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MORPHOLOGICAL FEATURES OF THE PHYSICAL STRUCTURE OF POWERLIFTERS OF DIFFERENT AGE AND LEVEL OF SPORTS QUALIFICATION

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Purpose: to identify and compare the characteristics of the physical development of people engaged in powerlifting, depending on the age and the level of sportsmanship.

Material and methods: to achieve this goal, the physical development of 32 male powerlifters was studied. To determine the physical development of athletes engaged in powerlifting, an anthropometric survey was conducted in a prominent contingent.

Results: according to the results of the calculation of the average values of the Pinier index, which determines the strength of the physique, it was found that in all studied groups a very strong physique prevails, but comparing age groups shows that qualified athletes have a more developed physique than their novice peers also reflected in the average shoulder diameter. The average indicators of the calculation of the Erisman index indicate that the studied contingent is characterized by chest hypertrophy, but the indicators of both groups of qualified athletes on average exceed those in the groups of beginners.

Conclusions: it was found that skilled powerlifters differ on average more weight and body length standing and sitting, relative long-legged, strong physique, chest hypertrophy, but slightly reduced mobility, well-developed muscles of the upper shoulder girdle and thighs and back (as evidenced by dynamometry results). The life index is calculated, which determines the possibilities of oxygen supply to the body and takes into account body weight, on average in all studied groups slightly below normal. This indicates that powerlifting does not sufficiently affect the development of aerobic capacity of athletes. Analysis of body composition indicates the optimal percentage of adipose tissue in all four study groups, which indicates that the comparative disproportion of individual indicators of physical development of athletes is due to the predominance or, conversely, lack of bone and muscle mass, which also confirms compliance with age calculated body mass index.

Keywords: sports morphology, power sports, qualified athletes, anthropometry, athletics.

Introduction

Currently, the development of power sports, in particular powerlifting, has gained unprecedented scope. Hundreds of thousands of people participate in competitions of strongmen, tens of thousands are regularly engaged in powerlifting (strength triathlon), bodybuilding and bodybuilding in sections under the guidance of professional trainers and independently, using available methodological literature [9, p.285; 11, p. 115].

Powerlifting classes increase muscle strength, strengthen ligaments and joints, help develop endurance and other useful qualities, cultivate willpower, self-confidence. Only a strong will can lead to the achievement of goals and to higher sports results.

Contrary to popular notions of strength sports, weightlifters, powerlifters and bodybuilders are similar only in that they chose a universal weight as a means of training - barbells, dumbbells and various exercise machines [2, p. 56; 8, p. 437].

It is impossible to compare not only their appearance, but also the indicators of their training, because training in each of these three sports differs in its specificity.

Human susceptibility to different training methods is also genetically determined. Highly skilled weightlifters tend to have a longer torso compared to leg length. The larger lever allows you to apply more acceleration to the fingerboard when performing tempo movements characteristic of weightlifting [1, p. 98; 7, p. 179].

Just like weightlifters, most powerlifters have a shorter torso than their legs. This gives them an advantage when performing deadlifts and squats.

As for bodybuilders, this is where we see the greatest variety of shapes, volumes and proportions. Among them are athletes with different ratios of torso and limb lengths. But the best has perfect proportions.

However, in the genotypes of the representatives of these three power sports there are common features [10, p. 241].

Genetically gifted weightlifter differs:

1. the predominance in the composition of muscle fibers that contract rapidly;
2. unexpressed structure of the pelvis or shoulder girdle;
3. longer torso compared to the length of the legs;
4. unexpressed trends in the thickness (circumference) of the joints;
5. very mobile elbow and ankle joints.

Genetically gifted bodybuilder is characterized by:

- predominance of rapidly shrinking fibers;
- narrow structure of the pelvis;
- wide structure of a shoulder girdle;
- aesthetically pleasing proportions of body parts;
- relatively small joint circumferences.

Genetically gifted powerlifter distinguishes:

- predominance of rapidly shrinking fibers;
- wide pelvic structure;
- wide structure of a shoulder girdle;

- short torso compared to the legs;
- vagueness of trends in joint thickness;
- longer (compared to average values) hands;
- for athletes equally performing in all three directions, this trend is not typical.

As you can see, a common feature of the three genotypes is a high percentage of rapidly shrinking muscle fibers [6, p. 25].

Some differences are also due to the content and methods of training. In bodybuilders, the effort is distributed evenly across all muscle groups, and as a result of their development, the external proportions of the athlete improve. Powerlifters and weightlifters care about the development of mainly those muscle groups that ensure the achievement of high strength results. These differences are manifested in the appearance of these three sports.

Bodybuilders strive for a balanced development of all muscle groups.

Weightlifters tend to look the same as any other strength-related sport; exceptions are more powerful trapezius muscles, triceps and rectifiers of the spine, as well as more clearly developed muscles of the upper thighs [3, p. 35].

Powerlifters develop strong muscles of the thighs, buttocks, back, chest, frontal deltoids and triceps.

As for the training method itself, we observe a great variety of exercises in bodybuilders, the number of approaches and repetitions, styles of movements in the exercises. In other words, they use a holistic approach in the development of muscle volume. This approach is acceptable for weightlifters and powerlifters only during certain periods of training cycles, because the increase in strength is less than in the "explosive" mode of exercise, when the weight rarely falls below 60% below the maximum possible in the approach. Such loads are able to stimulate the growth of muscle contractility, necessary for the manifestations of great strength [5, p. 158].

The analysis of strength training in powerlifting shows the unresolved number of issues related to the individualization of the training process and management of the physical condition of athletes, biomechanical parameters of competitive exercises, means of improving special strength training.

Purpose of the study: to identify and compare the characteristics of physical development of people engaged in powerlifting, depending on age and level of sportsmanship.

Material and Methods of research

To achieve this goal, the physical development of 32 male powerlifters was studied, which were divided into 4 groups. The first group (NQ1) included 8 novice athletes aged 17-22 years, whose training experience ranged from 3 months to 1 year. The second group (NQ2) included 8 athletes who do not have sports qualifications, aged 22-42 years, whose training experience ranges from 3 months to 2 years. The third group (QU1) consisted of 9 qualified athletes aged 16-22, including 2 masters of sports of international class, 1 master of sports, 5 Candidates for Masters of Sports and 1 athlete of the second adult category. The fourth group (QU2) consisted of 7 qualified athletes aged 23-51, including Honored Master of Sports, Master of Sports of international class, 4 Masters of Sports and 1 athlete of the 1st adult category. The training experience of qualified athletes is from 1 to 30 years. This distribution of athletes allows more differential assessment of morphological parameters of athletes, taking into account not only the level of sportsmanship, but also the biological age of the studied contingent, because with age in the human body there are certain changes in body composition.

Under the physical development of man understand the complex of morphological and functional properties of the organism that determine the stock of his physical strength. From this definition it is obvious how important the assessment of physical development is for the organization of trainings. The state of health and level of physical development of a person are factors that determine the possibility and nature of exercise. Body structure and condition of the musculoskeletal system are important criteria when choosing means and methods of training [4].

To determine the physical development of athletes engaged in powerlifting, an anthropometric survey (anthropometric measurements) was conducted in a prominent contingent. Anthropometric measurements should be performed in the morning, on

an empty stomach, with standard proven instruments according to generally accepted methods.

Body length (BL) – measured with a height meter or anthropometer. When measuring the subject becomes barefoot on the site of the height meter, heels, buttocks and interscapular area touch the vertical rack, the chin is slightly lowered so that the outer corner of the eye and the auricle were on the same horizontal. It is not necessary that the nape touches the vertical rack. The horizontal bar is lowered and slightly pressed to the crown; the reading is on a scale with an accuracy of 0.5 cm.

Body weight (BW) – measured naked to underwear on medical scales with an accuracy of 0.1 kg.

Neck circumference – measured by a centimeter tape applied under the thyroid cartilage. Chest girth – at the lower corners of the shoulder blades behind and at the level of the nipples in men and children and on the upper edge of the breast in women in front (chest girth is measured in three states: deep breathing, full exhalation and intermediate state). Abdominal girth – at the level of the umbilical point (measured at the time of pause between inhalation and exhalation). Thigh girth – under the buttocks (in the initial position: legs shoulder-width apart with even weight distribution on both legs). Shin girth – in the widest place of the calf muscle (in the initial position: legs shoulder-width apart with even weight distribution on both legs). Shoulder girth at rest - in the widest place of the shoulder muscle (arm hangs freely, muscles in a relaxed state). The girth of a tense shoulder – in the widest part of the shoulder (arm in a horizontal position, bent at the elbow, muscles as tense as possible). Forearm girth – in the widest place (arm hangs freely, muscles are relaxed).

Vital capacity of the lungs (VCL) – the measurement is made in a standing position, when the athlete performs 2-3 deep breaths and full exhalations, then performs 2 attempts of forced exhalation after a deep breath into the mouthpiece of the spirometer (nose during the test must be clamped). The best result is taken into account.

The study of the strength of the muscles of the palm and back is performed using wrist and post dynamometers. The strength of the muscles of the palm is

determined separately for the right and left hands with an accuracy of 2 kg, the strength of the muscles of the back – with an accuracy of 5 kg.

Measurement of body girth is usually performed to assess the proportionality of body structure, which is determined using indices.

Some indicators of girth are included in the formulas for calculating the component composition of the body in determining the fat and muscle content, as well as in determining the somatotype. In the dynamics (with a known influence), the girth indicators can be used as a criterion for the content of adipose or muscle tissue in a particular area of the body [4].

It is well known that determining the component composition of the body is important in sports and is used by coaches and sports doctors to optimize training regimes in preparation for competitions.

The OMRON-BF 306 is used for speed and ease of measuring the percentage of fat. The percentage of body fat is determined on the basis of measuring electrical resistance, taking into account such individual patient data as weight, height, age and sex.

The method of indices is most often used to assess physical development, as it operates on the relations of various anthropometric indicators, which in their relations are quite stable, and deviations indicate the characteristic features of physical development. More often, body mass, body length or their derivatives – body mass index and body surface area – are used as basic indicators included in the indices.

The most commonly used body mass index (Kettle's index, or BMI). The index is calculated according to the following formula:

$$BMI = \frac{BW\ (kg)}{BL\ (m)^2}$$

where: BW – body weight in kg, BL – body length in meters.

Indices of proportionality of body development are widely used, which include the Erisman, Manouvrier, and Pinye indices.

The Erisman Index (EI) determines the proportionality of chest development:

$$EI = CHC\ (cm) - ½\ BL\ (cm)$$

where: BL – body length (cm), CHC – chest coverage in a pause (cm).

The normative indicator of IE for men is +5.8 cm; for women – +3.3 cm. If the index is less than these numbers or with a negative sign, the chest is narrow; if more than these, on the contrary, wide. The Manouvrier Index (MI) determines the percentage of leg length to torso length:

$$MI = \left(\frac{BL\ (standing)}{BL\ (sitting)} - 1\right) x100$$

where: BL standing – body length in the standing position, cm; sitting – body length in a sitting position, cm

The proportionality of the length of the legs and torso corresponds to the value of the index equal to 87-92%, at lower values is determined by the relative short-leggedness, at larger – the relative long-leggedness. Body Proportionality Index (BPI):

$$BPI = BL\ sitting - (BL\ standing - BL\ sitting)$$

regulatory values are 9.5 for men and 12.5 for women.

Body strength index (Pinye index):

Pinye index = BL (cm) - (BW (kg) + CHC (on exhalation, cm))

Grade: less than 10 – strong physique; from 10 to 20 – good; from 21 to 25 – average; from 26 to 35 – weak; more than 36 – very weak.

To assess the capabilities of the respiratory system it is necessary to compare the measured indicator of vital capacity of lungs (VCL) with proper. Proper VCL for men can be determined by the formula:

$$VCL\ (l) = (0.0600 * BL\ (cm)) - (0.0214 * Age\ (years)) - 4{,}650$$

where: BL - body length in cm

Life Index (LI) calculated to assess the body's oxygen supply:

$$LI = \frac{VCL}{BW}$$

where: VCL - vital capacity of the lungs in ml; BW - body weight in kg, standard values for men are 65-70 ml/kg, for women – 55-60 ml/kg.

The analysis of the obtained research results was carried out by the method of

descriptive statistics. By using programs Microsoft Office Excel (Microsoft Corporation, USA) calculated the average values for each of the studied indicators, the standard deviation, as well as the p-criterion of reliability.

Results of the research

According to the results of the research, the average indicators of physical development of the selected contingent are calculated, which are presented in the table.

Table 1

Average indicators of physical development of persons engaged in powerlifting

Indicator	NQ1 M ± σ	NQ2 M ± σ	QU1 M ± σ	QU2 M ± σ
Body weight, kg	77.88 ± 3.71 *	83.50 ± 1.90*	77.56 ± 2.12*	83.07 ± 1.88*
Body length, cm	176.63 ± 2.42*	181.00 ± 3.35*	174.22 ± 1.93*	177.86 ± 1.68*
Body length (sitting), cm	91.44 ± 1.70*	94.13 ± 1.64*	89.33 ± 0.58*	92.00 ± 1.29*
Manouvrier index	93.31 ± 1.62*	92.32 ± 1.76*	95.03 ± 1.81*	93.45 ± 2.04*
PPI	6.25 ± 1.66*	7.25 ± 1.67*	4.44 ± 1.62*	6.14 ± 1.90*
Pinye index	3.25 ± 4.97*	-5.38 ± 3.75*	-1.67 ± 3.52*	-11.93 ± 4.10*
Diameter of shoulders, cm	39.50 ± 1.72*	41.94 ± 0.72*	40.72 ± 0.68*	42.86 ± 0.78*
Neck girth, cm	39.00 ± 1.55*	37.63 ± 0.80*	37.33 ± 0.76*	40.29 ± 0.92*
Abdominal girth, cm	82.38 ± 3.60*	92.00 ± 2.90*	79.00 ± 2.85*	96.71 ± 4.87*
OGK (pause), cm	99.75 ± 3.58*	105.75 ± 2.45*	100.44 ± 1.62*	109.29 ± 2.91*
Erisman index	11.44 ± 3.36*	15.25 ± 3.05*	13.33 ± 2.07*	20.36 ± 3.46*
CHC (breath), cm	104.25 ± 3.34*	109.50 ± 2.31*	105.78 ± 1.61*	114.14 ± 2.96*
CHC (exhale), cm	95.50 ± 2.98*	102.88 ± 2.34*	98.33 ± 1.63*	106.71 ± 2.50*
Excursion, cm	8.75 ± 0.59*	6.63 ± 1.00*	7.44 ± 0.38*	7.43 ± 1.19*
Shoulder circumference, cm	32.63 ± 1.18*	32.63 ± 0.60*	31.61 ± 0.76*	36.86 ± 1.78*
Shoulder girth (tension), cm	36.69 ± 1.73*	37.50 ± 0.85*	36.44 ± 0.65*	40.79 ± 2.00*
Forearm girth, cm	27.69 ± 0.95*	27.69 ± 0.53*	28.22 ± 0.49*	30.00 ± 1.00*
Coverage tightened, cm	57.63 ± 2.40*	58.56 ± 1.11*	57.33 ± 1.07*	65.57 ± 3.16*
Shin circumference, cm	37.44 ± 1.64*	36.88 ± 0.99*	34.89 ± 0.88*	37.57 ± 2.39*
Dynamometry right, kg	52.00 ± 3.31*	56.63 ± 1.12*	55.33 ± 3.18*	60.57 ± 4.55*

Continuation of Table 1

Dynamometry left, kg	48.00 ± 3.95*	51.00 ± 1.56*	52.33 ± 2.89*	55.71 ± 2.71*
Condition dynamometry, kg	146.88 ± 12.28*	148.63 ± 11.04*	168.13 ± 5.66*	185.00 ± 5.88*
VEL, ml	4588.7 ± 199.3*	5225.0 ± 352.5*	4578.8 ± 254.8*	4960.0 ± 243.6*

Proper VL, ml	4426.8 ± 58.7*	4321.0 ± 125.9*	4364.7 ± 49.1*	4185.9 ± 123.6*
Life index	59.39 ± 2.51*	62.42 ± 3.55*	59.86 ± 4.38	59.81 ± 3.02*
Relative fat content, %	18.61 ± 1.62*	21.84 ± 1.95*	16.13 ± 2.00*	22.09 ± 2.61
Body mass index	24.87 ± 0.77*	25.56 ± 0.67*	25.59 ± 0.77*	26.31 ± 0.84*

Note. The result is considered statistically significant if $p < 0.05$.

* - reliability $p < 0,05$.

Comparing the results obtained, we can say that on average more weight and length of the body standing and sitting are observed in the senior groups of beginners and skilled athletes.

Evaluating the calculation of the Manouvrier index, it is seen that on average the optimal ratio of torso and legs is observed in the older group of beginners, in other groups on average there is relative long-leggedness, which is also reflected in the average values of the calculated body proportionality index.

The average values of the Pinye index, which determines the strength of the physique, indicate that all studied groups are dominated by a very strong physique type, but comparing age groups shows that skilled athletes have a more developed physique than their novice peers, which is also reflected in average shoulder diameter. To some extent, this indicates the impact of powerlifting, rather than the manifestation of age.

The highest average neck coverage was observed in the senior group of qualified athletes (40.29 ± 0.92 cm). Relatively the smallest coverage of the abdomen is observed in the group QU1 (79.00 ± 2.85 cm), relatively the largest - in the group QU2 (96.71 ± 4.87 cm), which to some extent indicates the age features of the physique.

The average indicators of the Erisman index calculation indicate that the studied contingent is characterized by chest hypertrophy, but the indicators of both groups of qualified athletes on average exceed those in the groups of beginners.

The best average rate of chest excursion was observed in the younger group of beginners (8.75 ± 0.59 cm), slightly worse indicators were observed in groups QU1 and QU2 (7.44 ± 0.38 cm and 7.43 ± 1.19 cm, respectively), which indicates that insufficient attention is paid to the training of respiratory muscles.

Analyzing the average results of measurements of shoulder girth (relaxed and tense) and forearm, it is seen that in all studied groups the muscles of the upper shoulder girdle are sufficiently developed, which indicates a specific effect of powerlifting even in the early stages of training. It is obvious that in the group QU2 the largest indicators of these coverage were found.

Also, in the group QU2 there was a relatively greater hip coverage (65.57 ± 3.16 cm), which in some way reflects the longtime of powerlifting. Relatively the lowest coverage of the tibia was observed in the group QU1 (34.89 ± 0.88 cm), but this figure is proportional, given that in the group QU1 it does not differ from other groups with severe femoral hypertrophy. That is, we can assume that the load in powerlifting has a relatively more significant impact on the development of thigh muscles.

The average values of posture and wrist dynamometry are expected to be relatively higher in both groups of qualified athletes, although the indicators of posture dynamometry in both groups of beginners are almost the same. This fact indicates the specific effect of powerlifting on the development of back muscle strength.

Analyzing the experimentally obtained indicators of vital capacity of the lungs, it is seen that on average relatively better results were shown by athletes of older groups (NQ2 – 5225.00 ± 352.52 ml and 4960.00 ± 243.63 ml – QU2), which is due to age-related physiological features. This is confirmed by the fact that the calculated values of the appropriate for each age VCL in any of the groups do not exceed the empirically obtained. That is, VCL in all study groups exceeds the age norms. But the calculated vital index, which determines the possibilities of oxygen supply to the body and takes into account body weight, on average in all studied groups is slightly below the sexual norm. This indicates that powerlifting does not sufficiently affect the development of aerobic capacity of athletes.

Analysis of body composition indicates the optimal percentage of adipose tissue in all four study groups, which indicates that the comparative disproportion of individual indicators of physical development of athletes is due to the predominance

or, conversely, lack of bone and muscle mass, which also confirms compliance with age calculated body mass index.

Conclusions / Discussion

According to the results of the analysis of literature sources revealed that the training process in powerlifting must be built using significant strength loads, which are aimed at comprehensive involvement of the muscles involved in the competitive exercise. At the same time, the principle of separate training should be used, when during one day you perform a competitive exercise and auxiliary exercises for the muscles involved in the main exercise. The characteristic influence of certain types of power sports on the formation of morphological features of athletes and their role in the construction of the training process is also determined.

According to the results of the study of physical development of the selected contingent, it was found that skilled powerlifters differ in average greater weight and length of standing and sitting, relative long-legged, strong physique, chest hypertrophy, but slightly reduced mobility, well-developed muscles of the upper shoulder girdle and thighs and back (as evidenced by the results of dynamometry).

The life index is calculated, which determines the possibilities of oxygen supply to the body and takes into account body weight, on average in all studied groups slightly below the sexual norm. This indicates that powerlifting does not sufficiently affect the development of aerobic capacity of athletes.

Analysis of body composition indicates the optimal percentage of adipose tissue in all four study groups, which indicates that the comparative disproportion of individual indicators of physical development of athletes is due to the predominance or, conversely, lack of bone and muscle mass, which also confirms compliance with age calculated body mass index.

The results indicate the feasibility of using the proposed research methods. The novelty of the study lies in the rather informative experimental distribution of the studied groups not only by the level of sportsmanship, but also by age. Thus, it was possible to differentiate the impact of powerlifting on the morphological characteristics of athletes and age-related changes in the physique of the studied

contingent. In general, the obtained results confirm and supplement the statements of Starostin V.G., Krivoshapkina P.I., Platonova D.N., Alekseeva L.S. [4] on the morphological features of the selected contingent. Further research in this area will be to study the features of the functional state of athletes engaged in powerlifting.

Prospects for further research. For the given field of training, it is possible to visit the special features of the functional camp of athletes, to engage in powerlifting.

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