

Original Article

Analysis of the morphological changes in beginning bodybuilders due to resistance training

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Abstract

Bodybuilding is the kind of sport in which a sportsman's body shape influences the competition results[1;23]. In spite of scientific researches in the sport anthropology there is the lack of information about morphological changes of beginner bodybuilders as a result of resistance training [17]. The aim of this study was to trace changes of somatotype of bodybuilders of first and second class during mass gaining period.

Materials and methods involved: a total of 22 male first and second class bodybuilders aged from 19 to 26 year old participated in this study. Body weight, Height, Skinfolds thickness (Triceps, Subscapular, Abdominal and Medial calf, Girths of tensed arm and calf, and two Breadths (Biepicondylar Humerus Breadth and Biepicondylar Femur Breadth) from each participants were measured before and after the basic period. The Height was 180±1.11sm. The body mass in the beginning of study was 78.9±1.29kg, in the end it was 79.64±1.22kg (t=2.91, p<0.01). Measurement indicators of skinfolds in the beginning and the end of study were: Triceps - 4.55±0.27mm; 4.59±0.21mm (t=0.25, p>0.05), Subscapular - 6.91±0.51mm; 6.86±0.40mm (t=0.23, p>0.05), Abdominal - 10.05±0.95mm; 9.14±0.67mm (t=2.3, p>0.05), Medial calf - 4.68±0.26mm; 4.64±0.22mm (t=0.29, p>0.05). The Morphological level before and after study was: Endomorphy - 2.45±0.20; 2.36±0.14 (t=1.05, p>0.05), Mesomorphy - 5.20±0.13; 5.58±0.14 (t=4.7, p<0.001), Ectomorphy - 2.08±0.11; 1.76±0.07 (t=3.03, p<0.01). The Girth of tensed arm was 41.3±0.33mm; 42.6±0.31mm (t=4.12, p<0.001), The Girth of Medial calf - 40.23±0.27mm; 41.09±0.37mm (t=3.07, p<0.01). Our study has showed the changes of somatotype of bodybuilders 1st and 2nd class during the basic period of preparation. Bodybuilders shifted their somatotype towards mesomorphic type during mass gaining period.

Key words: - bodybuilding, anthropometry, somatotypes, off-season period

Introduction

Anthropometry plays an important role in athlete selection and performance criteria in most kinds of sport [8; 9].

The peculiarity of bodybuilding is that it is a kind of sport which involves development of muscle groups that are estimated during the competition. The main aim of bodybuilding training is to develop muscles mass and body symmetry with the lowest possible fat percent. Body composition one is the most important factors for bodybuilders [12; 4]. Nevertheless, athletes with different somatotypes achieves outstanding performance during competition [3;5]. Sportsmen in bodybuilding are judged not by performance but by appearance, therefore body composition, muscle size and definition are critical elements of success. (J. Funct)

Somatometry is fundamental research method in anthropology. It can help to understand current morphological condition of a sportsman, expressed through 3 basic components of body composition. The somatotype is defined as the quantification of the present shape and composition of the human body [2; 22]. The theory of somatotypes was developed by American physiologist William Herbert Sheldon in 1940. According to this study, human body is related to three different biotypes and combinations of their components [20].

The Heath-Carter method of somatotyping is the most commonly used today [15; 16]. Endomorphy, Ectomorphy and Mesomorphy may be determined by using mathematical formulas which have been described by Carter [2]. According to Grasgruber and Cacek, 2008, the somatotype of bodybuilders is the closest to the ideal mesomorph and often achieves extreme points of mesomorphy.

The appearance and body shape of a person is known to be determined by his genotype as well as influenced by his environment, lifestyle, diet ets [8].

In scientific literature there are several data that show anthropometry of elite and low-profile sportsmen who specialize in different kinds of sport. According to Gutnik, 2015, the range of mesomorphy for football players was from 0 to 4.6, for basketball players from 4,5 to 5,9, and for kayaking 5,9 and higher.

Novoa-Vingnau shows that mesomorphic component was dominant in group of elite climbers, however the level of ectomorphy also was significantly different from non-climbers group [13].

Mohd Irman [11] investigated comparison between somatotypes of Indian bodybuilders and weightlifters. The result of this study showed that weight lifters have much more fat percentage than

bodybuilders [7]. Although there was no significant difference between this sportsmen in mesomorphy status, bodybuilders showed slightly more developed muscles than weightlifters. Furthermore, ectomorphy status of weightlifters tend to be less ectomorph than sportsmen who do bodybuilding. The research has also proven that bodybuilders have rate of anthropometry (2.9; 5.95; 1.56), which affirms that bodybuilders have strong level of mesomorphy.

It is well known [24] that one of the most effective way to shift anthropometry towards mesomorphy is gaining muscle mass. Now it is widely believed that hight-volume, multiple-set training is effective with respect to muscle hypertrophy. The reason may be in a great total muscle tension, metabolic stress or damage of muscles. Furthermore, it may be the result of the combination of all these factors [17; 21].

Existing data confirms that periodization is the most important aspect of the training in the kinds of sport such as bodybuilding or powerlifting. Several basic training principles which are overload, variation, specificity, and reversibility make a substantial effect in training process outcomes. In order of using the principles presented above sportsmen can avoid overtraining, optimize adaptation and increase their performance.

Bodybuilding is usually planned in two phases: off-season which is requires mass gaining on account of muscle hypertrophy and pre-competitive period, during which sportsmen try to develop muscle definition [14]. The mass-gaining period consists of anaerobic training with a high caloric and protein intake. Nevertheless, nowadays bodybuilders try not to gain too much body fat during this phase, given the complexity of losing it in the pre-competitive phase [18].

In spite of scientific researches in the sport anthropology there is the lack of information about morphological changes of beginner bodybuilders as a result of resistance training. The aim of our study is to observe alterations in body composition of first and second class bodybuilders during three months of mass-gaining phase.

Materials and methods

Participants: 22 male 1st and 2nd class bodybuilders aged from 19 to 26 years old took part in the study conducted.

Methods: Body mass was measured on digital scales BEURER BG 17 with accuracy of 100g and height with a vertical metric RPV-2000 with a 1mm accuracy; skinfold thickness was obtained by a Digital Body Fat Caliper with a 0,2 mm accuracy; the girths were measured with a Lipoelastic Tape Technique with 1 mm accuracy scale, breadths with a 1mm accuracy Rosscraft Campbell-type bone caliper.

For determination of a somatotype we used method of Carter and Heath [6]. Level of Endomorphy (EN) was calculated by application of the formula:

$$EN = 0.7182 + 0.1451(X) - 0.00068(X^2) + 0.0000014(X^3),$$

$$\text{Where } X = \frac{170.18 * (TS + SbS + SpS)}{BH}$$

Where BH - body height (sm), TS - triceps skinfold (mm), SbS - Subscapular skinfold (mm), SpS - Supraspinal skinfold (mm).

The formula for determine the level of Mesomorphy is:

$$M = 0.858(EW) + 0.061(KW) + 0.188(BC) + 0.161(CC) - 0.131(BH) + 4.5,$$

Where EW - Width of the elbow joint (sm), KW - Width of the knee joint (sm), BC - Circumference of the flexed biceps (sm), CC - Circumference of the calf muscle (sm);

The level of Ectomorphy was calculated by the formula:

$$EC = 0.732 (HWR) - 28.58,$$

Where HWR is height-weight ratio:

$$HWR = \frac{BH}{\sqrt[3]{W}}$$

Where BH - Body height (sm), W - Weight (kg).

We used the formula above for calculate level of Ectomorphy, because HWR was ≥ 40.75 in all cases.

All measurements were made in the beginning and in the end of study.

Statistical analysis. The results are presented as the Mean \pm Standard Deviation ($M \pm SD$). Since a normal distribution was confirmed, a t-test for dependent samples was performed to define differences between results. The data were analyzed with the licensed computer program Microsoft EXEL. Significant levels in all tests were set at $P \leq 0.05$.

Results

Results can be seen in the table I.

Table I.

Results obtained before and after three months of off-season period among bodybuilders first and second class

Indicator	Before		After		t	p
	Mean	± SD	Mean	± SD		
Weight, kg	78.9	± 1.29	79.6	± 1.22	2,91	<0.01
Triceps skinfold, mm	4.55	± 0.27	4.59	± 0.21	0,25	>0.05
Subscapular skinfold, mm	6.91	± 0.51	6.86	± 0.4	0,23	>0.05
Supraspinal skinfold, mm	10.05	± 0.95	9.14	± 0.67	2,3	<0.05
Calf skinfold, mm	4.68	± 0.26	4.64	± 0.22	0,29	>0.05
Circumference of the flexed biceps, sm	41.3	± 0.33	42.6	± 0.31	4,12	<0.001
Circumference of the calf muscle, sm	40.23	± 0.27	41.09	± 0.37	3,07	<0.01
Endomorphy level	2.45	± 0.2	2.36	± 0.14	1,05	>0.05
Mesomorphy level	5.20	± 0.13	5.58	± 0.16	4,7	<0.001
Ectomorphy level	2.18	± 0.15	02.08	± 0.11	3,03	<0.01

The results of analysis show us that bodybuilders have significantly shifted their anthropometry towards mesomorphic somatotype. It occurs due to gaining sportsmen's body mass. Indeed, there were observed increasing of circumference of flexed biceps ($p < 0,001$) and calf muscle ($p < 0,01$), however, significant changes of skinfold thickness were not discovered, except supraspinal skinfold ($p < 0,05$). Furthermore, ectomorphic level has decreased significantly ($p < 0,01$). The change of level of endomorphy was not discovered.

The figure shows that sportsmen after basic period are nearer to the center of somatochart and higher than before.

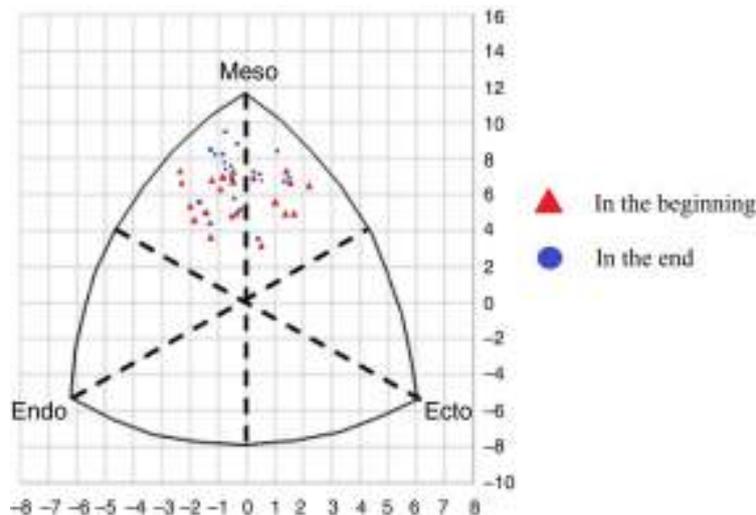


Fig. 1. Location of measured results in somatograph

Discussion

Despite the growing interest in bodybuilding research, there is still scant evidence about the morphological factors that determine success in this kind of sport. The objective of the study was to describe changes of somatotype of bodybuilders of the 1st and 2nd class during mass gaining period, which lasted three month. In our study, we found significant positive shifting of anthropometric parameters towards mesomorph [16]. It has been assumed that bodybuilders change their anthropometry parameters along with increasing their mastership. This study can be considered actual has never before been researched changing of bodybuilder's anthropometry in the off-season period.

Both showed the average value of bodybuilder's somatotype as 6.03, that means localization in endo-mesomorphic area. Similar result was obtained by Nikbakhsh [12], who showed low endomorphism (0.92 ± 0.24), high mesomorphism (6.86 ± 0.89), and low ectomorphism (1.84 ± 0.79) among Iranian bodybuilders, which can be classified as a balanced mesomorphism. However, Brazilian sportsmen had

significantly higher level of mesomorphy (8.10 ± 1.10). As a result, it can be suggested that low proportion of fat and high proportion of muscle, is great advantage in kind of sport as a bodybuilding.

These results were proved by Irman, who compared somatotypes of bodybuilders and Weight Lifters. It was showed that bodybuilders have level of mesomorphy as 5.95 ± 0.92 , Endomorphy - 2.90 ± 0.49 , Ectomorphy - 1.56 ± 1.19 .

The question of body physique and dominant somatotype regarding the level of sportsmen within different specialization have been investigated by Gutnik [8]. It was showed that the athletes of the elite groups, unlike the groups of low profile sportsmen, demonstrated a higher variability of endomorphic and mesomorphic level. Chatterjee proved this results and showed difference between constitution of low and high level athletes.

The index of mesomorphy depends on skeletal muscle mass in the human body. There are many kinds of sport where mesomorphic index is dominant. The average somatotype in elite sportsmen is balanced mesomorph. It has been shown that highly trained athletes demonstrate significantly greater measures of mesomorphy than beginners or non-trained men. The training process in most kinds of sport includes strong contractions of muscles that leads to increasing of muscle mass. Nevertheless, bodybuilders are interested in gaining muscle mass without percentage of fat growing. For this aim sportsmen use aerobic exercise and special diet which requires low carbohydrate [19].

Oroles's [14] study shows the improvement of fitness level under the influence of weight training. Sportsmen underwent the experiment during 40 weeks, and covered different training stages which included resistance from 75% RM to 85%RM and amount of reps was from 6 to 10 for each set. The Standart split system was used:

- Monday: pectoral, triceps, anterior deltoid;
- Wednesday: back, biceps, lateral and posterior deltoid
- Friday: things, calves, abdomen.

Exercises were changed and modified depending on goals of each stage. The improvement of strength ability in the bench press exercise was shown.

The results of this study confirmed the conclusion made by O. Tykhorskyi [23], in which elite bodybuilders during competitive period took part. According to this research percentage of body fat decreases in order to improvement level of sportsmen. It occurs due to increasing lean muscle mass and decreasing amount of fat in sportsmen's body. A special training program and supplementation were used to achieve these goals.

The study has several notable limitations that must be taken into account. First, under observation were male sportsmen so data does not apply to females. Second, in this study bodybuilders of 1st and 2nd class took part so the results for higher level sportsmen may be different. Third, observation carried out during three-month time however it would be useful to track changes during annual period. All of these last limitations point to necessity of exploring these problems in future studies.

Conclusion

It has been found that first and second class sportsmen who specialized in bodybuilding have changed their anthropometry indicators during mass gaining period which lasted three month. Monitoring of morphological changes showed significant increase in mesomorphy level on account of resistance training. Anaerobic exercises can be recommended for sportsmen of different specialization whose aim is to gain muscle mass and increase level of mesomorphy.

Conflict of interest – The authors declare that there is no conflict of interest.

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