Science & Cycling
4-5 Juli 2018, Nantes, France

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

Andrea Giorgi, MD
Androni Giocattoli – Sidermec Sports Physician

Email: andreagiorgi4@gmail.com

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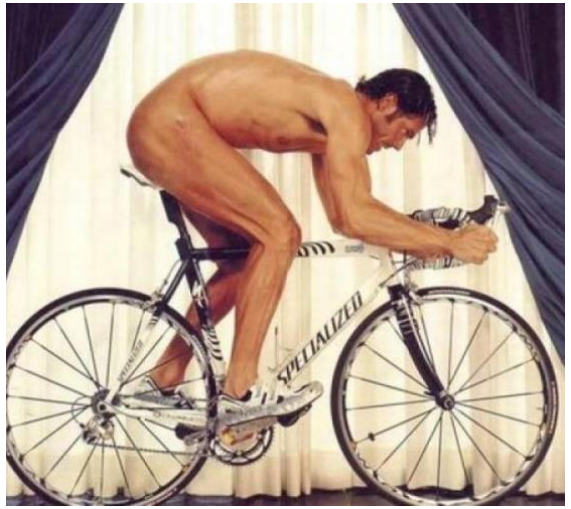
Understanding the impact body shape and body composition on performance is essential for experts working with athletes.



Elite athletes are accustomed to regular body composition assessment as a metric of both health and fitness status.

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"Body composition has been suggested to discriminate players of different skill levels and changes in body composition might actually influence performance "

Legaz, A., British journal of sports medicine 39.11 (2005): 851-856
Ackland, Timothy R., et al. "Current status of body composition assessment in sport." Sports Medicine 42.3 (2012): 227. Edwards et al. / Br J Sports Med 41 2007 385-391

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Why should it be used bioimpedance in cycling?

- ***Small portable tool and inexpensive***
- ***Reproducible***
- ***Fast test***
- ***Simple application protocols***
- ***Reliable with standardization***

Be aware:
Not all bioimpedance analyzers are the same: lack of standardization among the different BIA analyzers brands.

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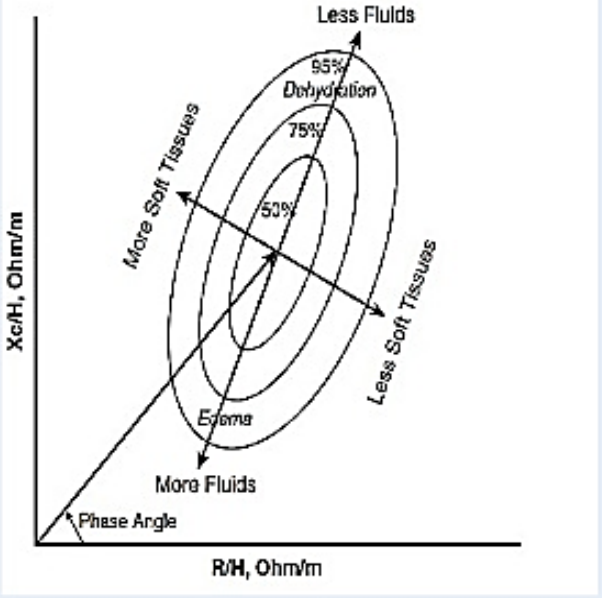
The right use of bioimpedance in sport settings: BIVA METHOD

Vector analysis

Patterns of body composition without equations/assumptions

Distance from the mean Z



BENEFITS OF BIVA:

1. ***5 times more sensitive to BC changes than conventional BIA***
2. ***Able to detect fast and acute changes of BC* without body composition limitations***
3. ***Validated to track fluid with weight loss between 1%-4%*****

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**Lukaski, H. C. European journal of clinical nutrition 67 (2013): S2-S9.*

*** Gatterer, H. et al. PloS one 9.10 (2014): e109729.*

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Vector BIA: mile stones in sports science

1994: A new method for monitoring body fluid variation by bioimpedance analysis: the RXc graph; *Piccoli et al 1994, Kidney international*

2014: Bioimpedance and impedance vector patterns as predictors of league level in male soccer players; *Levi Micheli et al 2014, Int J Sports Physiol Perform*

2014: Bioimpedance identifies body fluid loss after exercise in the heat: a pilot study with body cooling*; Gatterer et al 2014, PLoS One*

2016: Body Water Status and Short-term Maximal Power Output during a Multistage Road Bicycle Race (Giro d'Italia 2014); *Pollastri et al 2016, Int J Sports Med*

2016: Body fluid status and physical demand during the Giro d'Italia*; Pollastri et al 2016, Res Sports Med*

2017: *Power distribution, performance changes and bioelectrical impedance properties during the preparation period of professional cyclists*; Giorgi, et al. 2017**,** *Journal of Science and Cycling*

2018:Bioimpedance **Patterns and Bioelectrical Impedance Vector Analysis (BIVA) of Road** ***Cyclists; Giorgi et al 2018, J Sports Sci***

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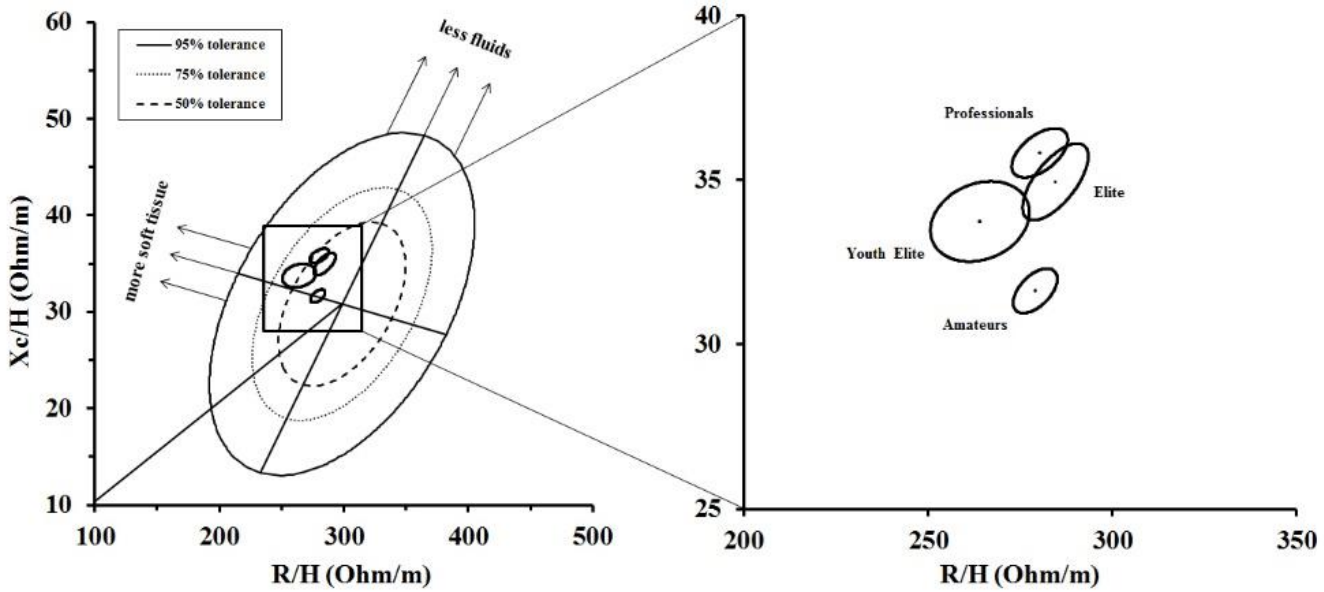
Bioimpedance patterns and bioelectrical impedance vector analysis (BIVA) of road cyclists



	all	elite	youth elite	amateurs	professionals			
	n=525	n=79	n=59	n=232	all n=155	sprinter n=28	all-rounder n=81	climber n=46
Age (yr)	30.1±11.3	21.1±2.9*#	16.8±1.1*#§	39.0±10.5*	26.3±4.7	26.1±4.1	26.5±4.3	26.2±5.6
Height (cm)	177.2±6.2	178.1±5.8	176.6±6.3	176.1±6.4*	178.6±5.9	179.4±5.5	178.8±6.0	177.9±6.3
Weight (kg)	69.7±8.3	69.2±7.5	65.4±7.2*#§	71.1±9.5 kg	69.5±6.2	73.5±4.3	71.0±5.8	64.3±4.6*#
BMI (kg/m²)	22.2±2.3	21.8±1.6#	20.9±1.7*#§	22.9±2.8*	21.8±1.6	22.9±1.3	22.2±1.3	20.3±1.2*#
PA (°)	6.9±0.9	7.0±0.7*#	7.4±1.2#	6.5±0.8*	7.4±0.8	7.8±0.9	7.4±0.8	7.0±0.8*#

Giorgi A et al. Journal of sports sciences (2018): 1-6.

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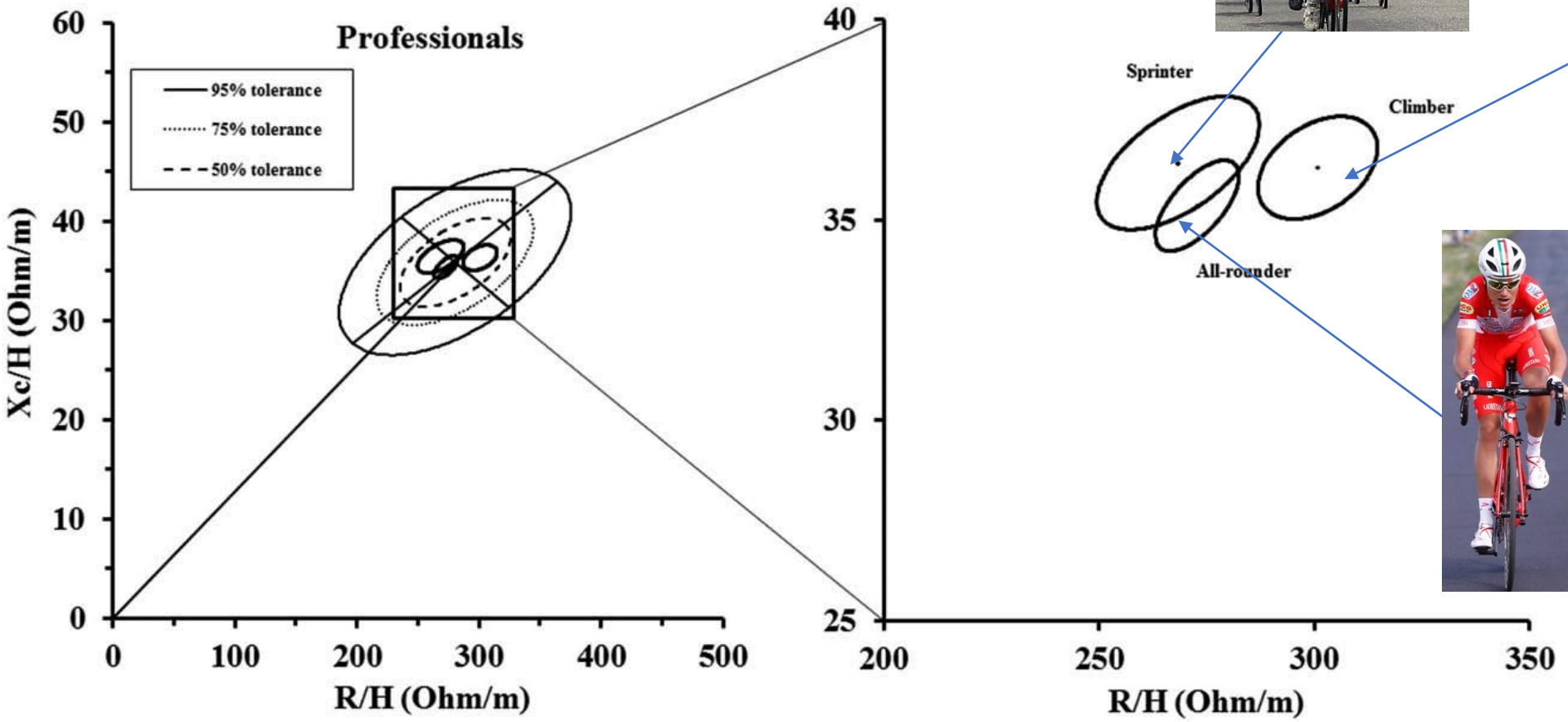
Body shape versus vector BIA



Giorgi A et al. Journal of sports sciences (2018): 1-6.

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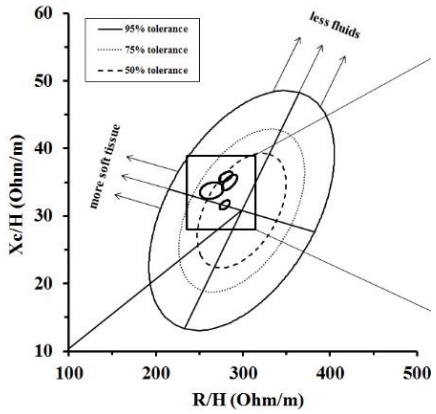
A step forward….



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4 professional road cyclists

Material and methods:

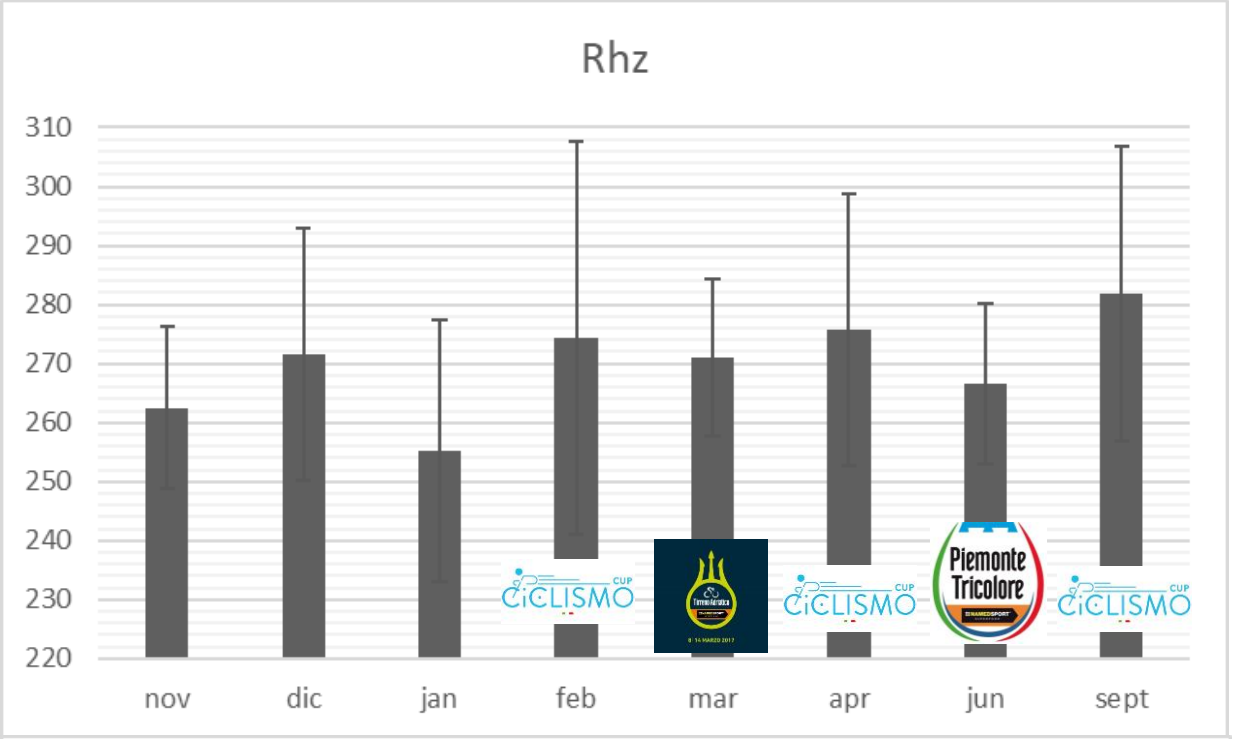
body mass, Bioimpedance Vector analysis (BIA 101 Ase AKern) and skinfold thickness measurements (7 sites, Australian Institute of Sport), lower limb circumferences, power meter (BEPRO - Favero)

Training load and Performance indexes:

- Training volume and intensity (4 zones: <100, 100-300, 300-500, >500W (Metcalfe et al, *International journal of sports physiology and performance*12.Suppl 2 (2017): S2-142)
- Training Stress Score (TSS) (Sanders et al, *International journal of sports physiology and performance* 12.5 (2017): 668-675)
- CTL (Chronic training load: TSS 28 days rolling average)
- ATL (Acute training load: TSS 7 days rolling average)
- functional threshold power (FTP)
- Maximal peak power 10 s (MMP10s)
- Maximal peak power 15s (MMP15s)
- Work (kJ)

Season assessment: The Protocol

T0	T30	T62	T84	T112	T156	T224	T318
Nov	Dec	Jan	Feb	Mar	Apr	June	Sept


Rhz
310
300
290
280
270
260
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230
220
nov
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jan
feb
mar
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jun
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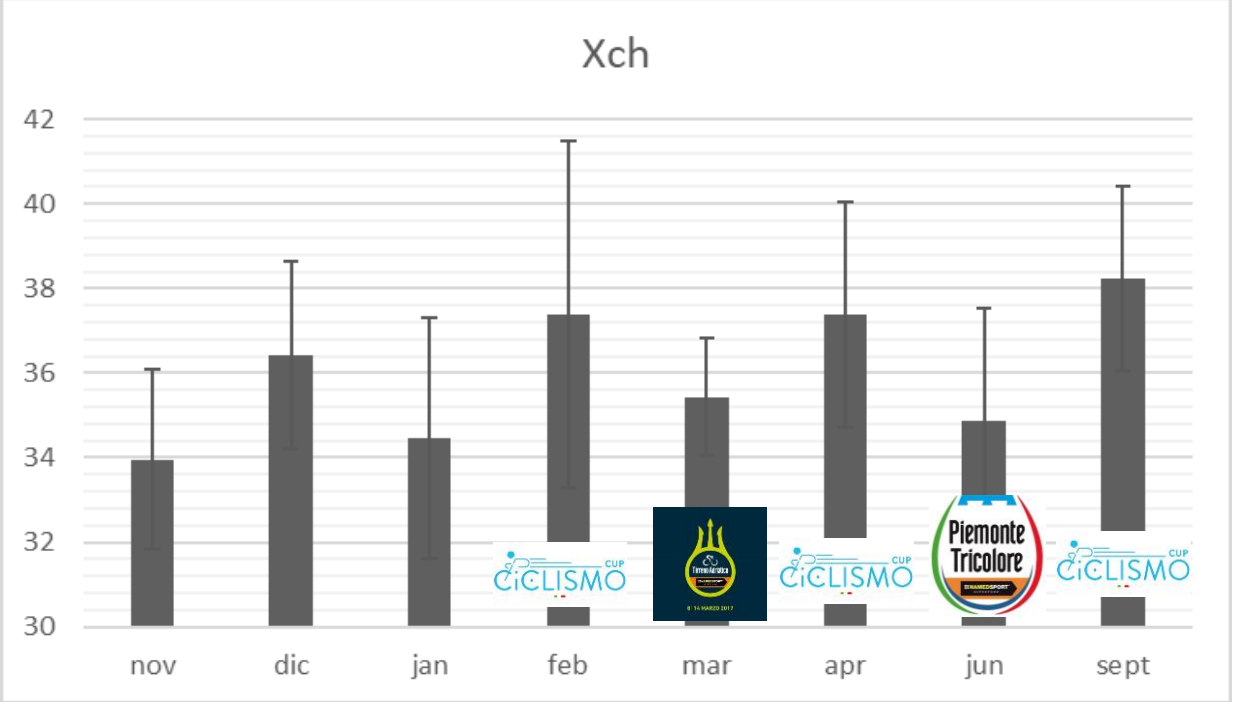
CICLISMO CUP
Piemonte Tricolore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38
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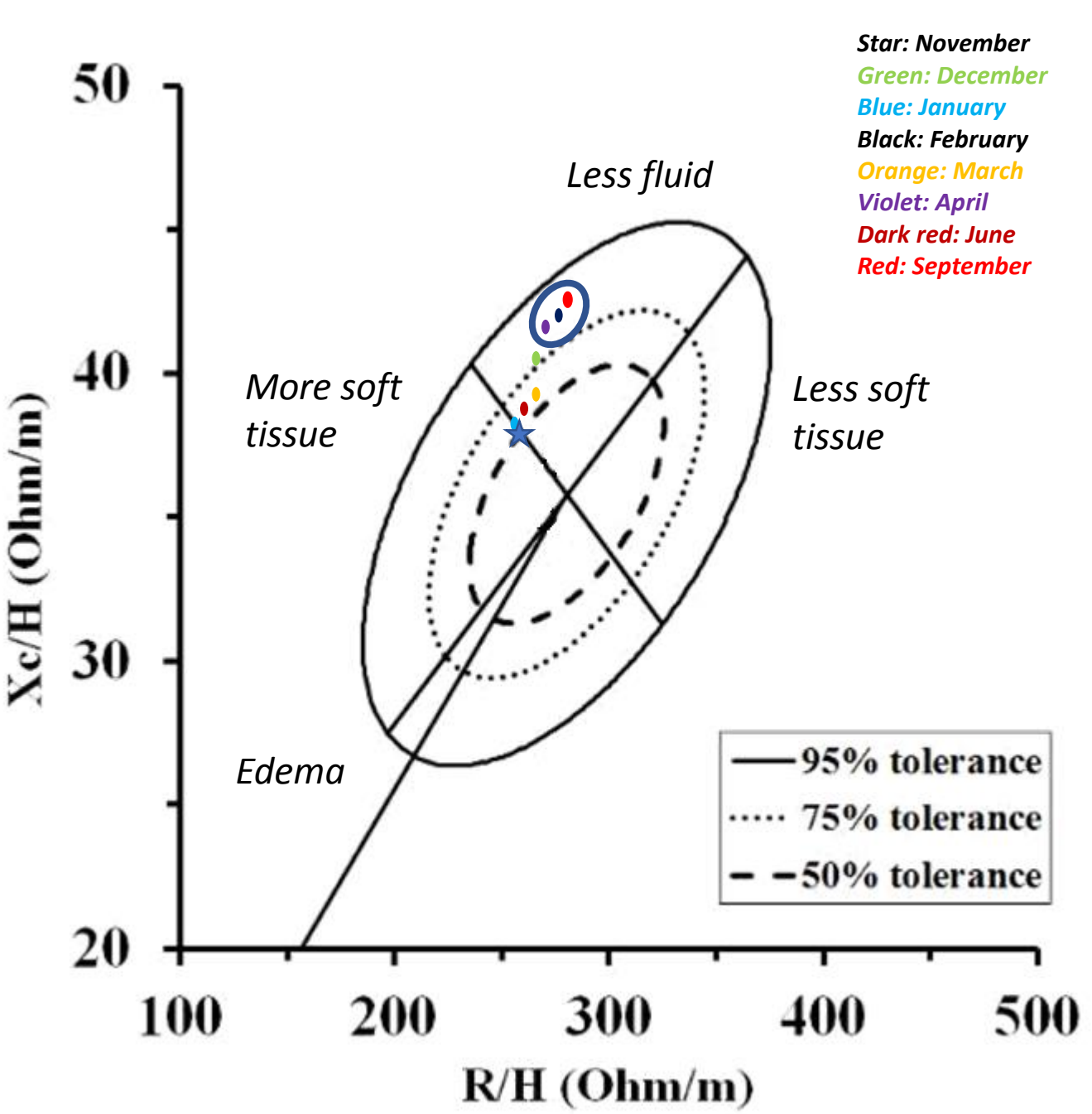
CICLISMO CUP
Piemonte Tricolore


Star: November
Green: December
Blue: January
Black: February
Orange: March
Violet: April
Dark red: June
Red: September
Less fluid
More soft tissue
Less soft tissue
Edema
95% tolerance
75% tolerance
50% tolerance
Xc/H (Ohm/m)
R/H (Ohm/m)
50
40
30
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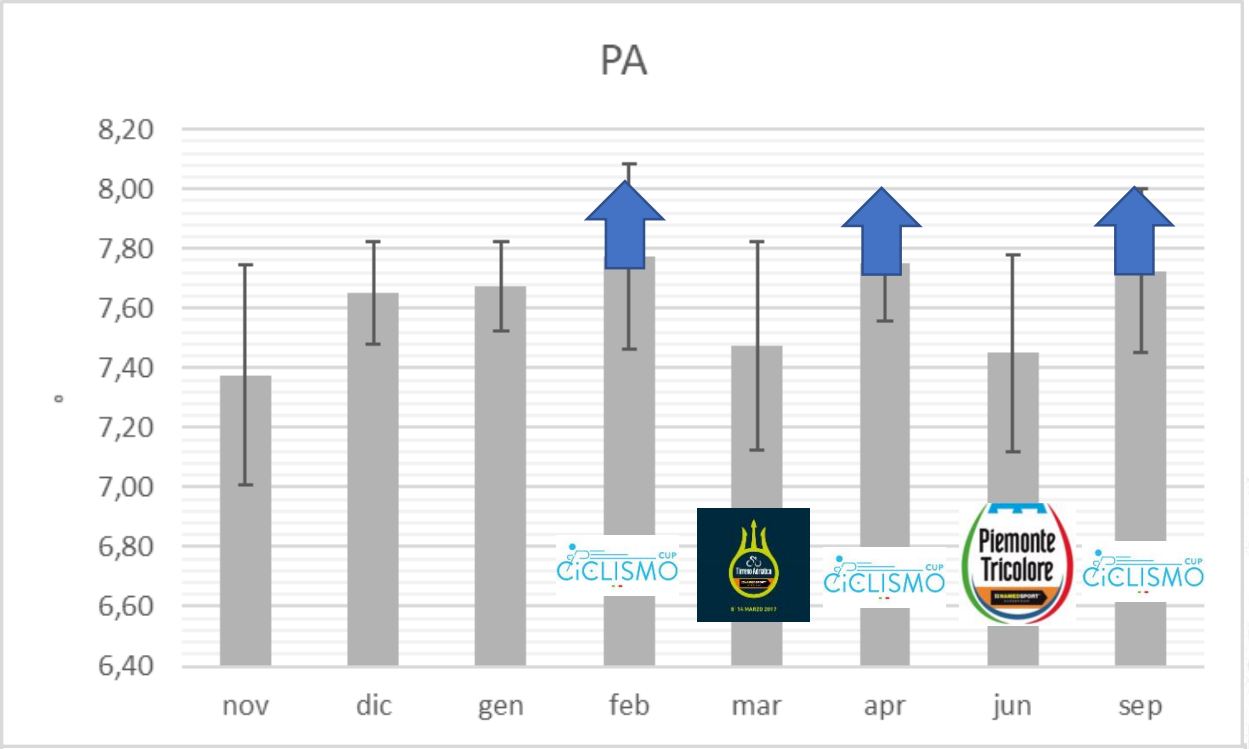
100
200
300
400
500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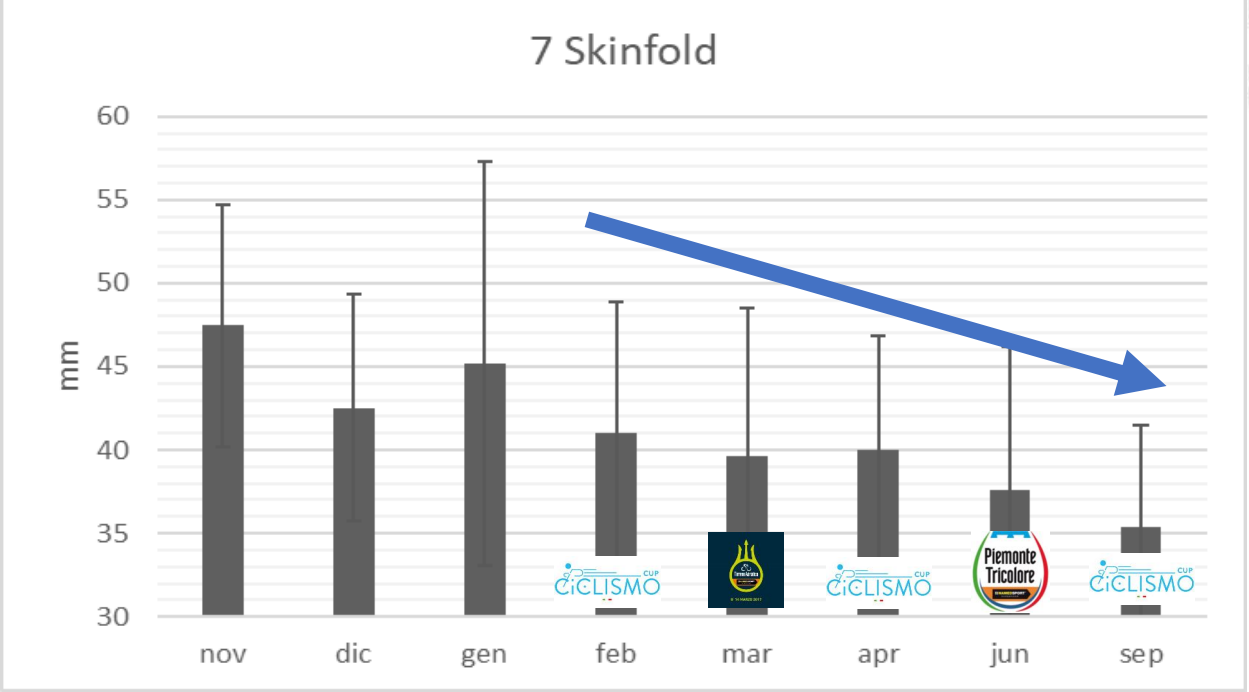
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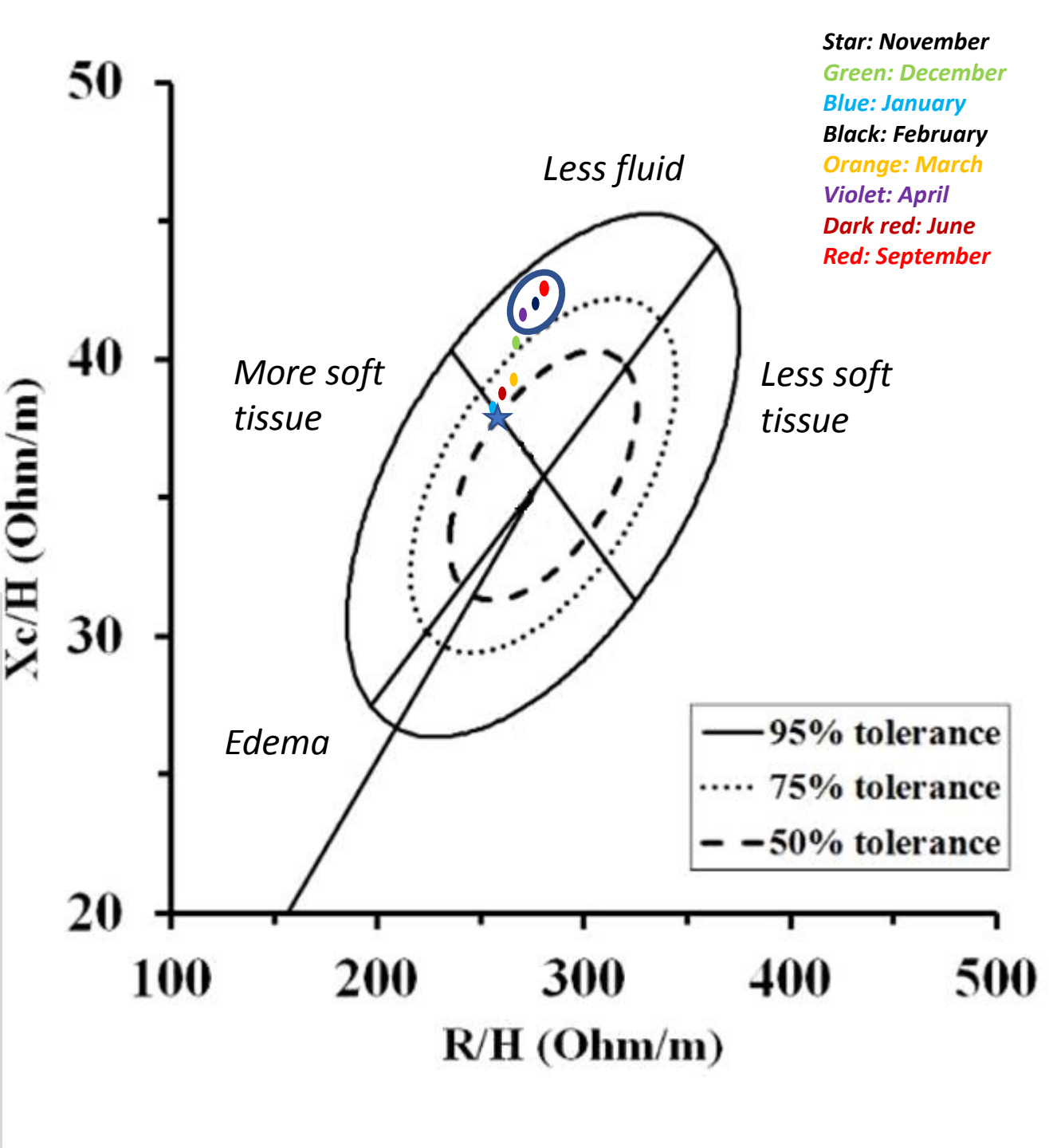
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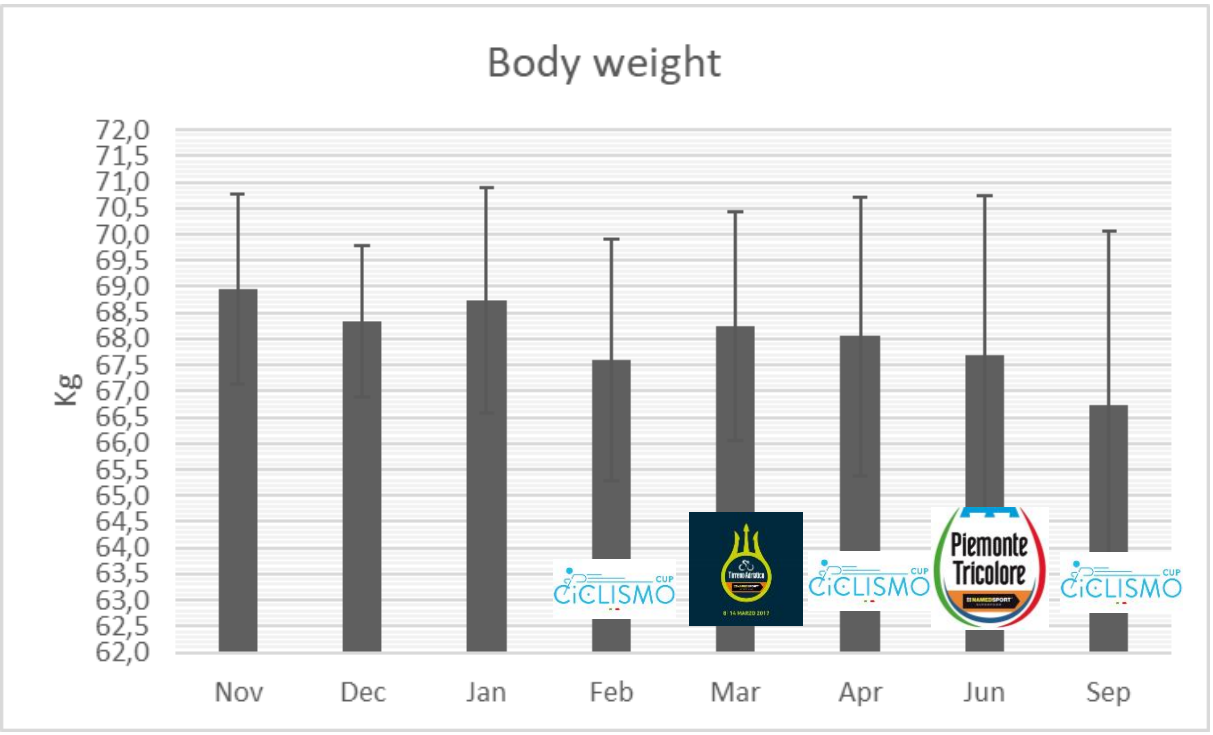
Body weight
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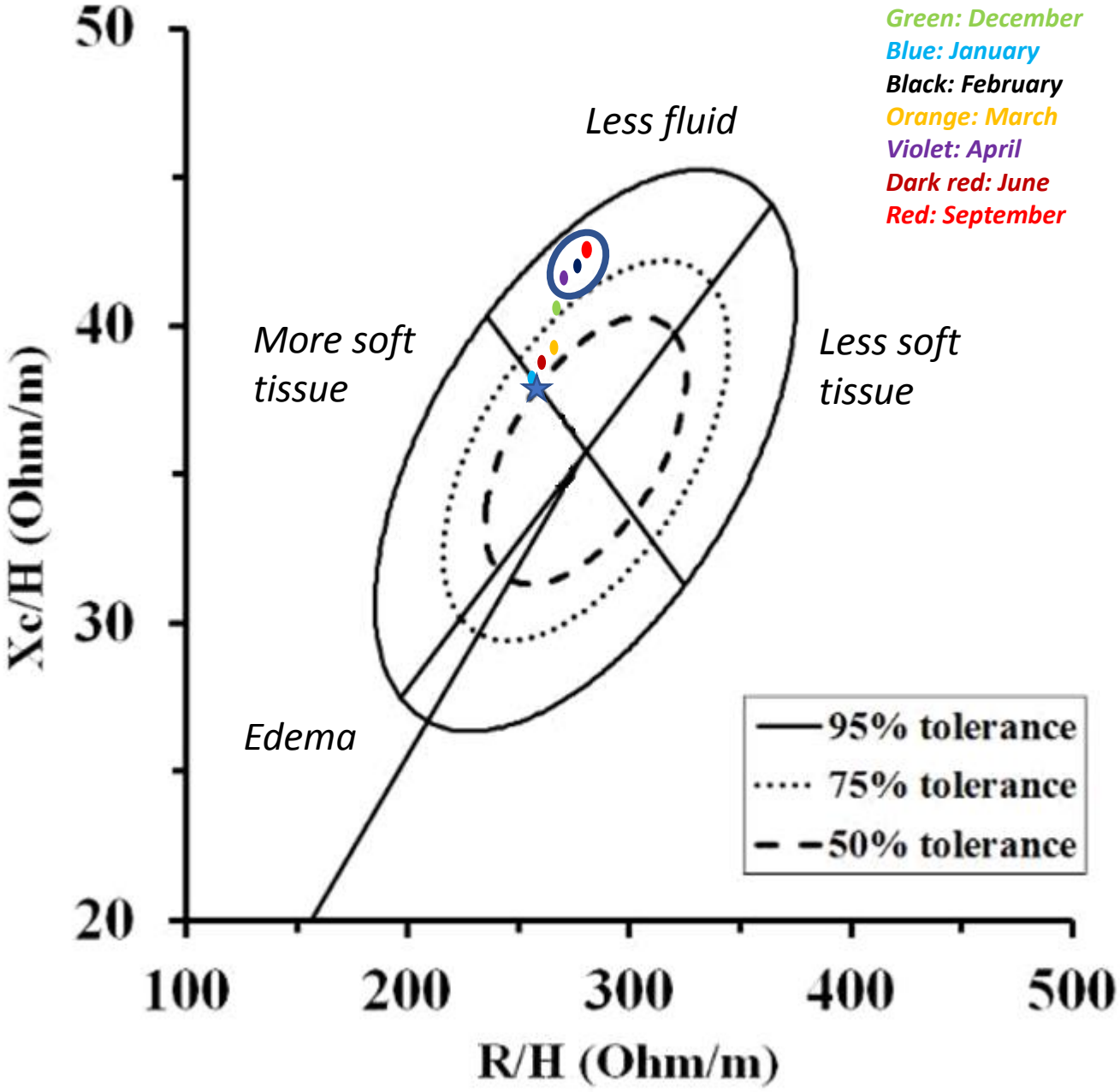
72,0
71,5
71,0
70,5
70,0
69,5
69,0
68,5
68,0
67,5
67,0
66,5
66,0
65,5
65,0
64,5
64,0
63,5
63,0
62,5
62,0
Nov
Dec
Jan
Feb
Mar
Apr
Jun
Sep
CICLISMO
Piemonte Tricolore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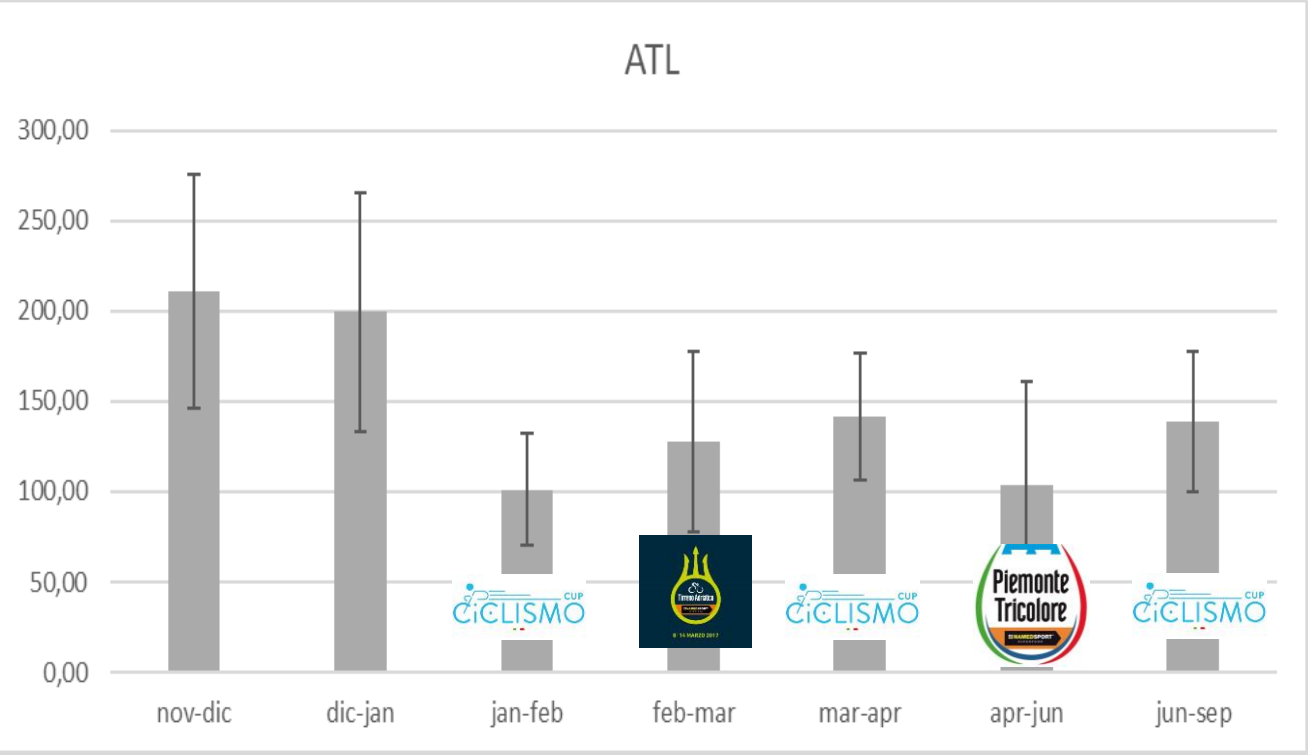
ATL
300,00
250,00
200,00
150,00
100,00
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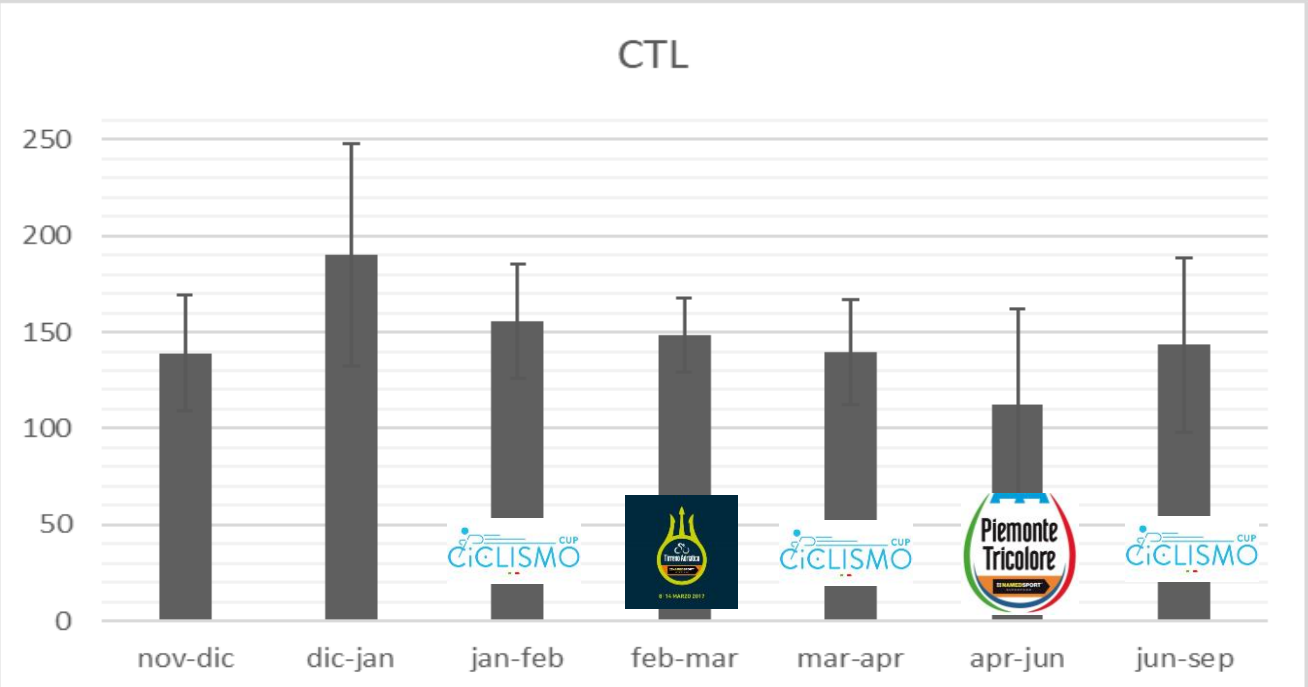
nov-dic
dic-jan
jan-feb
feb-mar
mar-apr
apr-jun
jun-sep


CTL
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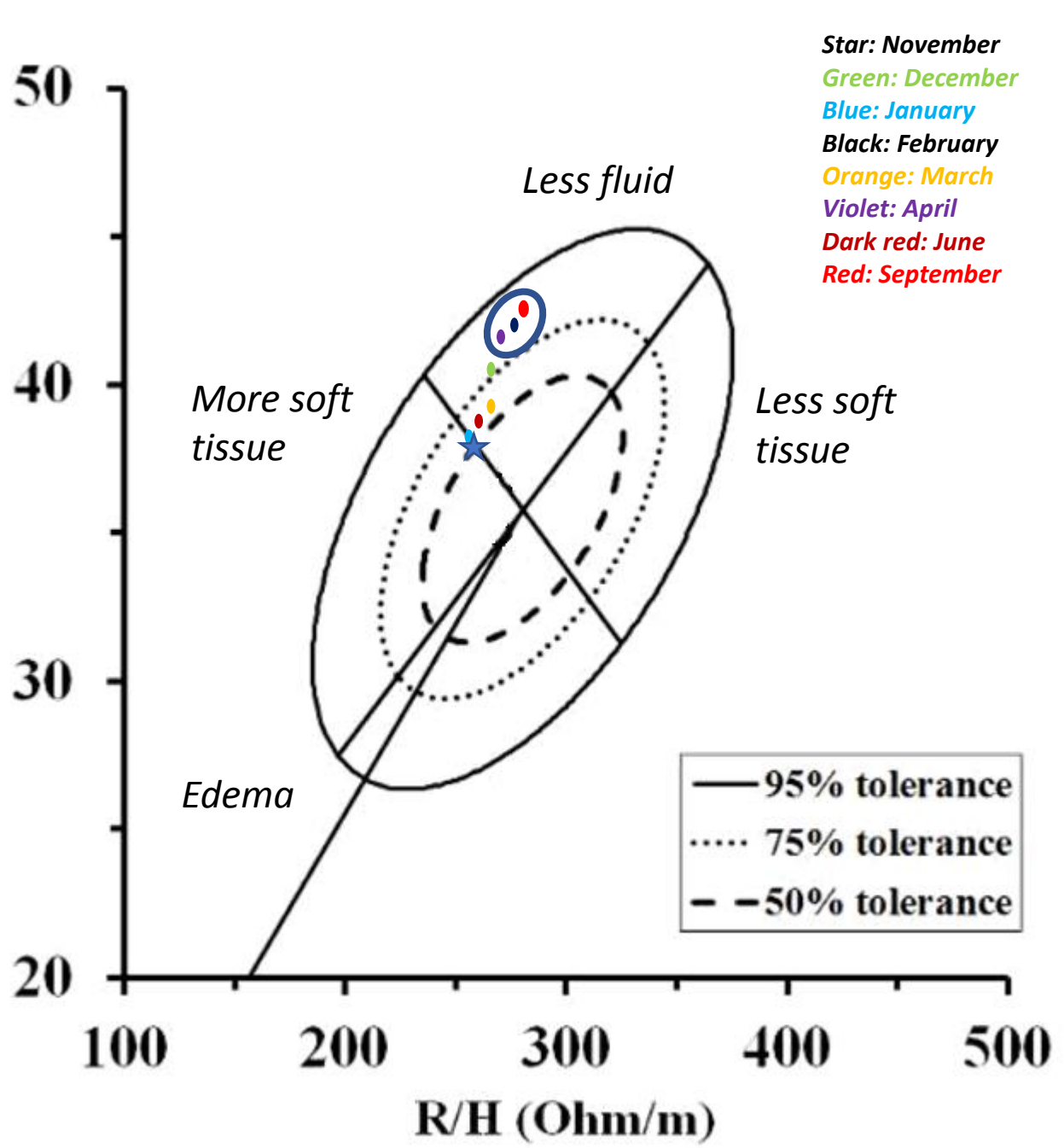
feb-mar
mar-apr
apr-jun
jun-sep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75% tolerance
50% tolerance
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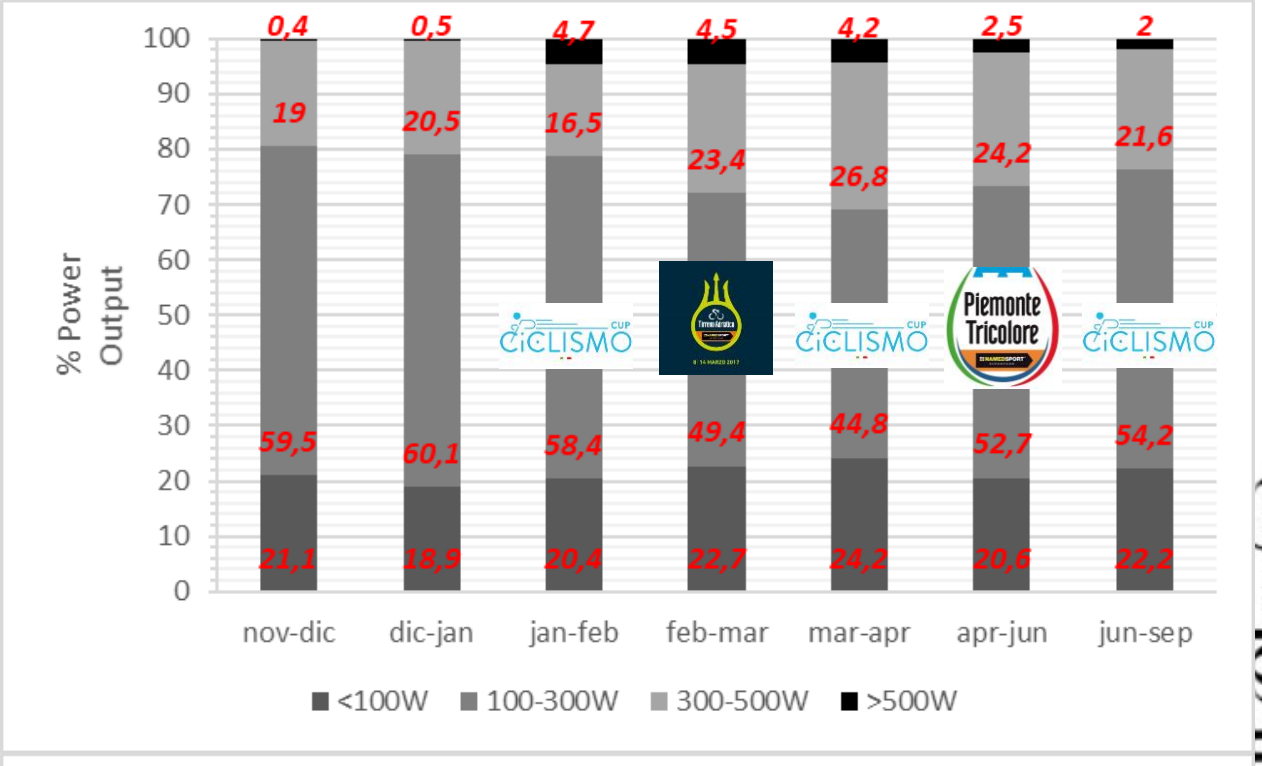
R/H (Ohm/m)


% Power Output
100
90
80
70
60
50
40
30
20
10
0
0,4
0,5
4,7
4,5
4,2
2,5
2
19
20,5
16,5
23,4
26,8
24,2
21,6
59,5
60,1
58,4
49,4
44,8
52,7
54,2
21,1
18,9
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22,7
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apr-jun
jun-sep
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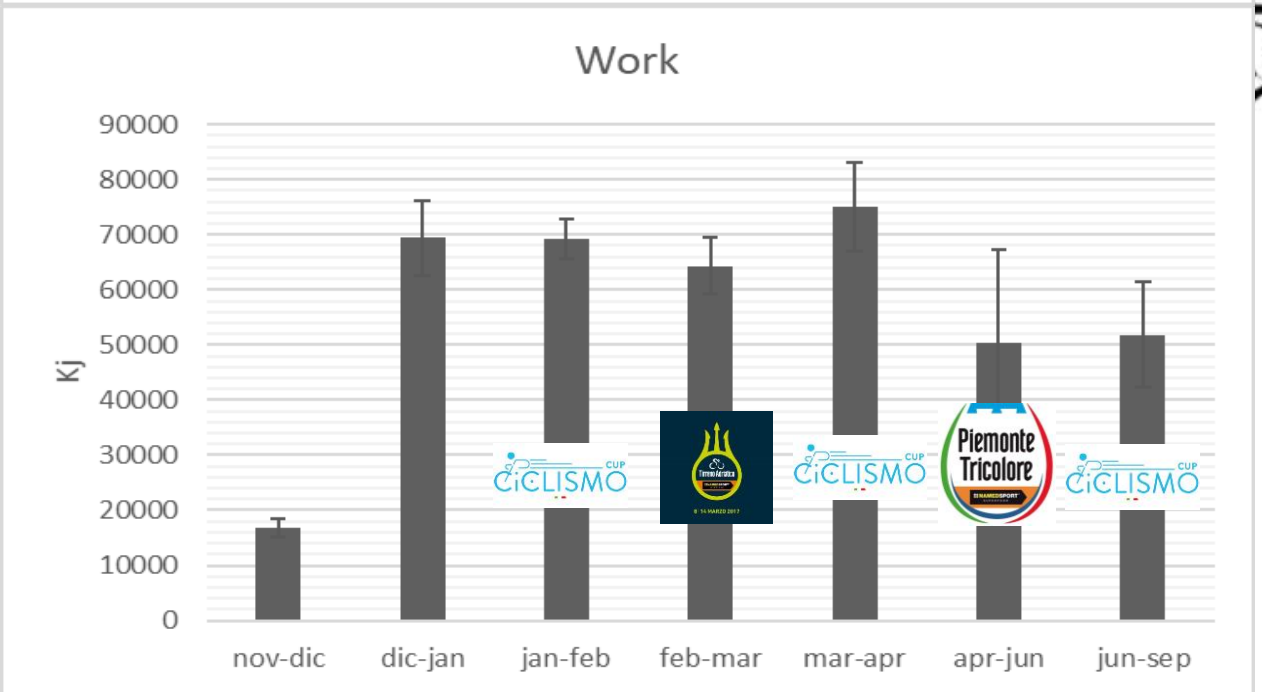
100-300W
300-500W
>500W


Work
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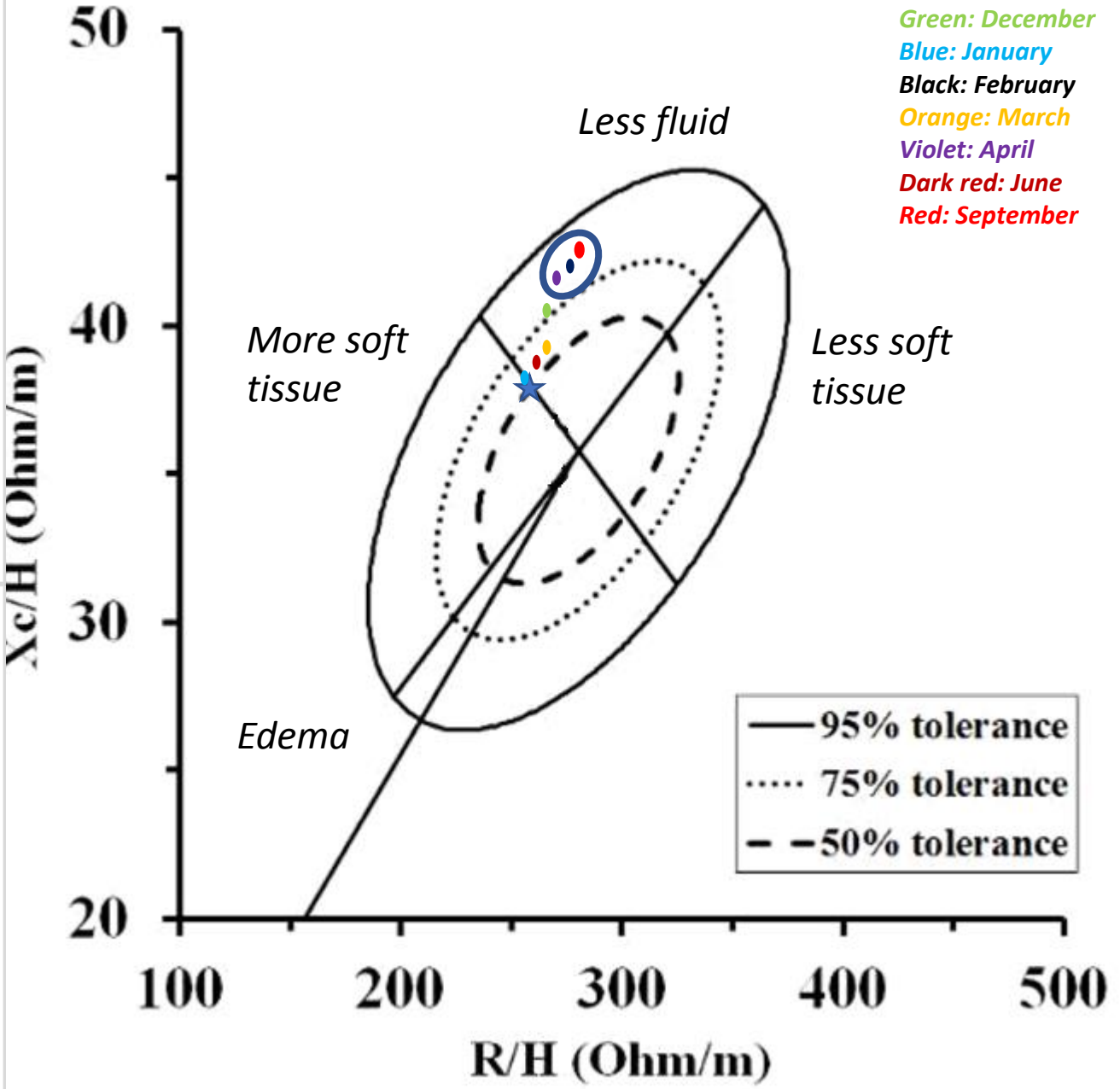
mar-apr
apr-jun
jun-sep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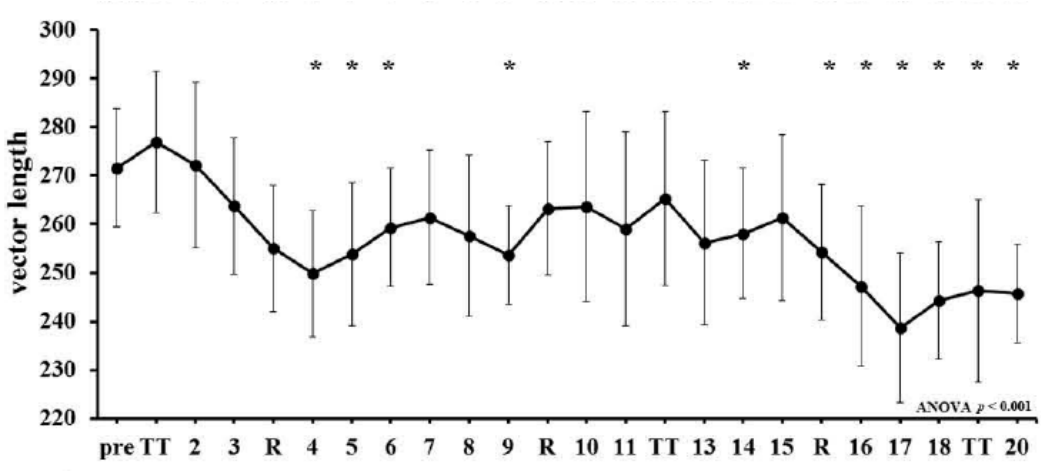
Impedance vector and External Workload

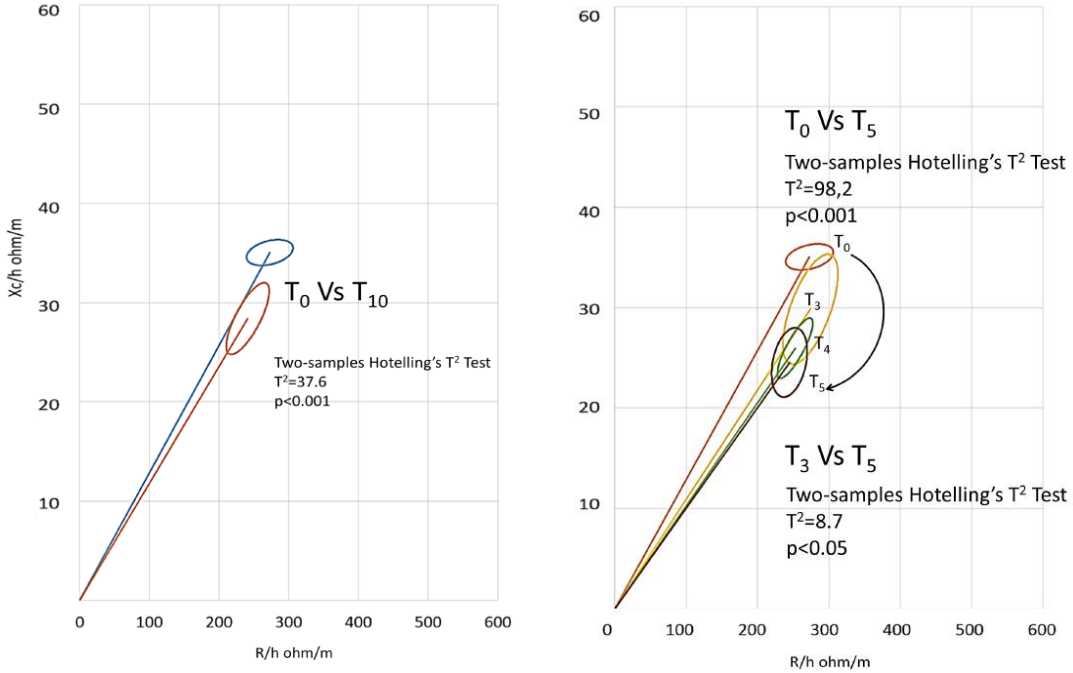
Body fluid status and physical demand during the Giro d'Italia



Pollastri et al. "Body fluid status and physical demand during the Giro d'Italia." Research in Sports Medicine 24.1 (2016): 30-38.

A novel method to assess changes in body fluids: 2015 Giro d'Italia bioimpedance vector analysis experience

Andrea GIORGI[12], Andrea NICOLO'[3], Maurizio VICINI[2], Michele BISOGNI[1], Jacopo TALLURI[4], Marco BONIFAZI[1]



Giorgi et al, Endurance Research conference 2015 University of Kent

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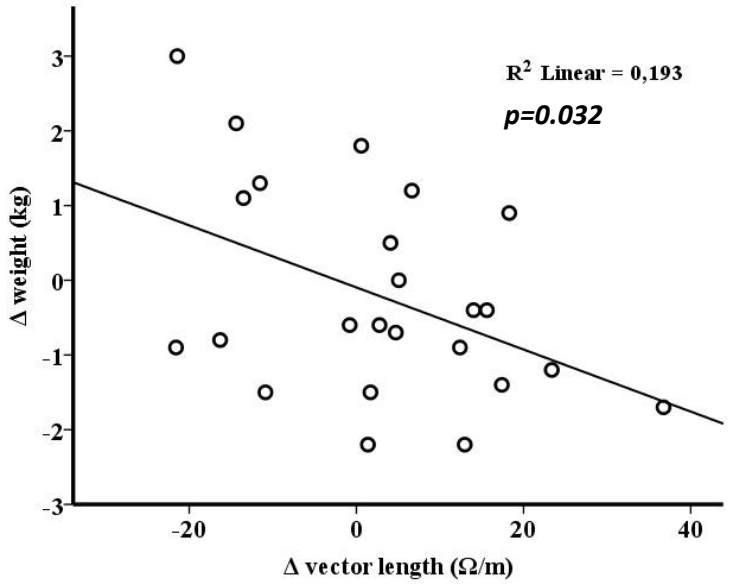
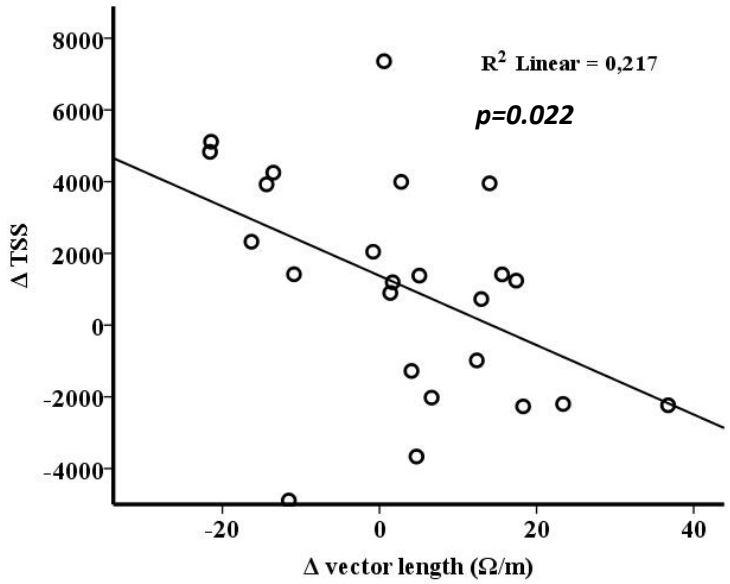
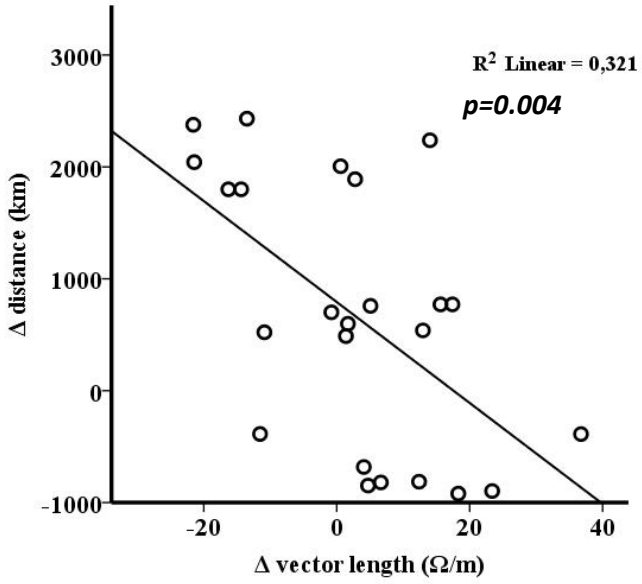
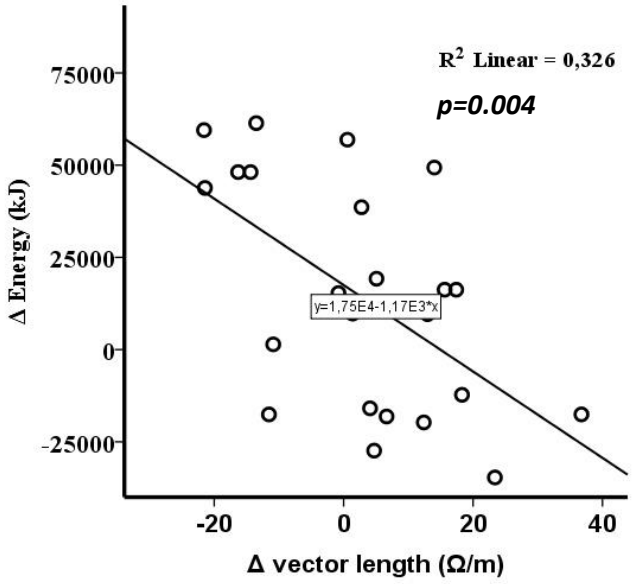
Bioelectrical values and External Workload

Negative correlation between external workload and vector length









Power distribution, performance changes and bioelectrical impedance properties during the preparation period of professional cyclists; Giorgi, et al. 2017, *Journal of Science and Cycling*

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What are the mechanisms behind changes of BIVA parameters: our hypothesises

Muscle Edema, hemodiluition, excess of water intake, fluids release from glycogen breakdown….. → ***Increase extracellular water*** → ***VECTOR LENGTH DECREASE***

Training tapering, carbo loading….. → ***Decrease extracellular water, gain intracellular water*** → ***VECTOR LENGTH INCREASE PHASE ANGLE INCREASE***

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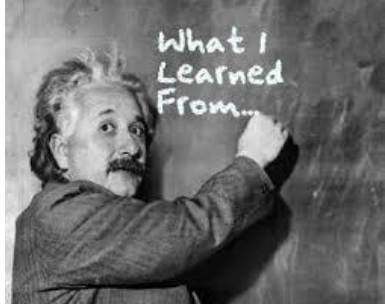
TAKE HOME MESSAGE



- Bioimpedance vector analysis is a innovative method to discriminate the professional cyclists body features.
- The riders body shape improved throughout the 2017 sport season along with the decrease of sum of skinfolds and increase of phase angle.
- Before the team key races, impedance vector lenght and phase angle improved, with a shift from extracellular to intracellular compartment, suggesting an increase of cells size and integrity of cells membranes.
- External training load and power output did not change according to the most important races for the team.
- BIVA detects with high sensitivity the intra-individual changes of body composition and can be used for longitudinal monitoring as well as to detect fast changes of body composition.
- Bioelectrical impedance is a practical method to monitor body water changes **avoiding false interpretation of body weight fluctuations.**

ANDRONI GIOCATTOLI SIDERMEC

Thank you for attention

Email: andreagiorgi4@gmail.com

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