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Introduction

Isokinetic testing of lower limbs has been used to assess strength in soccer players (Kellis, Kellis, Manou, & Gerodimos, 2000; Oberg, Moller, Gillquist, & Ekstrand, 1986). In addition, allometric scaling provides a truly dimensionless expression of data, which can be used in subsequent comparisons between groups that differ in body characteristics, (Schmidt-Nielsen, 1984). To our knowledge, there is a dearth of such data in Greek soccer players. Therefore, the aim of this study was to investigate concentric isokinetic torque of knee extensors in professional and amateur Greek soccer players using allometric scaling and examine whether the difference in performance is affected by the strength of the lower limbs.

Method

100 professional and 100 amateur Greek soccer players were assessed for height, body mass, and concentric isokinetic torque of knee extensors at 30°/sec, 60°/sec and 180°/sec. Age, anthropometric characteristics and training years of professional and amateur Greek soccer players are presented in Table 1.

Table 1. Age, anthropometric characteristics and training years of professional and amateur Greek soccer players (Mean±SD)

Level of skill	n	Age (yrs)	height (cm)	Body mass (kg)	Training years (yrs)
Professional	100	24.4 ± 3.8	175.3 ± 4.5*	71.5 ± 4.2*	14.2 ± 2.2
Amateur	100	24.8 ± 3.1	173 ± 5.3	65.6 ± 6.6	13.8 ± 2.5

* Significant differences compared to amateur ($p < .05$).

To correct for possible associations between body mass and isokinetic parameters **two different methods were used seperately. The first one was the ratio standard** and the second one was an allometric scaling method (power function ratios) described by Winter (1992).

Results

Table 2 shows the b exponents derived according to Winter from the allometric equation Peak Isokinetic Torque= $a \times$ body mass, where a is constant.

Table 2. b exponents derived from the allometric equation Peak Isokinetic Torque= $a \times$ body mass^b

Angular velocity (°/sec)	a	b	(± 95% CI)
30	1.51	0.95 †	0.06
60	1.31	0.97 †	0.08
180	0.40	1.18 †	0.08

a: constant, †:common exponent for professional and amateur soccer players

Independent-samples t-tests revealed that all examined parameters in absolute values and corrected isokinetic data for body mass ($p < 0.005$) were significantly higher ($p < 0.005$) in professional soccer players compared to their amateur counterparts (Tables 1 and 3).

Table 3.

Concentric isokinetic torque of knee extensors in professional and amateur Greek soccer players in absolute and relative values (Mean \pm SD)

Angular velocity ($^{\circ}$ /sec)	Professional			Amateur		
	Absolute values	Relative values		Absolute values	Relative values	
		PIT/BM	PIT/BM ^b		PIT/BM	PIT/BM ^b
30	274.84 \pm 15.66	3.85 \pm 0.26	4.77 \pm 0.31	235.96 \pm 26.54*	3.60 \pm 0.29*	4.44 \pm 0.36*
60	249.07 \pm 18.58	3.49 \pm 0.30	3.97 \pm 0.33	210.54 \pm 26,94*	3.22 \pm 0.33*	3.64 \pm 0.37*
180	166.49 \pm 14.52	2.33 \pm 0.21	1.13 \pm 0.10	136.33 \pm 18.97*	2.08 \pm 0.22*	1.02 \pm 0.11*

PIT : Peak Isokinetic Torque, BM: Body Mass, ^b : Allometric Exponent, * $p < .005$

Discussion

Different values for isokinetic peak torque in soccer players have been reported (da Fonseca et al., 2007; Oberg et al., 1986). Given that torque is related to the length of the testing limb, a possible explanation for these differences could be related to differences in anthropometric characteristics, and more specifically height.

The superiority of professional players found in this study using allometric means is in agreement with other studies (Cometti, Maffiuletti, Pousson, Chatard, & Maffulli, 2001; Rochcongar, Morvan, Jan, Dassonville, & Beillot, 1988). This superiority can be explained by the interaction between strength and level of competition. More specifically, soccer training at an elite level might increase leg strength (Rochcongar et al., 1988) but it is also possible that the stronger player is a better one and he is collected to play at a higher level.

Conclusion: To conclude, the difference in soccer performance possibly is affected by the strength of the lower limbs.

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