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Somatotype and Its Correlations with Body Composition, Aerobic Capacity and Strenght of Legs in Young Soccer Players

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ABSTRACT

Introduction: It is of interest to evaluate if some somatotypes of soccer players could develop higher aerobic capacity and strength of quadriceps and hamstrings. The aim of this study is to determine the somatotype and its influence on body composition, Yo-Yo IE2 and peak force and peak time of force development of quadriceps and hamstrings during the training process of young soccer players aged 15-17 years.

Material and Methods: In 46 soccer players, 15-17 years, 3 times during a season, we measured relative muscle (MM%) and fat mass (FM%) , BMI and muscle (AMC) and total (AC) surface of upper arm-cm2 (bioelectrical impedance); speed of running (km/h) and total distance covered (m) with Yo-Yo intermittent endurance test level 2 on field (Yo-Yo IE2); peak force (m/kg) of both quadriceps (PForQR, , PForQL) and both hamstrings (PForHR, PForHL)and peak time of force development (msec) of both quadriceps (PTimQR, PTimQL) and hamstrings (PTimHR, PTimHL) (hand dynamometer, manual muscle testing) by Kendall et Kendall). With Heath-Carter anthropometric somatotype model, we determined 13 categories of somatotype. Descriptive statistics and multiple regression were used ($p<0.05$)

Results: The mesomorph–ectomorph (44.68%), balanced mesomorph (17.02%) and balanced ectomorph (14.89%) were the most frequent somatotypes. There were a significant decrease of PForQL (17.89 to 16,28), PTimQl (2.63 to 2,46) of left quadriceps and PTimQR (3.84 to 2,42) at the end of season. PForHR (13.75 to 14.06) significantly increased and PTimHR (3.68 to 3.05) and PTimHL (3.52 to 2.60) decreased at the end of season. Balanced endomorphic players had for 5 times higher negative influence on AMC than other somatotypes.

Mesomorph-endomorphic and balanced mesomorphic players had for 2 to 3 times higher negative influence on PTimQL than other somatotypes. Central players had for 2 times higher negative influence on PTimRL than other somatotypes. Mesomorph-endomorphic players for 1.3 times higher positive influence on PTimQR.

Conclusion: Balanced endomorphic players should expect decreasing of protein status during the training process, provoking a new nutritional strategy for them. Mesomorph-endomorphic and balanced mesomorph players have for 3 times higher negative influence on peak time of force development of quadriceps muscles than other somatotypes during the training process, expecting more qualitative and quantitative improvement of quadriceps contraction during the training process, especially of the time of neuromuscular activation.

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Introduction

There are studies that report about somatotype of young soccer players and its distribution according with the position on the field and playing level. Some studies show correlations between body composition and anthropometric characteristics in young soccer players, together with the position on the field. On the other side, there is a lack of studies about influence of somatotype on aerobic endurance, often estimated through Yo-Yo-EI2 test in young soccer players. A study shows a significant somatotype-aerobic training interaction, suggesting different trainability with intermittent and individualized aerobic training according to somatotype. It is obvious that mesomorph component of somatotype is desirable for young soccer players, but it is of interest to evaluate if some somatotypes could develop higher strength and peak time of its development of quadriceps and hamstrings, as a dominant biomechanical chain in soccer game [1-11].

The estimation and evaluation of possible influence of somatotype on soccer performance, especially on individualization of training process, are of interest during the soccer training process. This interest is higher in young soccer process due to possibility to adequate selection and specialization. There is a lack of these type of studies.

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The aim of this study is to determine the somatotype and its influence on body composition, Yo-Yo IE2 and peak force and peak time of force development of both quadriceps and hamstrings during the training process of young soccer players aged 15-17 years.

Material and Methods

During a second half soccer season of 4 months, in 46 soccer players, 15-17 years, 3 times (at the beginning - P1, after 6 weeks of preparation period, before the start of the competitions - P2 and after the finishing of this process - P3), we measured: body composition by bioelectrical impendence InBody720 (MM%-relative muscle and FM%-fat mass, BMI and AMC-muscle and AC-total surface of upper arm-cm2); speed of running (km/h) and total distance covered (m) with Yo-Yo intermittent endurance test level 2 on field (Yo-Yo IE2); peak force (m/kg) of both quadriceps (PForQR, , PForQL) and both hamstrings (PForHR, PForHL)and peak time of force development (msec) of both quadriceps (PTimQR, PTimQL) and hamstrings (PTimHR, PTimHL) with hand dynamometer, with MMT (manual muscle testing) by Kendall et Kendall. With Heath-Carter anthropometric somatotype model, we determined 13 categories of somatotype. Descriptive statistics and multiple regression were used ($p<0.05$)

Results

There were no significant changes of body composition of soccer players, aged 15-17 years, during a half soccer season of 4 months (Table 1)

Table 1: The Changes of Relative Muscle and Fat Mass, BMI and Muscle and Total Surface of Upper Arm of Young Soccer Players During A Half Soccer Season of 4 Months.

	MM (%)	FM(%)	BMI (kg/m2)	AMC (cm2)	AC (cm2)
P1					
X	49.38	12.32	21.60	25.16	28.68
Sd	21.90	5.36	2.72	2.61	2.61
P2					
X	48.70	13.68	22.14	25.05	28.89
Sd	2.91	5.24	2.76	2.11	2.67
P3					
X	49.06	13.69	22.10	25.28	29.14
Sd	3.36	4.45	2.45	1.86	2.31
p<0.05	n.s.	n.s.		n.s.	n.s.

P1 - at he beginning, P2- after 6 weeks, P3- after the finishing of half season

n.s – no significant differences between periods of training and competition period

Although there was an increase of level and total distance covered with Yo-Yo IE2 of soccer players at the end of half soccer season, the difference were statistically insignificant (Table 2)

Table 2: The Changes of Speed of Running (Km/H) and Total Distance Covered (M) with Yo-Yo Ie2 of Young Soccer Players During A Half Soccer Season of 4 Months.

	Level	Total distance (m)
P1		
X	14.87	1454.734
Sd	0.81	316.89
P2		
X	15.22	1606.32
Sd	0.92	359.24
P3		
X	15.37	1675.789
Sd	0.97	381.88
p<0.05	n.s.	n.s.

P1 - at he beginning, P2- after 6 weeks, P3- after the finishing of half season

n.s – no significant differences between periods of training and competition period

There were a significant decrease of peak force (PForQL) and peak time of force development (PTimQl) of left quadriceps of young soccer players at the end of half soccer season. Peak time of right quadriceps (PTimQR) significantly decreased during the soccer half season. After insignificant decrease of peak force after 6 weeks, the peak force of right hamstring (PForHR) significantly increased at the end of half season and its peak time of development (PTimHR) significantly decreased. Peak time of force development of left hamstring (PTimHL) significantly decreased at the end of half season (Table 3).

Table 3: The Changes of Peak Force and Peak Time of Force Development of Both Quadriceps and Hamstrings of Young Soccer Players During a Half Soccer Season of 4 Months.

	PForQR (m/kg)	PTimQR (msec)	PForQL m/kg)	PTimQL (msec)	PForHR (m/kg)	PTimHR (msec)	PForHL (m/kg)	PTimHL (msec)
P1								
X	17.67	3.84	17.89	2.63	13.75	3.68	12.87	3.52
Sd	2.81	1.04	2.73	1.33	2.49	1.15	2.19	1.05
P2								
X	17.11	3.62	17.25	3.29	12.57	2.86	12	3.11
Sd	2.71	1.10	2.88	1.09	1.76	1.16	1.91	1.29
P3								
X	16.49	2.42	16.28	2.46	14.06	3.05	12.02	2.60
Sd	2.71	1.20	1.85	1.00	2.28	0.95	2.72	1.11
p<0.05	n.s.	b,c	b	c	c	a, b	n.s	b

P1 - at he beginning, P2- after 6 weeks, P3- after the finishing of half season

- PForQr – peak force of right quadriceps; PTimQR – peak time of force development of right quadriceps;
- PForQL – peak force of left quadriceps; PTimQ - peak time of force development of left quadriceps
- PForHR – peak force of right hamstrings; PTimHR – peak time of force development of right hamstrings
- PRofHL - peak force of left hamstrings; PTimHL - peak time of force development of left hamstrings
- **n.s** – no significant differences between periods of training and competition period
- **a** - significant differences between P1 and P2; **b** - significant differences between P1 and P3; **c** – significant differences between P2 and P3

The mesomorph–ectomorph, balanced mesomorph and balanced ectomorph were the most frequent somatotypes in soccer players aged 15-17 years (Figure 1)

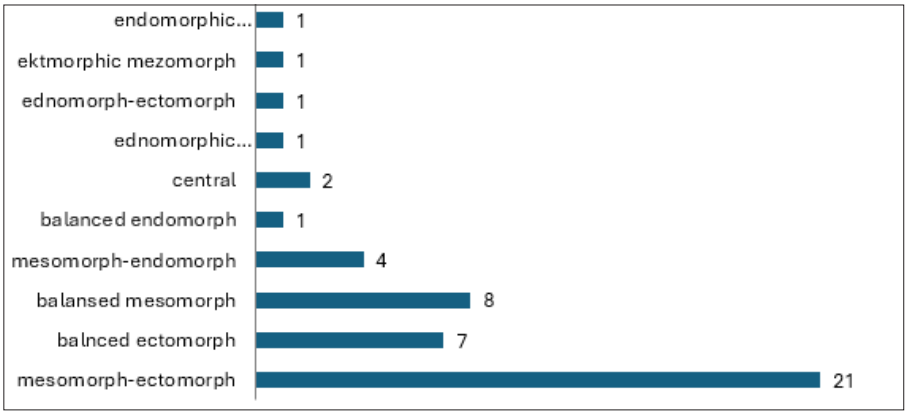

Figure 1: The Somatotype of 47 Young Soccer Players, Aged 15-17 Years.

Balanced endomorphic young soccer players had for 5 times higher negative influence on AMC (muscle surface of upper arm) than other somatotypes during at the beginning and after 6 weeks of training process (Table 4.)

Table 4: The Influence of Somatotype on the Changes of Body Composition of Young Soccer Players During A Half Soccer Season Of 4 Months. (only Significant Influences are Presented, p<0.05).

	Somatotype		Category of somatotype		
	R	p	balanced endomorph		
			beta	B	p
AMC/P1	0.70	0.007	-0.45	-5.0	0.03
AMC/P2	0.65	0.02	-0.48	-5.8	0.03

AMC/P1 – muscle surface of upper arm (cm2) at the beginning of training process

AMC/P2 – muscle surface of upper arm (cm2) after 6 weeks of training process

Mesomorph-endomorphic and balanced mesomorphic young soccer players had for 2 to 3 times higher negative influence on peak time of developed force of left quadriceps (PTimQL) than other somatotypes after 6 weeks of training process. Central young soccer players had for 2 times higher negative influence on peak time of developed force of right quadriceps (PTimRL) than other somatotypes after finishing of half soccer season. Mesomorph-endomorphic young soccer players for 1.3 times higher positive influence on peak time of developed force of right quadricpes than other somatotypes after finishing of half soccer season (Table 5.)

Table 5: The Influence of Somatotype on Peak Force and Peak Time of Force Development of Both Quadriceps and Hamstrings of Young Soccer Players During a Half Soccer Season of 4 Months (only significant influences are presented, p<0.05).

	Somathotype		Category	of somathotype	
	R	p	Mesomorph endomorph		
PTimQL/P_2	0.73	0.03	- 0.75	- 2.39	0.03
			Balanced	mesomorph	
			-0.82	- 3.11	0.01
PTimQR/P_3	0.72	0.03	-0.46	- 1.90	0.14
			mesomorph ednomorph		
			0.37	1.30	0.27

PTimeOL/P_2 – peak time of force development of left quadriceps (msec) after 6 weeks of training process

PTimeQR/P_3 - peak time of force development of right quadriceps (msec) after finishing of half season

There were no significant influence of somatotype on speed of running and total distance covered with Yo-YoIE2 of young soccer players during a half soccer season of 4 months.

Discussion and Conclusion

In our study, from 13 categories of somatotype by Heath-Carter, 10 are presented in young soccer players, with predomination of mesomorph-ectomorph (45%), together with balanced mesomorph (17%), balanced ectomorph (15%) and mesomorph-endomorph (9%), according with the other studies [13-15].

Although there are no significant changes of body composition during soccer half season, relative muscle and fat mass are not appropriate for this young soccer players (18,19). Balanced endomorphic young soccer players, although presented with low rate in this study (2%), seem to have for 5 times higher negative influence on AMC (muscle surface of upper arm) than other somatotypes during the training process. We could speculate that young soccer players with this somatotype should expect decreasing of protein status during the training process which provokes maybe a new nutritional strategy for them. Namely, these new strategy is necessary too due to inadequate muscle and fat mass in these young soccer players.

Although there was an increase of level and total distance of Yo-Yo IE2 test during the half soccer season, this increase was insignificant. On the other side, this study does not show any significant influence of somatotype on changes of aerobic endurance capacity. This could be connected to training process and relative lower playing level of these young soccer players [16-18].

In our study, peak force of left quadriceps significantly decreased and peak force of right hamstrings significantly increased. This could be connected to dominancy of right leg. On the other side, times for development of the force of both quadriceps and hamstrings significantly decreased during the half soccer season. We could expect this effect according to the training process and adaptability of neuromuscular junction and its time of activation. It seems that mesomorph-endomorphic and balanced mesomorphic young soccer players, respectfully presented in this study (9% and 17%), have for 3 times higher negative influence on peak time of force development of quadriceps muscles than other somatotypes during the training process. We could speculate that young soccer players with these somatotypes should expect more qualitative and quantitative improvement of quadriceps contraction during the training process, especially of the time of neuromuscular activation. More studies are necessary to support these findings [19-22].

The findings of this study could only suggest that the somatotype characteristics of young soccer players would be of interest in process of selection, planning and individualization of soccer training process. The need for more studies is essential.

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