

# Relationship between daily Bioimpedance patterns and training load of professional cyclists during training and racing.

Giorgi, A. ✉<sup>1</sup> Martinez, B.<sup>2</sup> Vicini, M.<sup>1</sup> Hopker, J.<sup>2</sup>

<sup>1</sup> Androni Giocattoli – Sidermec Professional Cycling Team-Medical Staff

<sup>2</sup> School of Sport and Exercise Sciences, University of Kent

✉ Contact email: [andrea giorgi4@gmail.com](mailto:andrea giorgi4@gmail.com)

## Purpose:

A high energy demand is required for training and racing in road cycling. On a daily basis, road cyclists are exposed to several stress factors that could negatively influence their performance, such as illness, injuries, overtraining, underperformance and poor wellbeing. In the last decade, monitoring of day-to-day variation in athlete physiological status and training load has become a routine practice for coaches and doctors in elite cycling. The aim of this study is determine the association between daily fluid body changes and training load responses observed from monitoring elite road cyclists across the course of a competitive season.

## Methods:

Five professional cyclists (age:  $26 \pm 6$  years; body mass:  $66.2 \pm 8.4$  kg; height:  $177 \pm 7$  cm) from Androni Giocattoli – Sidermec Professional Cycling Team (Italy) participating in two training camps and two 5-days stage races (Tour of the Alps and Vuelta a Burgos HC 2.1). Body mass (BM) and BIA measurements (BIA-101 Anniversary AKERN/RJL-Systems, Italy) were performed each morning between 7 and 9 am in a fasted condition. Bioelectrical values were associated with vector length (VL) were used to indicate changes in total body water. Power output data were collected during every training session and race stage using a power meter (BePro, Favero Electronics srl, Italy). Training load was calculated as the percentage of time spent in 4 zones: <100W, 100-300W, 300-500W, >500W (Metcalfe et al. 2016). Training Peaks Software (Peaksware LLC, Lafayette, CO, USA) was used to analyse training data and calculate Normalized power (NP).

## Results:

The distribution of training during the two training camps and Tour races are presented in table 1. Significant negative correlations were found between: VL and BM ( $r=-.856$   $p<.001$ ); VL and % time spent at 300-500W ( $r=-.335$   $p<.001$ ); BM and time spent at 100-300W ( $r=-.352$   $p<.001$ ); VL with NP ( $r=-.268$   $p<.01$ ). Positive correlations were found between: VL and %time spent below 100W ( $r=.235$   $p<.05$ ); VL and %time spent at 100-300W ( $r=.254$   $p<.01$ ); BM and %time spent at 300-500W ( $r=.383$   $p<.001$ ); BM and NP( $r=.337$   $p<.001$ ).

## Conclusion:

The main findings of this study are that body water content, reflected by either an decrease or increase of VL, changes according the preceeding effort sustained during training and racing. Thus, changes in training load of cyclists during

training camps and races are likely to have influenced the total body water (increasing and decreasing). Results



suggest that a higher proportion of time spent at lower intensities (<300W) is associated with an increase of VL, and a decrease of BM. Conversely, increases in total body water following training and racing at higher intensities (300-

**Table 1.** The proportion of total time spent in intensity zones during training and racing. a = significantly different Training Camp 1; b significantly different Training Camp 2.

	Training Camp 1	Training Camp 2	Tour of the Alps	Vuelta Burgos
<100W	16.4±3.8	14.4±2.4	14.2±3.1	20.7±3.6
100-300W	62.3±4.9	66.3±7.6	45.3±8.9 <sup>a,b</sup>	51.5±5.4 <sup>a,b</sup>
300-500W	20.2±6.5	18.9±9.0	36.8±9.3 <sup>a</sup>	24.5±4.6
>500W	1.1±0.6	0.3±0.3	3.7±2.1	3.4±1.5 <sup>a,b</sup>

500W) is associated with a decrease of VL, and increased BM. These results suggest that if a greater proportion of a cyclists training and racing time is spent at higher exercise intensities the resultant muscle oedema, haemodilution (Giorgi et al 2018), or release of water stored with muscle glycogen during substrate oxidation (Pollastri et al 2016) may lead to these increases in total body water. Often these small changes are not detected by measuring a change in BM or via urine osmolality (Shirreffs 2003). However, these changes in total body water could be determinant for the performance (Pollastri et al 2016). VL changes from bioimpedance vector analysis could be used as a method to detect these small changes of body water content and subsequently identify the physiological effects of training load on the cyclist.

#### References:

1. Giorgi A et al. Body fluid status, plasma volume change and its relationship to physical effort during a multistage professional road cycling race. *International Journal of Performance Analysis in Sport*, 2018; 18(5): 679-685.
2. Metcalfe AJ et al. The Within-Season Distribution of External Training and Racing Workload in Professional Male Road Cyclist. *Int J Sports Physiol Perform*. 2016; 5 :1-15.
3. Pollastri L, et al. Body Water Status and Short-term Maximal Power Output during a Multistage Road Bicycle Race (Giro d'Italia 2014). *Int J Sports Med*. 2016;37(4):329-33.
4. Shirreffs SM, Markers of hydration status. *European journal of clinical nutrition* 2003; 57(S2): S6.