DEPARTAMENTO DE DESPORTO INSTITUTO POLITÉCNICO DE BRAGANÇA

cidesd Centro de Investigação em Desporto, Saúde e Desenvolvimento Humano / Research Center for Sports Sciences, Health and Human Development

Mário J Costa [1,5], José A Bragada [1,5], Jean E Mejias [1,5], Daniel A Marinho [2,5], Hugo Louro [4,5], António J Silva [3,5] and Tiago M Barbosa [1,5]

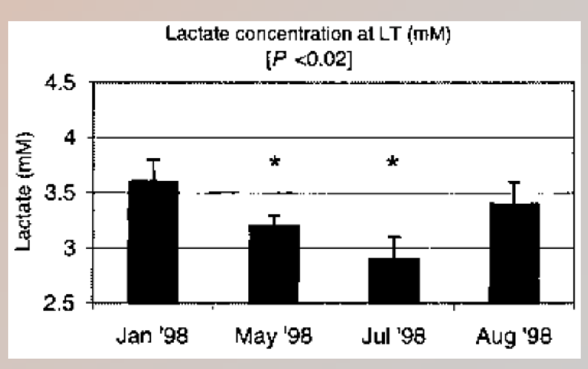
[1] Polytechnic Institute of Bragança, Bragança, Portugal
[2] University of Beira Interior, Covilhã, Portugal
[3] University of Trás-os-Montes and Alto Douro, Vila Real, Portugal
[4] School of Sport Sciences, Rio Maior, Portugal
[5] Research Centre in Sports, Health and Human Development, Vila Real, Portugal

MONITORING THE ELITE SWIMMER'S PERFORMANCE AND ENERGETICAL PROFILE THROUGHOUT A TRAINING SEASON

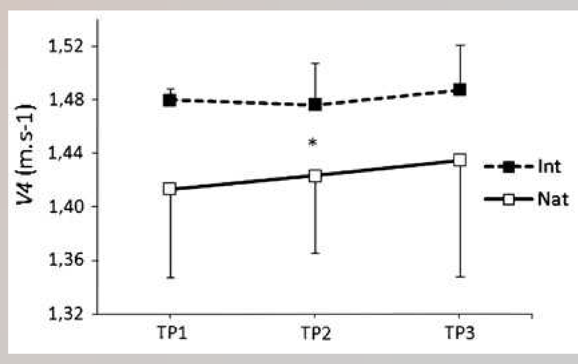
INTRODUCTION

SCIENTIFIC PROBLEM: The evaluation of seasonal performance and energetical adaptations are probably the most critical element of testing for the coach and athlete. The ability to monitor changes within a season provides fundamental information on the response of swimmers to their training periodization. Since performance depends from energetical profile, there are several factors that can provide an important feedback on training progress and in competition conditions. Adaptations to swim training are determined by the form of the training stimulus. The training volume, intensity and frequency are in constant change as the as the competitive season goes by.

EARLIER FINDINGS: Few longitudinal studies were conducted regarding the adaptations on national and/or international level swimmers throughout a conventional training periodization. Training induced slight increases in swimming speed at submaximal blood lactate concentrations over the season, whereas the performance remained unchanged during such period (Pyne et al., 2001; Costa et al., 2011).



(adapted from Pyne et al., 2001)



(adapted from Costa et al., 2011)

PURPOSE OF THE STUDY: The present study aimed to add new evidences about the variations on performance and other energetical variables deemed important throughout one training season.

HIPOTHESYS: It was hypothesized a high stability for performance and those energetical variables during such period.

METHODS

SUBJECTS: Nine elite male swimmers (21±3.30 years of age; 1.80±0.06 m of body height; 74.49±6.74 kg of body mass) volunteered to serve as subjects.

STUDY DESIGN: Swimmers completed a full training preparation (figure 1) during the 2010-2011 season. They were evaluated in three different time periods: December (TP_1); March (TP_2) and July (TP_3). At the end of each time period an incremental set of 7x200-m Front Crawl in a long course pool, was applied to collect blood samples and oxygen uptake data for further energetical analysis. Measurements were made of velocity at the 4-mmol of lactate levels (V4, $m.s^{-1}$), peak of lactate concentration (La_{peak}, $mmol.L^{-1}$), maximal oxygen consumption (VO_{2max}, $ml.kg^{-1}.min^{-1}$), total energy expenditure (E_{tot}, kJ), energy cost (C, $J.kg^{-1}.m^{-1}$) and propelling efficiency (np, %). Performance was assessed based on 200 m freestyle race times during official long course competitions.

DATA COLLECTION: The V4 was obtained by linear interpolation considering the lactate values measured immediately before and after of the 4 $mmol{\cdot}L^{-1}$ reference. The La_{peak} was the highest blood lactate concentration after exercise. The VO_{2max} was estimated using the backward extrapolation of the O_2 recovery curve (Laffite et al., 2004). The E_{tot} was calculated in the last 200 m trial based on its metabolic elements in terms of aerobic (Aer) and anaerobic (AnS) contributions:

$$E_{tot} = Aer + AnS$$

The C was calculated as the ratio between E_{tot} and the average velocity. The np was obtained according with the equation (Zamparo et al., 2005):

$$\eta_p = \left(\frac{v \cdot 0.9}{2\pi \cdot SF \cdot l} \right) \cdot \frac{2}{\pi}$$

STATISTICAL PROCEDURES: Data variation was analyzed with the Friedman test, as well as, the Wilcoxon signed-rank test . Stability was computed based on the Spearman correlation coefficient and considered to be: (i) high if r ≥ 0.60; (ii) moderate if 0.30 ≤ r < 0.60 and; (iii) low if r < 0.30 (Malina, 2001). The level of significance was determined when P ≤ 0.05.

RESULTS

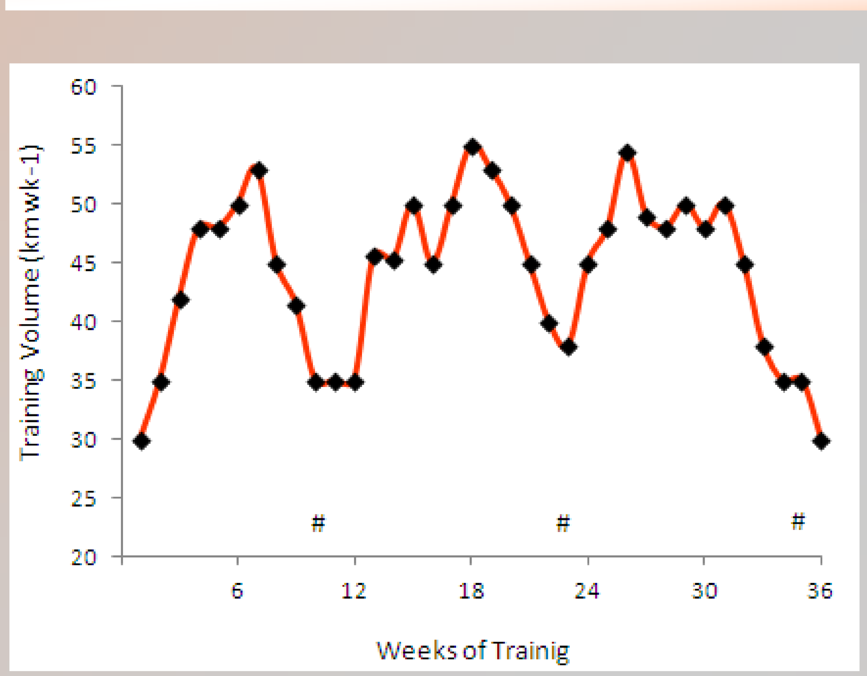


Figure 1. Total weekly volume throughout the season. # indicates testing occasions

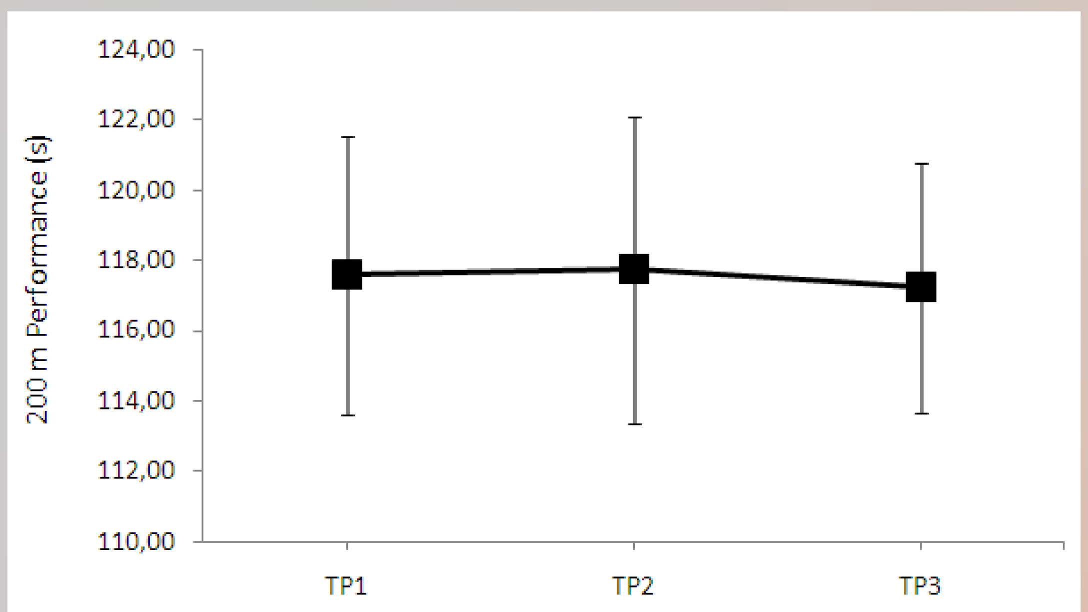


Figure 2. Variation of the 200 m freestyle performance throughout the training season.

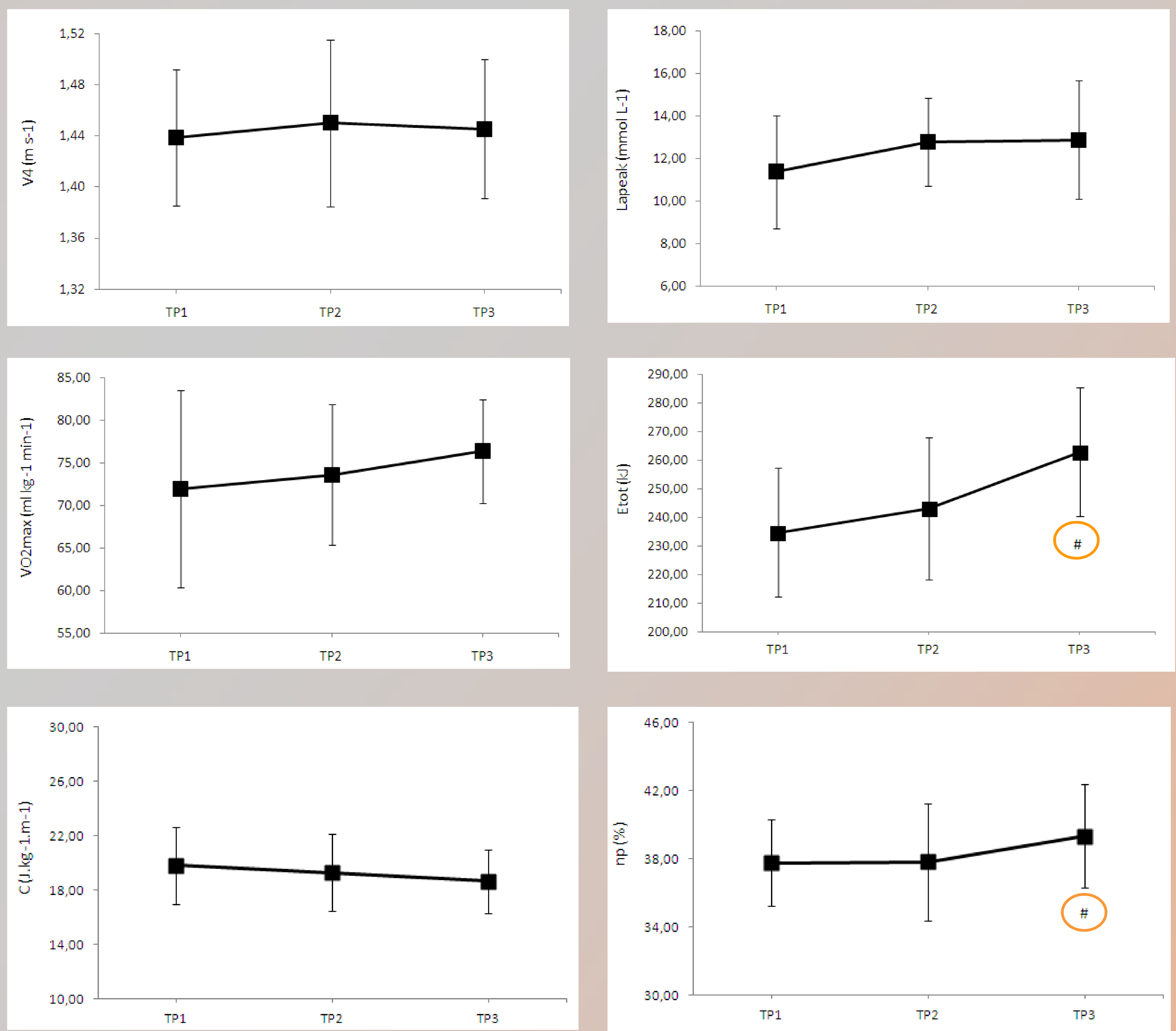


Figure 3. Variation of the energetical profile throughout the training season. # indicates significant differences.

Table 1. Spearman Correlation Coefficients of the energetic variables measured at the time periods of training.

V4	TP1	TP2	TP3	La_{peak}	TP1	TP2	TP3
TP1	1			TP1	1		
TP2	0.81**	1		TP2	0.22	1	
TP3	0.79*	0.78*	1	TP3	0.53	0.60	1
VO_{2max}	TP1	TP2	TP3	E_{tot}	TP1	TP2	TP3
TP1	1			TP1	1		
TP2	0.88**	1		TP2	0.63	1	
TP3	0.63	0.70*	1	TP3	0.67*	0.55	1
C	TP1	TP2	TP3	np	TP1	TP2	TP3
TP1	1			TP1	1		
TP2	0.87	1		TP2	0.40	1	
TP3	0.80	0.55	1	TP3	0.55	0.60	1

* P < 0.05
** P < 0.01

CONCLUSIONS

It can be concluded that, despite slight changes, elite swimmers demonstrate high stability in their performances and energetical profile throughout one single season. Further research should focus on analyzing individual trends in order to facilitate the adequate training prescription for new adaptations.

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