Science & Cycling
29-30 June 2016, Caen, France

Qualitative body composition of cyclists: bioimpedance vector analysis discriminates different categories of cyclists

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Introduction:

Bioelectrical impedance vector analysis (BIVA) and the phase-angle (PA), derived from bioelectrical impedance raw values (i.e., resistance, R, and reactance, Xc) allow qualitative and descriptive assessments of body composition and hydration status, independent of prediction equations, body weight and body composition models [3,4,5]. Bioelectrical impedance reference values for the healthy normal population, soccer players [6] and several clinical settings are well established [1,2], but are lacking for male cyclists. Therefore, the aim of the present study was to obtain reference bioelectrical impedance data characterizing professional, elite, junior, and amateur male road cyclists.

Methods:

The study included 102 male professional riders (age: 25.6±4.7 yr, height: 178.3±5.9 cm, weight: 68.5±5.9 kg), 225 male amateur riders (age: 39±2 yr, height: 176.1±6.4 cm, weight: 71.1±9.5 kg), 46 male junior cyclists (age: 16.9±1.2 yr, height 176.60±5.94 cm, weight 65.62±7.27 kg) and 69 male elite road cyclists (age: 21±2.9 yr, height: 178.2±5.7 cm, weight: 69.03±7.6 kg). The controls were represented by normal values of healthy male Italian population (age: 48±17 yr, height: 170.4±8 cm, weight: 72.6±11.5 kg) [2]. Professional cyclists were classified into 3 groups according to their team role (sprinter, n=16; climber, n=35; all-rounder, n=51), whereas the juniors, amateurs and elite cyclists were all considered all-rounder. Whole-body impedance measurements (BIA- 101 Anniversary AKERN/RJL-Systems) were performed during the peak performance period of the cyclists. All measurements were obtained in compliance with the manufacturer's guidelines and analyzed according to the BIVA method [1].

BIVA, compared to the estimated fat and fat-free masses with conventional BIA, does not use regression prediction equations, and was shown to adequately display differences in hydration and soft tissue mass in healthy people and athletes [7]. Furthermore, BIVA allows establishing population- specific norms (50, 75 and 95% tolerance ellipses).

Results:

Compared to the amateur cyclists and the normal population, the group vector and the tolerance ellipses of the professional cyclists was displaced to the upper left ($p<0.001$) as well as the comparison of the amateurs and juniors ($p<0.001$), amateurs and elite cyclists($p<0.001$) (fig. 1). Also, all categories showed a shift to the upper left in comparison of controls. Comparisons of professional cyclists to amateurs and elite cyclists to amateurs showed a higher phase-angle (7.1°±0.1 vs 6.5°±0.8 ($p<0.001$) and 7.0°±0.7 vs 6.5°±0 ($p<0.001$), respectively). Significant differences in vector position were found between sprinters and climbers ($p<0.05$) and between allrounders and climbers ($p<0.02$) (fig. 2).

Conclusion:

The main finding of the present study is that road cyclists in general and specialists have specific bioimpedance values compared to non-cyclists. Muscle mass and function, as indicated by the left shifted vector and the phase-angle, increased with increasing performance level. The specific tolerance ellipses of the professionals might be used for classifying individual vectors of professional cyclists and to define target regions for lower level cyclists.

References:

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Figure 1

50%, 75%, and 95% tolerance ellipses of the professional (left) and the amateur cyclists (right) (colored) depicted on the ellipses of the general population (gray) [2].

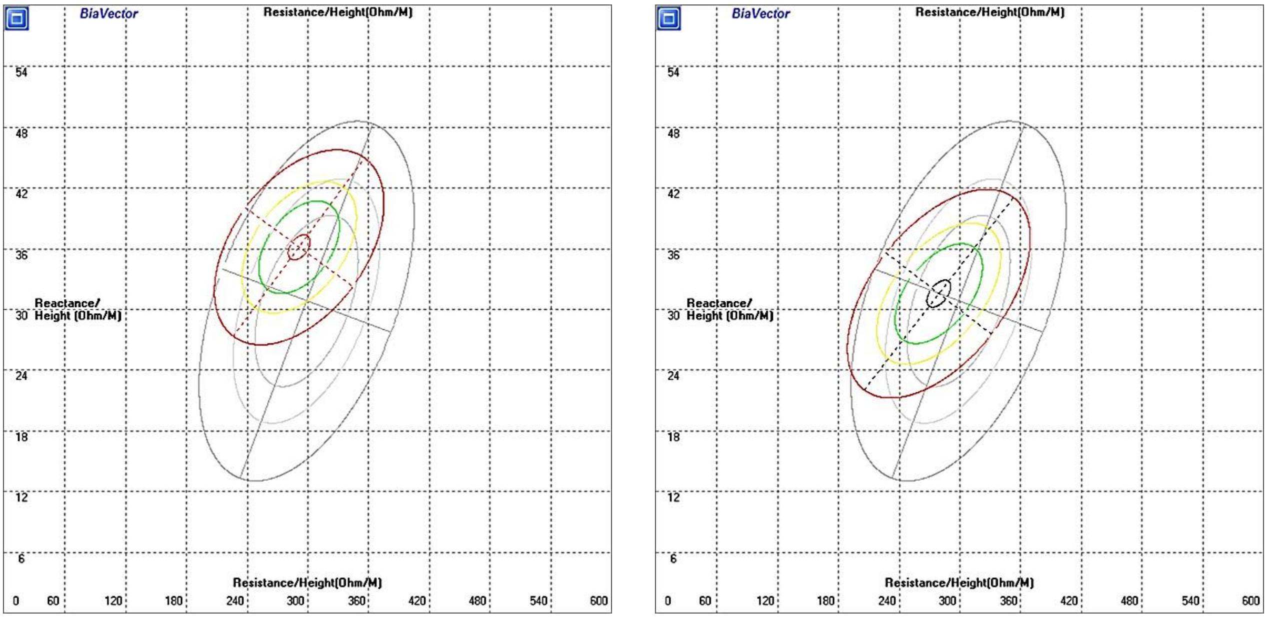

Figure 2

Mean impedance vectors with 95% confidence ellipses of the professional cyclists plotted by categories (red=sprinters; black= climbers; blue: all-rounders).