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Original research article

THE INFLUENCE OF SOMATOTYPE COMPONENTS ON SUCCESS IN SPORT CLIMBING

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Abstract. *The aim of this research was to determine if there is any influence of somatotype components on success in sport climbing on natural rock. The research was conducted on 31 male, Serbian sport climbers (mean age: 28.1 ± 5.5 years, body height 181.2 ± 6.5cm, weight 72 ± 6.2kg) with a climbing experience of 6.7 ± 4.1 years. Ten measurements were used for calculating somatotype components and regression analysis was used to determine the influence of somatotype components on competition results. The results showed that there is a statistically significant influence of somatotype components on competition results. The endomorphic component showed a statistically significant influence on success, while the mesomorphic and the ectomorphic component did not influence success in sport climbing. We can conclude that sport climbers can benefit from low body fat, which can improve their climbing results.*

Key words: *sport climbers, endomorphic component, mesomorphic component, ectomorphic component.*

1. INTRODUCTION

Morphological characteristics represent a part of the mosaic that, together with other factors like physical training, nutrition and motivation, affect the performance of an athlete. Climbers, in general, believe that smaller body weight positively affects their climbing. According to previous studies on the morphological characteristics and somatotypisation of sport climbers, these athletes are characterized by a relatively small body height, weight and BMI compared to other athletes and non-athletes (Watts, Martin & Durtschi, 1993; Watts, Joubert, Lish, Mast & Wilkins, 2003; Cheung, 2009; Tomaszewski, Gajewski & Lewandowska, 2011; Cheung, Tong, Morrison, Leung, Kwok et al., 2011). Their somatotype is ectomorphic mesomorph (Alvero-Cruz, 2011) and

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mesomorphic ectomorph (Viviani & Calderan, 1991) with a small body fat percentage (Viviani et al., 1991; Watts et al., 1993; Watts et al., 2003; Cheung 2009; Tomaszewski et al., 2011; Cheung et al., 2011). Watts et al. (2003) believe that decreased endomorphy represents an advantage in climbing. Although they are characterized by low body fat, sport climbers showed normal weight, according to their BMI (Stankovic, Rakovic, Aleksandrovic & Joksimovic, 2009), while the relative body weight does not affect the result in sport climbing (Binney & Cochrane, 2003). In elite climbers there is a difference between athletes in the disciplines of bouldering and lead climbing, where boulderers had higher body fat percentage than the lead climbers (Mladenov, Mihailov & Schoffl, 2009). Regardless of their smaller stature, morphological characteristics didn't show any significant influence on the result in sport climbing (Mermier, Janot, Parker & Swan, 2000; España-Romero, Ortega Porcel, García-Artero, Ruiz & Gutiérrez Sainz, 2006; Mladenov et al., 2009; Tomaszewski et al., 2011). The aim of this research was to determine if there is any influence of somatotype components on success in sport climbing on natural rock.

2. METHOD

2.1 Participants

The participants in this research were 31 male, Serbian sport climbers (mean age: 28.1 ± 5.5 years, body height 181.2 ± 6.5cm, weight 72 ± 6.2kg), with a climbing experience of 6.7 ± 4.1 years. All of the participants took part in the third round of the Serbian National Championship in sport climbing on natural rocks (discipline lead), held in Ljubovija 2013.

2.2 Measurements

Somatotype components of the participants were determined in the program Somatotype 1.1 (downloaded from the website http://www.somatotype.org/studies.php) according to the Heath-Carter method. For the calculation of the endomorphic component (ENDO), skinfold thickness was measured according to Carter (2002) at four sites on the right side of the body: upper arm above the triceps (UASF), upper back beneath the scapula (UBSF), abdominal (ASF) and calf below the fossa poplitea (CSF). Skinfold thickness was measured with a caliper to the nearest 0,2mm. For the calculation of the mesomorphic component (MESO) five measurements were taken: body height (BHE), upper arm circumference (UAC), lower leg circumference (LLC), humerus bicondylar breadth (HBB) and femur bicondylar breadth (FBB). Body height (BHE) was measured barefoot in a standing position with an anthropometer to the nearest 0.1cm. Upper arm circumference (UAC) was measured on biceps brachii muscle bulk at muscle contraction and lower leg circumference (LLC) around the maximum girth of the calf. Both were measured by a measuring tape to the nearest 0.1cm. The diameters of the humerus bicondylar breadth (HBB) and femur bicondylar breadth (FBB) were measured with the sliding caliper to the nearest 0.1mm. Circumferences of the upper arm and calf as well as diameters of the humerus and femur bicondylar breadths were measured on the right side of the body according to Carter (2002). For the calculation of the ectomorphic component (ECTO), two measurements were used: body height (BHE) and body weight (BWE).

Body weight (BWE) was measured barefoot in a standing position by a precision scale (Bilance SALUS, Milan, Italy) to the nearest 0.1kg. Both body height and weight were measured according to the instructions of the International Biological Program – IBP (Weiner and Lourie, 1969). The anthropometer, measuring tape, sliding caliper and caliper are components of the anthropometric set GPM - Swiss Made. All of the instruments were calibrated before measuring each participant.

Competition results (RES) were determined according to the competition regulations of The Sport Climbing Commission of the Mountaineering Association of Serbia. All competitors had 20 new, unclimbed sport routes for climbing in two days (eight hours per day), with the difficulty from VI to X+ on the UIAA grading scale. Each route is worth 1000 points, and they are divided by the number of climbers that have successfully climbed the route. The aim is to gather as many points from 20 routes (Competition rule book of SCC MAS in sport climbing on natural rocks, 2013).

The study was conducted in September 2013 in cooperation with the Mountaineering Association of Serbia. All of the measurements were taken on the first day of the competition from 10 to 12 am, and all of the participants were measured in the same manner and conditions.

2.3 Statistical analysis

The obtained data was statistically analyzed in the program package Statistica 8.0. (StatSoft, Inc., 2007). Descriptive statistics included the measured mean (Mean), standard deviation (SD), error of standard deviation (Error), minimum (Min) and maximum (Max) measured values, range (Range), skewness (Skew) and kurtosis (Kurt). The correlation of variables used to determine the somatotype and somatotype components with the criteria are presented in the intercorrelation matrix by the Pearson correlation coefficient. A regression analysis was conducted for the purpose of determining the influence of somatotype components on the competition results. The significance level was set at $p<0.05$.

3. RESULTS

Table 1 shows the basic statistic parameters for anthropometric measures that were used to determine the somatotype, the somatotype components and competition results. The data distribution in all the variables is symmetrical around the mean, except for the variable RES, that shows a strong right orientation (Skew = 2.55) with an extremely non-liner distribution of the results (Kurt = 8.04). The results in Table 1 also show that the mean somatotype of Serbian sport climbers is ectomorphic mesomorph ($2.24 \pm 0.75 – 3.95 \pm 0.90 – 3.35 \pm 0.96$).

Table 2 shows the correlation between the variables used to determine the somatotype and somatotype components with the criteria. Out of the three somatotype components, only the endomorphic component has a significant correlation with the criteria (-0.45), i.e. competition results (RES), together with two variables used to calculate the endomorphic component. All with a negative coefficient.

Table 1 The descriptive statistic parameters of anthropometric measures used to determine the somatotype, somatotype components and competition results for the whole sample (N = 31)

Variable	Mean	SD	Error	Min	Max	Range	Skew.	Kurt.
UASF	5.84	2.11	0.38	3.00	12.30	9.30	0.89	1.20
UBSF	7.56	1.26	0.23	5.70	10.50	4.80	0.30	-0.61
ASF	9.51	4.02	0.72	3.20	18.90	15.70	0.84	-0.09
CSF	7.48	3.12	0.56	3.50	15.20	11.70	0.87	-0.18
BHE	181.23	6.51	1.17	168.00	199.50	31.50	0.39	1.26
UAC	32.77	2.18	0.39	28.70	37.40	8.70	0.16	-0.30
LLC	35.22	1.71	0.31	32.90	39.80	6.90	0.73	0.17
HBB	6.85	0.35	0.06	6.20	7.40	1.20	-0.30	-0.67
FBB	9.50	0.45	0.08	8.60	10.70	2.10	0.30	0.56
BWE	71.97	6.21	1.12	60.00	86.50	26.50	0.14	-0.28
ENDO	2.24	0.75	0.14	0.90	4.20	3.30	0.61	0.13
MESO	3.95	0.90	0.16	2.60	5.90	3.30	0.27	-0.82
ECTO	3.35	0.96	0.17	0.90	5.00	4.10	-0.60	0.16
RES	645.16	763.39	137.11	0.00	3663.92	3663.92	2.55	8.04

Legend: UASF (mm) – upper arm skin fold; UBSF (mm) – upper back skin fold; ASF (mm) – abdominal skin fold; CSF (mm) – calf skin fold; BHE (cm) – body height, UAC (cm) – upper arm circumference; LLC (cm) – lower leg circumference; HBB (cm) – humerus bicondylar breadth; FBB (cm) – femur bicondylar breadth; BWE (kg) – body weight; ENDO – endomorphic component; MESO – mesomorphic component; ECTO – ectomorphic component; RES (points) – competition results

Table 2 The intercorrelation matrix for variables used to determine the somatotype and somatotype components with the criterion variable (RES)

VAR.	UASF	UBSF	ASF	CSF	BHE	UAC	LLC	HBB	FBB	BWE	ENDO	MESO	ECTO	RES
UASF	1.00													
UBSF	**0.53**	1.00												
ASF	**0.69**	**0.65**	1.00											
CSF	**0.57**	0.18	0.31	1.00										
BHE	-0.04	-0.14	-0.08	0.19	1.00									
UAC	0.27	0.32	0.11	0.34	0.18	1.00								
LLC	0.11	0.26	0.07	0.08	0.17	**0.65**	1.00							
HBB	0.18	0.27	**0.39**	-0.03	**0.37**	0.05	0.35	1.00						
FBB	0.13	0.07	0.24	-0.06	**0.60**	0.03	0.18	**0.65**	1.00					
BWE	0.33	**0.38**	**0.36**	0.19	**0.57**	**0.67**	**0.68**	**0.47**	**0.58**	1.00				
ENDO	**0.85**	**0.76**	**0.95**	**0.41**	-0.09	0.20	0.11	**0.36**	0.21	**0.39**	1.00			
MESO	0.22	**0.44**	0.31	-0.10	**-0.51**	**0.49**	**0.61**	0.31	0.03	0.30	0.34	1.00		
ECTO	-0.35	**-0.54**	**-0.43**	0.04	**0.62**	**-0.44**	**-0.44**	-0.02	0.14	-0.29	**-0.47**	**-0.88**	1.00	
RES	-0.30	**-0.43**	**-0.44**	-0.22	0.25	-0.09	-0.08	-0.21	0.05	-0.03	**-0.45**	-0.34	0.31	1.00

For a significance level of $p<0.05$

Table 3 The regression analysis for the influence of somatotype components on competition

Variable	R	Part-R	Beta	Std.Err. - of Beta	t(27)	p-level
ENDO	-0.446	-0.393	-0.4247	0.1912	-2.2207	**0.0350***
MESO	-0.339	-0.226	-0.4225	0.3502	-1.2062	0.2382
ECTO	0.311	-0.132	-0.2585	0.3733	-0.6925	0.4945
R= 0.5023		R^2= 0.2523		F(3,27)=3.0368		p<0.0462*

For a significance level of $p<0.05$

The results in Table 3 show that there is a statistically significant influence of somatotype components on competition results in sport climbing at a multivariate level ($p<0.0462$). The multiple correlation coefficient was relatively high ($R = 0.5023$), while the coefficient of determination indicated a common variability of the system variables and criteria around 25% ($R^2 = 0.2523$). At the univariate level, only the endomorphic component had a statistically significant influence on the competition results ($p = 0.0350$).

4. DISCUSSION

The somatotype of sport climbers, who participated in the third round of the Serbian National Championship in sport climbing on natural rocks in 2013, was ectomorphic mesomorph, which is in accordance with the findings of Alvero-Cruz (2011) (1,34 – 5,22 – 3,05), and differs slightly from the findings of Viviani et. al. (1991) whose sample was mesomorph-ectomorph (2,0 ± 0,6 – 4,0 ± 0,8 – 3,7 ± 0,9). Together with previous studies, our findings confirm that mesomorphy and ectomorphy are dominant somatotype components within sport climbing athletes.

Since five competitors scored 0 points during two days of competition, and 10 of them had less than 500 points, we can assume that the selection of routes could have been inadequate for the sample studied in this research. The determination of competition results could also have influenced such a large range of results, as well as the form of the competition that suits climbers who have more endurance and experience.

Larger skin folds, i.e. a higher body fat percentage, have a negative effect on sport climbing results, meaning that competitors with lower body fat percentage had better results in this competition, since only the endomorphic component showed a statistically significant influence on the competition results. These findings confirm the assumption of Watts et al. (1993) that decreased endomorphy represents an advantage in climbing. In accordance with the results obtained by Binney et al. (2003) the ectomorphic component does not have an effect on success in sport climbing. Rather than absolute body weight, it is the higher percentage of body fat that has an influence on success in sport climbing. The results in this research show that some morphological characteristics, the endomorphic component in this case, can have an influence on sport climbing results, which does not coincide with the findings of foreign researchers (Mermier et al., 2000; España-Romero et al., 2006, Mladenov et al., 2009; Tomaszewski et al., 2011). In those studies, morphological characteristics did not show any significant influence on the results in sport climbing.

Future studies of the influences and relations of morphological characteristics on sport climbing results should be conducted with newly designed apparatuses for determining body fat percentage, absolute body fat, muscle mass percentage and absolute muscle mass, as well as the Ape index, arm length, finger and hand dimensions. The tests used in this research should be used on sport climbing athletes involved in competition climbing on artificial climbing walls in order to confirm or reject the results obtained in this study.

5. CONCLUSION

In accordance with the aim of this research, we can conclude that somatotype components have an influence on success in sport climbing. Sport climbers can benefit from low body fat which can improve their climbing results. This statement does not mean that being underweight and anorexic can improve climbing results. Climbers should carefully plan their diet together with their training program in order to decrease their fat mass percentage. Reduced body weight on the account of body fat can help in achieving better climbing results due to the decrease in the total weight that climbers have to carry up the climbing wall.

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UTICAJ KOMPONENTI SOMATOTIPA NA USPEH U SPORTSKOM PENJANJU

Cilj ovog istraživanja je bio da se utvrdi da li postoji uticaj komponenti somatotipa na uspeh u sportskom penjanju na prirodnim stenama. Istraživanje je izvršeno na 31 sportskom penjaču iz Srbije, muškog pola (starosti: 28.1 ± 5.5 godina, telesne visine 181.2 ± 6.5cm, težine 72 ± 6.2kg) sa penjačkim iskustvom od 6.7 ± 4.1 godina. Deset mera je korišćeno za izračunavanje komponenti somatotipa, dok je regresiona analiza korisćena za utvrđivanje uticaja komponenti somatotipa na rezultate takmičenja. Rezultati su pokazali da postoji statistički značajan uticaj komponenti somatotipa na rezultate takmičenja. Endomorfna komponenta je pokazala statistički značajan uticaj na uspeh, dok mezomorfna i ektomorfna komponenta nisu uticale na uspeh u sportskom penjanju. Možemo zaključiti da sportski penjači mogu imati koristi od malog procenta telesnih masti, što može poboljšati njihove penjačke rezultate.

Ključne reči: *sportski penjači, endomorfna komponenta, mezomorfna komponenta, ektomorfna komponenta.*