BOOK OF ABSTRACTS **Open Access**

External training load, performance markers and body composition of professional road cyclists with-in competitive season

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Purpose:

Throughout the competition season, exercise performance and body composition are modified depending on the specific training regime employed as to face the races schedule at the best. In professional cyclists, the time course of such changes and the techniques used to track these, related to performance parameters are seldom consistently reported with-in season. Thus, this study investigates training volume and intensity, performance indexes, body composition and bioelectrical impedance properties within a professional cycling team over the course of an entire competitive season.

Methods:

During the season (8 times in 10 months, see table 1 and table 2), bioelectrical impedance analyses (BIA), alongside weight, body circumferences and skinfold thickness measurements (7 sites), were performed on four professional road cyclists. All measurements were completed in the morning in fasting condition. Training volume and intensity as well as the Training Stress Score (TSS) were monitored during the season. Power output data were analyzed with the Training Peaks Software (Peaksware LLC, Lafayette, CO, USA) to determine the functional threshold power (FTP), peak power, maximal power output over a 10 (MMP10") and 15 sec (MMP15"), total net energy expenditure (EEwork, Kj). Concurrently, Training Stress Score (TSS) was analyzed as acute training load (ATL: 7 d rolling average of TSS) and chronic training load (CTL: 28 d rolling average of TSS).

Results:

Performance and body composition parameters are shown in Table 1 and 2. EEwork increased after the first month, thereafter remained stable, and showed an overall decrease when the full competition period started (Table 1). On average, external workload (did not significantly change over the course of the season. However, time spent at the highest training intensity increased during the full competitive season (Table 1). MMP15" and FTP improved during the preparation period reaching the highest values in competition period. Resistance, reactance and vector length slightly increased over the season, whereas sum of skinfolds showed a slight decrease (Table 2).

Discussion:

This study documents external training load, as well as changes in performance indexes and body composition of professional road cyclists over the course of an entire competitive cycling season. These data showed that intensity distribution throughout the season remains relatively stable, except for the highest power output, which follows patterns similar to EEwork. EEwork increased during the preparation period, and was sustained consistently high, culminating in concomitant improvements in key performance markers and potentially leading to beneficial alterations in body composition. The initial decreased of skinfolds sum indicates a reduction in body fat mass (Table 2), which may lead to benefit in terms of power-to-weight ratio (Jobson et al 2008). BIA highlighted the increased of resistance (Rz/h), reactance (Xc/h) and vector length. Taking together, the BIA changes indicate a decrease of body fluids, with a shift from extracellular to intracellular compartment suggesting an increase of cell size and integrity of the cell membranes (Lukaski, 2013). In conclusion, this study describes the season distribution of external workload, performance indexes and body composition in four professional road cyclists. The best performance values and the body shape were reached closer the most important races for the team. This study provides a brief insight into within-seasonal training and body composition differences in professional male road cyclists.

Table 1. External workload and performance parameters recorded over the course of a cycling season

	Nov.-Dec.	Dec.-Jan.	Jan.-Feb.	Feb.-Mar.	Mar.-Apr.	Apr.-Jun.	Jun.-Sep.	p-value
training intensity power zones % time								
<100W %	21.1±5.7	18.9±2.9	20.4±1.7	22.7±1.9	24.2±10.2	20.6±4.0	22.2±1.0	ns
300W-100W %	59.5±4.1	60.1±6.2	58.4±6.8	49.4±4.1	44.8±21.4	52.7±5.2	54.2±3.6	ns
300W-500W %	19.0±3.2	20.5±3.5	16.5±2.1	23.4±1.4	26.8±8.9	24.3±2.7	21.6±3.4	ns
>500W %	0.3±0.1	0.5±0.2	4.7±6.8	4.5±+1.7	4.2±2.7	2.5±0.6	2.0±1.0	0.004
EEwork (kJ)	16,755±1,701	69,405±6,836	69,286±3,607	64,350±5,089	74,949±8,048	50,264±17,140	51,847±9,637	0.001
Performance								
Peak Power (W)	1288.3±323.7	1562.3±496.5	1396±220.1	1381.75±200.2	1940.8±693.2	1565±364.0	1699.5±537.4	ns
MMP15" (W)	785.5±228.4	949.0±188.34	919.0±155.9	976.5±102.4	1011.3±91.2	948.5±75.7	1042.8±104.0	0.021
MMP10" (W)	861.8±267.3	1054.8±148.8	1047.8±146.4	1043.3±113.1	1093.8±69.7	1081±112.2	1110.5±142.1	ns
FTP (W)	356.3±24.1	371.8±32.5	384.5±19.7	419.0±42.0	440.5±60.8	424.0±10.7	416.75±36.7	0.026
ATL (AU)	210.8±64.8	199.5±66.1	101.3±30.8	127.8±50.1	141.8±35.1	103.3±57.5	139.0±39.0	ns
CTL (AU)	139.0±30.0	190.0±57.8	156±29.7	148.3±19.3	139.8±27.1	112.3±49.8	143.3±45.3	ns

EEwork: energy expenditure during work adjusted for different time periods

Table 2. Changes in body composition of professional road cyclist in the course of a cycling season

	BASAL	Dez.	Jan.	Feb.	Mar.	Apr.	Jun.	Sep.	p-value
Rz/h (Ω/h)	262.5±13.7	271.5±21.3	255.2±22.1	274.3±33.2	271.0±13.4	275.6±23.0	266.5±13.5	281.9±25.0	0.014
Xc/h (Ω/h)	34.0±2.1	36.40±2.2	34.4±2.8	37.4±4.1	35.4±1.4	37.4±2.7	34.9±2.7	38.2±2.2	0.052
Vector lenght (Ω/h)	264.7±13.8	274.0±21.4	257.5±22.3	276.8±33.4	273.3±13.3	278.1±23.2	269.0±13.7	284.5±25.1	0.014
Phase angle (°)	7.4±0.4	7.7±0.2	7.7±0.2	7.8±0.3	7.5±0.4	7.8±0.2	7.5±0.3	7.7±0.3	ns
Weight (kg)	69±1.8	68.4±1.4	68.7±2.2	67.6±2.3	68.3±2.2	68.1±2.7	67.7±3.0	66.7±3.3	ns
Thigh circumference (cm)	54.1±1.7	54.7±2.6	54.4±0.6	54.2±1.5	54.1±1.5	53.9±1.3	52.8±1.9	53.8±2.3	ns
Calf circumference (cm)	36.4±2.1	36.9±1.2	36.8±0.7	36.1±0.8	35.5±1.4	36.2±1.7	35.2±1.5	36.1±1.0	0.035
∑7 skinfold (mm)	47.5±7.2	42.5±6.8	45.12±12.1	41.0±7.8	39.6±8.9	40.0±6.8	37.6±8.7	35.34±6.1	0.028

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Key words:

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