Comparative analysis of competitive and specially preparatory exercises of women's arm wrestling

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Abstract

Objective of the study was to identify effective special-preparatory exercises for female armwrestlers based on the developed criterion for assessing the manifesta-tion of speed-strength abilities.

Methods and structure of the study. During the experiment, the electrical activity of the five main muscles of the upper limb of female armwrestlers was studied, followed by statistical processing. The experiment involved nine female athletes (age - 23.3 ± 1.9 years, height - 164.5 ± 1.2 cm, weight - 59.2 ± 2.0 kg) of the entry level, specializing in arm wrestling. After a ten-minute warm-up, the subjects performed competitive exercises using the “hook” and “top” methods and six special preparatory exercises.

Results and conclusions. The proposed method makes it possible to single out special preparatory exercises that are most effective for developing the power and strength of a certain muscle group. The most effective exercises for sportswomen performing exercises using “hook” and “top” methods have been determined.

Keywords: *arm wrestling, women, speed-strength abilities, special preparatory exercises, electromyography, efficiency coefficient.*

Introduction. At present, a sport called arm wrestling has become widespread in the world - one of the types of arm wrestling between two participants. This sport allows you to quickly and evenly develop all muscle groups, and also improves health (S.Yu. Makhov, 2016).

For a long time, arm wrestling was a purely male sport, although female arm wrestling is also actively developing at present, however, studies devoted to studying the features of women’s strength training are clearly not enough. This is especially felt in the field of strength training of female armwrestlers. It is still not clear how effective the used specially-preparatory exercises are for the development of the speed-strength qualities of female athletes.

Objective of the study was to reveal effective special-preparatory exercises of female armwrestlers.

Methods and structure of the study. Electromyography (EMG) was used to study the electrical activity of five major muscles that move the arms of the upper limb in arm wrestling: flexor carpi radialis (FCR); brachioradialis (BR); long head of the biceps brachii (BBcL); the lateral head of the triceps brachii (TBcL) and the latissimus dorsi (LAT). To record the electrical activity of the muscles, telemetric sensors of the Trigno Avanti Research + system were used, localized above the muscle belly in the projection of the motor zone. The EMG signals were processed using the EMG Works Analysis software. The root-mean-square value of the signal amplitude (RMS) of the entire activity area (mV) was calculated.

The experiments involved nine female athletes (age - 23.3±1.9 years, height - 164.5±1.2 cm, weight - 59.2±2.0 kg) of the entry level, specializing in arm wrestling.

After a ten-minute warm-up, the subjects performed competitive exercises using the “hook” and “top” methods and six special preparatory exercises:

flexion of the hand with the forearm resting on the roller without tilting the body; flexion of the hand with the support of the forearm on the roller with the torso tilted; flexion of the hand in a static position without tilting the torso; flexion of the hand in a static position with an inclination of the torso; lifting the barbell for biceps with a regular grip; lifting the bar for biceps with a reverse grip. The weight of the rod was 90% of the maximum. All exercises were performed three times. In the future, the best attempt was chosen for comparative analysis. The figure shows the moment of the experiment.

Statistical data processing was carried out using the Statgraphics Centurion V.16 package. The arithmetic mean and the error of the arithmetic mean were calculated.

The moment of the experiment

Results of the study and their discussion. For a comparative analysis of competitive and special-preparatory exercises, the RMS indicator was chosen as the most accurately characterizing the manifestation of the speed-strength abilities of athletes (L.L. Tsipin, F.E. Zakharov, 2020).

It should be noted that the RMS values obtained by recording EMG in different subjects should be normalized, because the amplitude of the electrical activity of the muscles is affected not only by the degree of muscle excitation, but also by other factors, for example, the electrical resistance of the athlete (DeLuca C.J., 1997). When normalized by amplitude, in the present study, the indicators obtained from the analysis of special preparatory exercises were compared with the result in the test exercise. Competitive exercises performed in two versions were chosen as test exercises: the "hook" method and the "top" method.

During the subsequent processing of the data of each exercise, the efficiency coefficient was determined (A.V. Samsonova, 1998; L.L. Tsipin, 2018), based on the calculation of the efficiency coefficients for the studied muscles.

The efficiency coefficient was calculated by dividing the RMSex value achieved during the performance of special preparatory exercises by the RMScomp value obtained for the competitive exercise.

$$K_{ef} = \frac{RMS_{ex}}{RMS_{comp}} .$$

If the value of the efficiency coefficient was more than one, it meant that the specially-preparatory ex-

Table 1. *Efficiency coefficients and rating of specially-preparatory exercises (competitive exercise by the "hook" method), n=5*

Exercises	Muscles					∑	M	R
	FCR	BR	BBcL	TBcL	LAT			
Flexion of the hand with the support of the forearm on the roller without tilting the body	1,37	1,16	1,29	1,10	1,05	5,97	1,19	1
Lifting the barbell for biceps with a regular grip	1,35	1,49	1,38	0,84	0,72	5,78	1,16	2
Flexion of the wrist in a static position without tilting the torso	1,67	0,98	1,15	0,60	0,86	5,26	1,05	3
Flexion of the hand with the support of the forearm on the roller with a tilt of the torso	1,04	0,86	1,48	0,68	0,66	4,72	0,94	4
Lifting the bar for biceps with a reverse grip	1,20	0,60	1,26	0,79	0,61	4,46	0,89	5-6
Flexion of the wrist in a static position with a tilt of the torso	1,11	1,08	0,81	0,54	0,89	4,43	0,89	5-6

Notations: ∑ – the sum of the values of muscle efficiency coefficients; M is the arithmetic mean of the efficiency coefficients; R is the exercise rating.

Table 2. *Efficiency coefficients and rating of special-preparatory exercises (competitive exercise in the "top" way), n=4*

Exercises	Muscles					∑	M	R
	FCR	BR	BBcL	TBcL	LAT			
Flexion of the hand with the support of the forearm on the roller without tilting the torso	0,94	0,96	1,44	1,43	2,27	7,04	1,41	1
Flexion of the hand with the support of the forearm on the roller with a tilt of the torso	0,84	0,76	1,30	1,02	1,53	5,45	1,09	2-3
Flexion of the wrist in a static position without tilting the torso	1,14	0,87	1,02	0,75	1,66	5,44	1,09	2-3
Lifting the barbell for biceps with a regular grip	1,08	1,06	1,24	1,09	0,75	5,22	1,04	4
Flexion of the wrist in a static position with a tilt of the torso	0,92	1,08	0,81	0,77	0,96	4,54	0,91	4
Reverse barbell lift	0,85	0,33	0,81	0,73	0,74	3,46	0,69	6

Notations: ∑ – the sum of the values of muscle efficiency coefficients; M is the arithmetic mean of the efficiency coefficients; R is the exercise rating.

ercise exceeded the competitive exercise by some indicator.

After that, the average value of the efficiency coefficient was calculated for each muscle. Evaluation was made only for female athletes (n=5) who performed the competitive exercise using the "hook" method. Then the rating of each exercise was determined, which was based on taking into account the efficiency coefficients of all the studied muscles. The obtained values of the efficiency coefficients and the rating of the exercises are presented in Table 1.

The efficiency ratios presented in Table 2 were determined in a manner similar to that described above. At the same time, the data of female athletes (n=4) who performed the competitive exercise using the "top" method were used in the calculation.

Conclusions. For the development of speed-strength qualities of female athletes performing competitive exercises using the "hook" method, the following special preparatory exercises are the most effective:

- flexion of the hand with the support of the forearm on the roller without inclination of the torso;
- lifting the bar for biceps with a regular grip;
- flexion of the wrist in a static position without torso tilt.

For the development of speed-strength qualities of female athletes performing competitive exercises using the "top" method, the following special-preparatory exercises are the most effective:

- flexion of the hand with the support of the forearm on the roller without tilting the torso;
- flexion of the hand with the support of the forearm on the roller with the inclination of the torso;
- flexion of the wrist in a static position without torso tilt.

References

1. Makhov S.Yu. Silovaya podgotovka [Strength training]. Teaching aid. Orel: Mezhregionalnaya Akademiya bezopasnosti i vyzhivaniya publ., 2016. 160 p.
2. Samsonova A.V. Motornye i sensornye komponenty biomekhanicheskoj struktury fizicheskih uprazhnenij [Motor and sensory components of the biomechanical structure of physical exercises]. Doct. diss. (Hab.). St. Petersburg, 1997. 359 p.
3. Tsipin L.L. Biomekhanicheskoe obosnovanie principov i metodov optimizacii uprazhnenij specialnoj silovoj napravlennosti v ciklicheskih vidah sporta i sportivnyh edinoborstvah [Biomechanical substantiation of the principles and methods of optimizing exercises of a special strength orientation in cyclic sports and martial arts]. Doct. diss. (Hab.). 2018. 486 p.
4. Tsipin L.L., Zakharov F.E. Elektromiografiya v sportivnoj biomekhanike [Electromyography in sports biomechanics]. Proceedings of the Department of Biomechanics Lesgaft NSU, St. Petersburg, 2020. No. 14. 2020. pp. 65-78.
5. De Luca C.J. The Use of Surface Electromyography in Biomechanics. Journal of Applied Biomechanics, 1997. Vol. 13. pp. 135-163.