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Biological determinants of phase angle among Brazilian elite athletes

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Intense physical training may affect cellular membrane stability. Phase angle (PA) is a non-invasive measure related to cellular membrane composition and stability that is calculated from resistance and reactance and is obtained by bioelectrical impedance (BIA)⁽¹⁾. Previous reports have shown that PA is associated to age, gender and BMI⁽²⁾ but little is known about the sources of variation in PA among athletes. The aim of the present study was to investigate the determinants of PA in male elite athletes (≥ 3 h training daily, and participation in international competition). Healthy athletes (*n* 158; age 13–48 years) who participated in this cross-sectional observational study practiced the following specialist sports: adventure running, *n* 6; cycling, *n* 11; judo, *n* 7; long-distance running, *n* 27; short-distance running, *n* 14; soccer, *n* 50; swimming, *n* 13; triathlon, *n* 15; water polo, *n* 15. BIA was performed using a BIA 101-Q impedance analyser (RJL Systems, MI, USA) under a strict standardized procedure⁽²⁾. The BIA measurements were routinely carried out at 08.00 hours after ≥ 8 h fast and 16 h rest. All the subjects were of normal BMI and hydration status. The athletes were stratified according to age⁽²⁾ and the data for PA, weight, height and BMI are presented in the Table.

Age subgroup (years)	<i>n</i>	PA (°)		Weight (kg)		Height (m)		BMI (kg/m ²)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
10–19	79	6.89 ^a	1.02	56.2 ^a	13.9	1.67 ^a	0.12	19.8 ^a	2.70
20–29	50	8.14 ^b	0.68	73.3 ^b	11.8	1.77 ^b	0.07	23.4 ^b	2.57
30–39	22	7.78 ^{a,b}	0.68	73.8 ^b	10.7	1.79 ^b	0.07	23.0 ^b	2.70
40–49	7	7.47 ^{a,b}	0.39	70.5 ^b	7.8	1.72 ^{a,b}	0.09	23.8 ^b	1.93

^{a,b}Means with unlike superscript letters in the same column were significantly different (ANOVA with Tukey's *post-hoc* test; *P*<0.005). The effect of age on PA was independent of BMI and sport specialism (MANOVA).

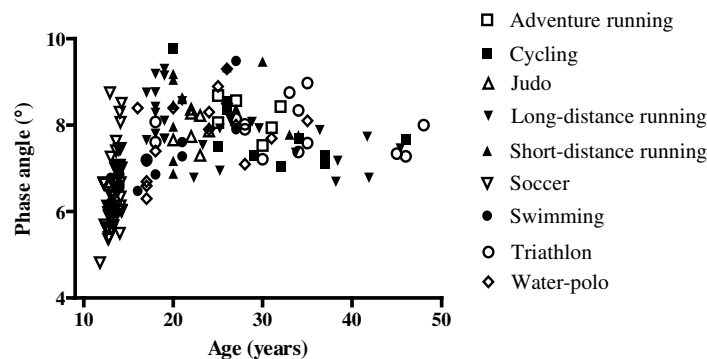


Figure. Association between PA and age for all athletes.

In agreement with previous findings⁽²⁾ PA was positively correlated with BMI (*r* 0.66; *P*<0.001). In contrast to previous reports⁽²⁾ PA was lower in adolescents than in young adults (Table), and increased steeply with age within the same specialty (soccer; Figure). Among athletes aged 10–19 years 57% of PA values were lower than the 5th percentile of a reference group⁽²⁾, in contrast to the other three age subgroups, for whom the corresponding values were 2%, 0% and 0%, respectively. The results suggest that the intense physical training, which is usual for elite athletes, may negatively influence PA of male adolescents, which might be related to cellular membrane stability.

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