

Thyroid hormones response in simulated laboratory sprint duathlon

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ABSTRACT

Alvero-Cruz JR, Ronconi M, Carrillo de Albornoz M, García-Romero JC, Rosado-Velázquez D, de Diego Acosta AM. Thyroid hormones response in simulated laboratory sprint duathlon. *J. Hum. Sport Exerc.* Vol. 6, No. 2, pp. 323-327, 2011. Increased activity of the pituitary-thyroid axis, plays a role in adaptations to exercise. The aim of this study was to assess changes in thyroid hormones (TH) in a simulated laboratory competition of sprint duathlon. Eight duathletes trained males [mean (SD), age 24.8 (6.8) years, height 174.4 (6.8) cm, body mass 67.12 (8.1) kg] participate in this study. The duathletes performed two graded maximal exercise in random order, one on cycle-ergometer and other on a treadmill, to determine their VO_{2peak}. Simulated laboratory competition was carried out during 20 min Run1, 40 min Bike and 12 min Run2 sectors. A blood sample was drawn to determine serum concentrations of TSH, T4, T3 and were analyzed by chemiluminiscence. A one-way analysis of variance (ANOVA) was used to analyze differences among sectors and Pearson correlation coefficients were calculated between TH and exercise intensity. Athletes perform a high intensity exercise reaching high mean values of aerobic power (89.6 ± 6.1 , 85.1 ± 8.7 and 87.1 ± 6.9 of %VO₂ in Run1, Bike and Run2 respectively). TSH shown differences between -30 min and Run2 ($p < 0.05$), and did not find changes in T3 and T4 during exercise ($p > 0.05$). Significant inverse correlations between T3 ($r = -0.86$) and T4 ($r = -0.86$) and percent VO₂ ($p < 0.01$) were found. The hormones of the hypothalamic-pituitary-thyroid axis show significant changes in TSH. Thus our results suggest, at least partly, an association between both T3 and T4 with intensity of competition as percent of VO₂ in athletes with normal thyroid function during intense and submaximal exercise simulating a duathlon competition. The decrease of TH in relation to exercise intensity is due to the use of peripheral tissues. In conclusion our findings suggest that thyroid function might play a role related to exercises performed to high intensity. **Key words:** DUATHLON SPRINT, THYROID HORMONES



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INTRODUCTION

Increased activity of the pituitary-thyroid axis, plays a major role in adaptations to physical exercise. Moreover, it has been demonstrated that changes in its secretor activity in response to exercise is not only closely correlated with muscular work intensity, but also influenced by thermal stress. However, few studies have been published on acute hormonal regulation during simulated competitions.

Thyroid gland secretes two separate hormones as T3 y T4 whose importance on the regulation of general metabolism, growth, and tissue differentiation as well as gene expression has been known for a long time (Edwards et al., 1994). It is also known that thyroid hormones act in fatty acid oxidation and thermoregulation. Thyrotropin-releasing hormone (TRH) secreted from hypothalamus stimulates anterior pituitary to release thyrotropin (TSH, thyroid stimulating hormone). When exercise is repeated at certain intervals, there is a pituitary-thyroid reaction that is properly coordinated by increasing turnover of thyroid hormones. When thyroxine turnover and related hormonal action is increased, this would lead to hyperthyroidism. However, there is no evidence that such a case occurs in trained athletes. For example, in trained athletes the difference between basal metabolic rate and body temperature is rarely abnormal (Gullu et al., 2004). Thus, it appears that an increase in thyroxine turnover, which occurs with physical training, may have a different mechanism.

In this study we report on the changes in serum concentration of thyroid stimulating hormone (TSH), thyroxine (T4), triiodothyronine (T3) after a simulated duathlon sprint. The aim of this study was to assess changes in thyroid hormones in a simulated laboratory competition of sprint duathlon related to load intensities.

MATERIAL AND METHODS

Eight duathletes trained males [mean (SD), age 24.8 (6.8) years, height 174.4 (6.8) cm, body mass 67.12 (8.1) kg] participate in this study, approved by Ethics Committee of Faculty of Medicine of University of Málaga. All duathletes performed two graded maximal exercise tests in random order, one on cycle-ergometer (CE) and other on a treadmill (TR), to determine their peak oxygen consumption ($\text{VO}_{2\text{peak}}$). Simulated laboratory competition was carried out during 20 min in Run1, 40 min in Bike and 12 min in Run2 sectors, derived as average time of three sprint duathlon competitions (5km run, 20-km bike, 2.5 km run), developed at individual intensities (Ronconi & Alvero, 2011). A blood sample was drawn by clean venipuncture from each subject to determine serum concentrations of thyrotrophin (TSH), thyroxine (T₄), 3-5-3' triiodothyronine (T₃) in -30 min, at start (0 min), after Run1, Bike, Run2 phases and +15min. Thyroid hormones were analyzed by chemiluminiscence assay.

Descriptive statistical analysis was performed using MedCalc software. Data is expressed as mean \pm SD and a one-way analysis of variance (ANOVA) was used to analyze differences among sectors and Pearson product-moment correlation coefficients were calculated to determine relationships between thyroid hormones and exercise intensity. Statistical significance was set at $p<0.05$.

RESULTS

Athletes perform a high intensity exercise reaching high mean values of aerobic power (89.6 ± 6.1 , 85.1 ± 8.7 and 87.1 ± 6.9 of % VO_2 in Run1, Bike and Run2 sectors respectively). TSH shown statistical differences between -30 min and Run2 ($p<0.05$), (Figure 1) and did not find changes in T₃ and T₄ during

exercise sectors ($p>0.05$). Significant inverse correlations between serum concentrations of T_3 ($r= -0.86$) and T_4 ($r= -0.86$) and percent VO_2 ($p<0.01$) were found (Figure 2).

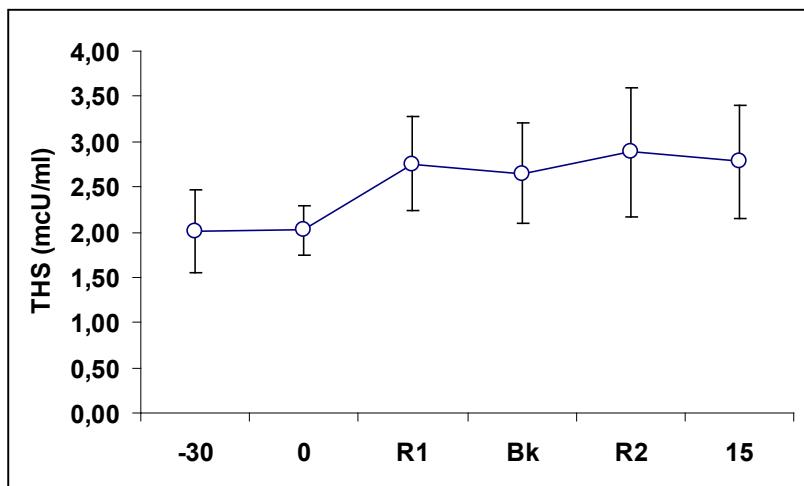


Figure 1. TSH response in simulated competition. Statistical differences between -30 min and Run2 ($p<0.05$).

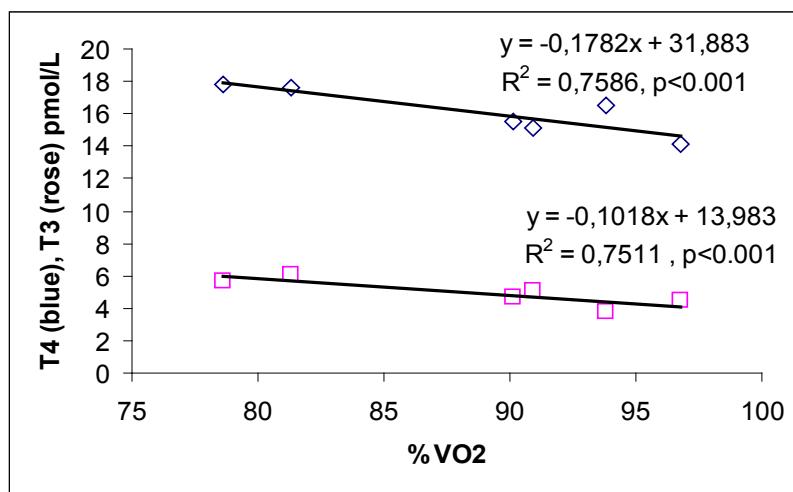


Figure 2. Correlations between T_4 and T_3 and intensity R2 different from -30 ($p<0.05$) (% VO_2) in exercise.

DISCUSSION

The biological effects of changes in thyroid hormones are not completely understood but are potentially important in the body's adjustments to stress and catabolic states (Ciloglu et al., 2005). Some studies performed on animals show that thyroid hormones regulate the transcription of several genes expressed in skeletal muscle, such as the gene coding for type I myosin heavy-chain (MHC), actin and the sarcoplasmic reticulum Ca21 ATPase pump (Pakarinen et al., 1991).

Therefore, hypothyroidism and hyperthyroidism states might respectively reduce and increase Ca+2 uptakes by the sarcoplasmic reticulum. As a result of the effects of thyroid hormones on MHC expression and Ca+2 uptake mechanisms, the shortening velocity of skeletal muscles increases with increasing thyroid levels. The increased thyroid activity might be related with a higher efficiency of mechanical work performed by exercising muscles (Miller et al., 1988).

Our findings indicate on one hand that under conditions of simulated duathlon competition performed at high intensity, the hormones of the hypothalamic-pituitary-thyroid axis show significant changes in TSH. A possible cause for the increase of TSH levels may serve to fulfil the exercise induced increase in peripheral need for thyroid hormones. Thus our results suggest, at least partly, an association between both T₃ and T₄ with intensity of competition as percent of VO₂ in athletes with normal thyroid function during intense and submaximal exercise simulating a duathlon laboratory competition. It has been reported that the slow fibers exhibit a greater sensitivity to thyroid hormones than the fast ones and the increased thyroid activity might be associated with a higher efficiency by exercising muscles (Lucia et al., 2001).

These results are in accordance with data presented by Ciloglu et al. (2005) when maximal aerobic exercise greatly affects the level of thyroid hormones.

The decrease of thyroid hormones in relation to exercise intensity is due to the use of peripheral target tissues (Carrillo de Albornoz, 2010; Koistinen, 1996). The hormones T₃ and T₄ are indeed involved in the regulation of oxygen uptake and muscular function as transcription of several genes expressed in skeletal muscle (Koistinen, 1996; Edwards et al., 1994).

Considering a physiological limit increased TSH activity due to T3 and T4 changes during exercise, might be associated with a higher efficiency of mechanical work performed during our simulation (Ciloglu, 2005), and a rise of cell metabolism and changes of internal medium of the organism serves to change the thyroid hormone levels.

CONCLUSION

In conclusion our findings suggest that thyroid function might play a role related to exercises performed to high intensity as a duathlon sprint competition.

REFERENCES

1. CARRILLO DE ALBORNOZ GIL M. TSH and free thyroid hormones changes during incremental maximal aerobic exercise. [PhD thesis]. Málaga: University of Málaga, 2010. [[Back to text](#)]
2. CILOGLU F, PEKER I, PEHLIVAN A, KARACABEY K, ILHAN N, SAYGIN O, ET AL. Exercise intensity and its effects on thyroid hormones. *Neuro Endocrinol Lett.* 2005; 26(6):830-4. [[Full Text](#)] [[Back to text](#)]
3. GULLU S, ALTUNTAS F, DINCER I, EROL C, KAMEL N. Effects of TSH-suppressive therapy on cardiac morphology and function: beneficial effects of the addition of beta-blockade on diastolic dysfunction. *Eur J Endocrinol.* 2004; 150:655-61. [[Full Text](#)] [[Back to text](#)]
4. EDWARDS JG, BAHL JJ, FLINK IL, CHENG YS, MORKIN E. Thyroid hormone influences beta myosin heavy chain (beta MHC) expression. *Biochem Biophys Res Commun.* 1994; 199:1482-1488. doi:[10.1006/bbrc.1994.1398](https://doi.org/10.1006/bbrc.1994.1398) [[Back to text](#)]
5. KOISTINEN P, MARTIKKALA V, KARPAKKA J, VUOLTEENAHO O, LEPPÄLUOTO J. The effects of moderate altitude on circulating thyroid hormones and thyrotropin in training athletes. *J Sports Med Phys Fitness.* 1996; 36:108-111. [[Abstract](#)] [[Back to text](#)]
6. LUCIA A, HOYOS J, PÉREZ M, CHICHARRO J. Thyroid hormones may influence de slow component of VO₂ in professional cyclist. *Japan J Physiol.* 2001; 51:239-242. [[Abstract](#)] [[Back to text](#)]
7. MILLER RG, BOSKA MD, MOUSSAVI RS, CARSON PJ, WEINER MW. Nuclear magnetic resonance studies of high energy phosphates and pH in human muscle fatigue. Comparison of aerobic and anaerobic exercise. *J Clin Invest.* 1988; 81:1190-1196. [[Full Text](#)] [[Back to text](#)]
8. PAKARINEN A, HAKKINEN K, ALEN M. Serum thyroid hormones, thyrotropin and thyroxin binding globulin in elite athletes during very intense strength training in of one week. *J Sports Med Phys Fitness.* 1991; 31:142-6. [[Abstract](#)] [[Back to text](#)]
9. RONCONI M, ALVERO-CRUZ JR. Heart rate and oxygen uptake responses in duathlon's sprint competition. *Apunts Med Esport.* 2011 (accepted). [[Back to text](#)]