that enhance the rate of recovery from DOMS and exercise-induced muscle damage may enhance the beneficial effects of the taper for triathletes.

Massage: Massage therapy after eccentric exercise that resulted in DOMS is a commonly used recovery treatment, but few investigations have examined the effect of massage on sports performance. There is also a wide range of massage techniques utilized and outcome measures examined. However, there is some evidence to suggest that massage after eccentric exercise may reduce muscle soreness (Weerapong et al., 2005).

Compression garments: The use of clothing with specific compressive qualities is becoming increasingly widespread, especially as competition approaches. The use of lower limb compression for athletes derives from research in clinical settings showing positive effects of compression following trauma or some chronic diseases, and performance and recovery after exercise-induced damage may also improve in athletes (Ali et al., 2007; Bringard et al., 2006; Kraemer et al., 2001; Trenell et al., 2006).

Recovery of the autonomic nervous system: Triathletes usually endure very severe training loads, inducing both adaptive effects and stress reactions. The high frequency of the stimuli imposed makes these adaptive effects cumulative. Unfortunately, incomplete recovery from frequent training can make the stress-related side-effects cumulative as well. One key aspect of the stress response is the decrease of the activity of the autonomic nervous system (ANS), which regulates the basic visceral processes needed to maintain normal bodily functions. The reduction of the ANS activity during intensive training correlates with performance losses, and a rebound in ANS activity during tapering parallels performance gains (Garet et al., 2004). The most important factor determining the ANS reactivation seems to be sleep duration and quality. Maximizing sleep in a dark, calm, relaxing and fresh atmosphere is essential during the week preceding the race for optimal performance (Halson, 2008).

MANAGING NUTRITION AND HYDRATION DURING THE TAPER

Maintaining a good nutritional and hydration status is critical for successful triathlon competition. Starting a race with a poor hydration status or low glycogen stores jeopardize performance. Triathletes must adopt nutrition and hydration strategies before competition to maximize the benefits of the taper.

Hydration status: Environmental heat stress can challenge the limits of a triathlete's cardiovascular and temperature regulation systems, body fluid balance, and performance. Evaporative sweating is the principal means of heat loss in warm-hot environments where sweat losses frequently exceed fluid intakes. Dehydration augments hyperthermia and plasma volume reductions, which combine to accentuate cardiovascular strain and reduce $\dot{V}O_{2max}$ (Cheuvront et al., 2010). Maintaining adequate hydration during the taper and especially during the 48 h preceding a triathlon competition is key to ensure that work capacity is not diminished at the beginning of the race (Casa et al., 2010). Urine color is an inexpensive and reliable indicator of hydration status (Armstrong et al., 1994), and it may provide a valid means for triathletes to self-assess hydration level, notably during the taper period.

Glycogen resynthesis/supercompensation: Reductions in the training-load during the taper in favor of rest and recovery lower a triathlete's daily energy expenditure, potentially impacting on their energy balance and body composition. Triathletes should therefore pay special attention to their energy intake during the taper to avoid energy imbalance and undesirable changes in body composition (Almeras et al., 1997; Mujika et al., 2010). Not only energy intake should match energy expenditure; carbohydrate-loading during the taper should be emphasized to optimize muscle glycogen storage (Wilson and Wilson, 2008).

ADDITIONAL CONSIDERATIONS

A taper intends to minimize a triathlete's habitual stressors, allowing physiological systems to undergo "supercompensation''. Environmental factors may represent an additional source of stress for a triathlete, and they must be considered in a systematic way when tapering is prescribed (Pyne et al., 2009).

The stress of travel

International travel is an essential part of the life of elite triathletes, both for competition and training. Long-distance travel is associated with transient negative effects known as 'travel fatigue'. Travel fatigue lasts for only a day or so, but for those who fly across several time zones, there are also the longer-lasting difficulties associated with 'jet lag'. The problems of jet lag can last for over a week if the flight crosses 10 time zones or more and they can reduce performance (Waterhouse et al., 2007). The time-scale for adjustment of the body clock can be incorporated into the taper when competition requires travel across multiple meridians.

Heat acclimatization

Most triathlon competitions take place during summer and in warm environmental conditions, and exercising in the heat can lead to serious performance decrements. Because heat acclimatization seems to be the most effective strategy to limit the deleterious effect of heat on performance, this specific aspect needs to be taken into account by triathletes to optimize the benefits of the taper. Tapering in hot conditions before competition is compatible with the 7-14 days reduction in training volume advocated when encountering heat stress (Pyne et al., 2009).

Altitude

Altitude training is used in many sports at elite level for conditioning purposes. Athletes using training camps at altitude are aware that a reduction in training load is imperative at altitude, prior to an increase as the initial phase of acclimatization occurs. A period of lowered training is also observed prior to competing after altitude training, which constitutes a form of tapering. However, the extent of the benefit, as well as the variation between individuals, has not been adequately explored (Pyne et al., 2009).

Multiple peaking in triathlon

Triathletes competing in Olympic distance competitions have reduced opportunities to taper because of repeated racing during the competitive period. Peaking for major competitions every two to four weeks poses the problem of choosing between recovering from previous competition and then rebuilding fitness, or maintaining intensive training and capitalizing on adaptations acquired during the previous training cycle. Both approaches can be valid, depending on a triathlete's level of fatigue after a race or series of races and the time frame between triathlons.

REFERENCES

1. Ali A, Caine MP, Snow BG (2007) Graduated compression stockings: physiological and perceptual responses during and after exercise. J Sports Sci 25: 413-419
2. Almeras N, Lemieux S, Bouchard C, Tremblay A (1997) Fat gain in female swimmers. Physiol Behav 61: 811-817
3. Armstrong LE, Maresh CM, Castellani JW, Bergeron MF, Kenefick RW, LaGasse KE, Riebe D (1994) Urinary indices of hydration status. Int J Sport Nutr 4: 265-279
4. Banister EW, Carter JB, Zarkadas PC (1999) Training theory and taper: validation in triathlon athletes. Eur J Appl Physiol Occup Physiol 79: 182-191
5. Bosquet L, Montpetit J, Arvisais D, Mujika I (2007) Effects of tapering on performance: a meta-analysis. Med Sci Sports Exerc 39: 1358-1365
6. Bringard A, Perrey S, Belluye N (2006) Aerobic energy cost and sensation responses during submaximal running exercise--positive effects of wearing compression tights. Int J Sports Med 27: 373-378
7. Casa DJ, Stearns RL, Lopez RM, Ganio MS, McDermott BP, Walker Yeargin S, Yamamoto LM, Mazerolle SM, Roti MW, Armstrong LE, Maresh CM (2010) Influence of hydration on physiological function and performance during trail running in the heat. J Athl Train 45: 147-156
8. Cheung K, Hume P, Maxwell L (2003) Delayed onset muscle soreness : treatment strategies and performance factors. Sports Med 33: 145-164

9. Cheuvront SN, Kenefick RW, Montain SJ, Sawka MN (2010) Mechanisms of aerobic performance impairment with heat stress and dehydration. J Appl Physiol 109: 1989-1995
10. Coutts AJ, Slattery KM, Wallace LK (2007) Practical tests for monitoring performance, fatigue and recovery in triathletes. J Sci Med Sport 10: 372-381
11. Garet M, Tournaire N, Roche F, Laurent R, Lacour JR, Barthelemy JC, Pichot V (2004) Individual Interdependence between nocturnal ANS activity and performance in swimmers. Med Sci Sports Exerc 36: 2112-2118
12. Halson S (2008) Nutrition, sleep and recovery. Eur J Sport Sci 8: 199-126
13. Kraemer WJ, Bush JA, Wickham RB, Denegar CR, Gomez AL, Gotshalk LA, Duncan ND, Volek JS, Putukian M, Sebastianelli WJ (2001) Influence of compression therapy on symptoms following soft tissue injury from maximal eccentric exercise. J Orthop Sports Phys Ther 31: 282-290
14. Mujika I, Busso T, Lacoste L, Barale F, Geyssant A, Chatard JC (1996) Modeled responses to training and taper in competitive swimmers. Med Sci Sports Exerc 28: 251-258
15. Mujika I, Chaouachi A, Chamari K (2010) Precompetition taper and nutritional strategies: special reference to training during Ramadan intermittent fast. Br J Sports Med 44: 495-501
16. Mujika I, Padilla S (2003) Scientific bases for precompetition tapering strategies. Med Sci Sports Exerc 35: 1182-1187
17. Pyne DB, Mujika I, Reilly T (2009) Peaking for optimal performance: Research limitations and future directions. J Sports Sci 27: 195-202
18. Thomas L, Busso T (2005) A theoretical study of taper characteristics to optimize performance. Med Sci Sports Exerc 37: 1615-1621
19. Thomas L, Mujika I, Busso T (2008) A model study of optimal training reduction during pre-event taper in elite swimmers. J Sports Sci 26: 643-652
20. Thomas L, Mujika I, Busso T (2009) Computer simulations assessing the potential performance benefit of a final increase in training during pre-event taper. J Strength Cond Res 23: 1729-1736
21. Trenell MI, Rooney KB, Sue CM, Thompson CH (2006) Compression garments and recovery from eccentric exercise: a 31P-MRS study. J Sport Sci Med 5: 106-114
22. Waterhouse J, Reilly T, Atkinson G, Edwards B (2007) Jet lag: trends and coping strategies. Lancet 369: 1117-1129
23. Weerapong P, Hume PA, Kolt GS (2005) The mechanisms of massage and effects on performance, muscle recovery and injury prevention. Sports Med 35: 235-256
24. Wenger HA, Bell GJ (1986) The interactions of intensity, frequency and duration of exercise training in altering cardiorespiratory fitness. Sports Med 3: 346-356
25. Wilson JM, Wilson GJ (2008) A practical approach to the taper. Strength Cond J 30: 10-17