ATLANTIS PRESS

Advances in Health Sciences Research, volume 17

4th International Conference on Innovations in Sports, Tourism and Instructional Science (ICISTIS 2019)

Pre-competitive training of weightlifters based on indicators of the functional status and hemodynamics

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Abstract. The purpose of the article is to individualize the pre-competitive training of highly skilled weightlifters based on the indicators of the cardiovascular system and initial functional status. Materials and methods. The hemodynamics indices were determined with the help of impedance rheography using a certified Centaur computer technology (Microlux, Chelyabinsk). The characteristics of central and peripheral hemodynamics in horizontal and vertical position were revealed. Results. The study proved the effectiveness of individualized training (based on CCC indicators) in the pre-competitive period for successful performance at the main competitions of the season. Conclusion. The results of competitions proved the effectiveness of individualized training.

Keywords - individualization, pre-competitive preparation, cardiovascular system, highly skilled weightlifters.

I. INTRODUCTION

One of the key problems in the formation of high competitive performance in weightlifting is the individualization of pre-competitive training based on the achieved level of physical fitness and the current functional status of the athlete's body [2, 3]. The cardiovascular system is one of the limiting systems for maintaining homeostasis in the conditions of motor activity, which is necessary to ensure energy production in accordance with the needs of the body and mitigate the effects of aggressive actions on the internal environment and metabolites [1, 4, 6, 7].

II. MATERIALS AND METHODS

The study was conducted on the premises of the Research Center for Sports Science of the South Ural State University. For analysis, we used survey data for the period 2012-2016. Weightlifters of high qualification (n = 30) with the same level of physical fitness, aged 18-24 years participated in the study. The survey was conducted at the beginning and end of each stage.

The hemodynamic parameters were determined with the help of impedance rheography using a certified computer technology (Centaur, Microlux, Chelyabinsk). The characteristics of central and peripheral hemodynamics in the horizontal and vertical positions (active orthostatic test) were revealed. Myocardial contractility was evaluated by the values of the ejection fraction (EF%). Heart performance was assessed by stroke volume (SV, ml) and heart rate (HR, bpm).

A spectral analysis of heart rate (HR), mean dynamic pressure, stroke volume (SV) was performed. In each position, the absolute values of the parameters and their variability were automatically recorded over a period of 500 heartbeats (ECG) using the fast Fourier transform. Fluctuations were considered as a measure of the autonomic regulation of blood circulation. The power of the spectral density was estimated as a function of frequency; the standard deviation is the standard deviation of the duration of the R-R intervals. The study was carried out in four spectral ranges: 1. Ultra-low-frequency range (ULF) - reflects the activity of metabolic regulation; 2. Very low frequency range (VLF) - reflects the activity of higher centers of autonomic regulation; 3. Low-frequency range (LF) - reflects the activity of the sympathetic system; 4. High-frequency range (HF) - reflects the influence of the parasympathetic system. Statistical data processing was carried out using the Statistica V.10.0. software.

III. RESULTS AND DISCUSSION

Based on the initial functional status of athletes (high, decreased and low) at the beginning of the pre-competitive stage, the optimal options for the training process were determined. The optimal duration of loads is determined by the rational sequence of their alternation. There is a sufficient amount of empirical material about the duration of pronounced and stable adaptation changes of an individual pre-competitive nature. Taking into account the initial status of the athletes, individual description of the main training components was carried out (number of bar lifts (NBL), average weight (Table 1)).

TABLE 1 - GENERAL TECHNOLOGICAL CHARACTERISTICS OF PRE-COMPETITIVE PREPARATION OF HIGHLY SKILLED WEIGHTLIFERS (N = 30)

Initial status	Load parameters	Formation of special fitness				Integral values
		I	II	III	IV	
1. High - average values	NBL NBL, % Average weight, %	475 23.5 73.3	350 17.3 72.0	480 23.7 74.7	360 17.8 75.9	20251 010.0 73.4
2.Decreased - average values	NBL NBL, % Average weight, %	380 21.9 76.3	350 20.2 72.5	320 18.5 77.1	300 17.3 74.3	1730 100.0 75.0
3.Low - average values	NBL NBL, % Average weight, %	400 23.7 76.4	360 21.3 74.6	240 14.2 80.4	330 19.5 80.2	1690 100.0 76.1

According to the data obtained (Table 2) at the beginning of the experiment, all weightlifters did not differ from each other in the studied parameters (p> 0.05).

TABLE 2 - INDICATORS OF HEART FUNCTION IN VERTICAL AND HORIZONTAL POSITIONS IN HIGHLY SKILLED WEIGHTLIFTERS AT THE BEGINNING OF THE PRE-COMPETITIVE PERIOD (N = 30)

Test	HR, bpm	SV, ml	TSP (SV), ms^2	EF, ml	TSP (EF), ms^2
Control group (CG) (n=15)					
Horizontal	80.60±4.20	94.50±12.40	18.20±4.60	59.20±1.90	4.90±1.50
Vertical	104.40±5.80	66.00±8.60	142.40±18.70	54.30±1.80	3.20±1.60
t_p p_1	3.324 (<0.01)	1.888 (>0.05)	6.435 (<0.001)	1.870 (>0.05)	0.752 (>0.05)
Experimental group (EG) (n=15)					
Horizontal	81.20±2.60	95.20±9.20	20.20±8.10	60.10±1.90	5.00±1.60
Vertical	101.20±4.00	68.30±7.60	151.80±15.60	56.10±1.30	3.80±1.40
t_p p_2	4.193 (<0.001)	2.225 (<0.05)	7.486 (<0.001)	1.739 (>0.05)	0.563 (>0.05)
t_p p_3	0.121 (p>0.05)	0.045 (p>0.05)	0.215 (p>0.05)	0.335 (p>0.05)	0.046 (p>0.05)
t_p p_4	0.454 (p>0.05)	0.200 (p>0.05)	0.386 (p>0.05)	0.811 (p>0.05)	0.282 (p>0.05)

The average heart rate corresponded with the reference values for a healthy person, but did not match the data for weightlifters described in the literature of the 80-90s of the last century [2, 4]. However, an analysis of the literature of recent years allows us to consider heart rate values in the range of 75-82 bpm as within the reference values for highly qualified weightlifters [1, 5]. Heart rate at rest was within normal limits for a healthy person. The transition to the upright position (orthostatic test) significantly changes the pumping function of the heart and the power of its regulation. Blood SV decreases (p <0.05 in all cases) with a simultaneous increase in its regulation power (p <0.001 in all cases). The volume of EF remains unchanged. A significant increase in heart rate with a simultaneous decrease in blood SV decreases the efficiency of the heart, which indicates tension in the cardiovascular system and possible premorbid conditions in weightlifters of both groups.

The data of spectral analysis of the contribution of various regulatory mechanisms of SV and EF to TSP indicate that at the beginning of the experiment, the athletes of both groups did not differ (p> 0.05 in all cases).

At the end of the experiment, an excessive reaction to a change in body position in terms of HR and SV became less pronounced in both groups (Table 3).

TABLE 3 - INDICATORS OF HEART FUNCTION IN VERTICAL AND HORIZONTAL POSITIONS IN HIGHLY SKILLED WEIGHTLIFTERS AT THE END OF THE PRE-COMPETITIVE PERIOD (N = 30)

Test	HR, bpm	SV, ml	TSP (SV), ms^2	EF, ml	TSP (EF), ms^2
Control group (CG) (n=15)					
Horizontal	78.40±3.40	97.90±10.20	21.50±3.80	60.70±1.40	5.20±1.30
Vertical	99.40±3.60	69.00±7.40	161.10±3.90	57.30±1.00	3.50±0.70
t_p p_1	4.242 (p<0.01)	2.294 (p<0.05)	25.615 (p<0.001)	1.977 (p>0.05)	1.149 (p>0.05)
Experimental group (EG) (n=15)					
Horizontal	69.70±3.20	114.60±7.00	52.40±5.60	61.50±1.20	9.80±1.80
Vertical	88.10±3.50	81.00±7.60	213.80±26.80	58.50±0.70	5.60±1.10
t_p p_2	3.608 (p<0.01)	3.966 (p<0.1)	5.895 (p<0.001)	2.158 (p>0.05)	1.991 (p>0.05)
t_p p_3(C-E)	1.862 (p>0.05)	1.350 (p>0.05)	4.564 (p<0.01)	0.435 (p>0.05)	2.072 (p>0.05)
t_p p_4(C-E)	2.251 (p<0.05)	1.131 (p>0.05)	1.946 (p>0.05)	0.984 (p>0.05)	1.612 (p>0.05)

Note:
tp is the Student's t-criterion;
p1 – significane of the results obtained in horizontal and vertical positions (CG);
p2 - significane of the results obtained in horizontal and vertical positions (EG);
p3 – significance of the results obtained in the horizontal position (CG and EG);
p4– significance of the results obtained in the vertical position (CG and EG).

However, in the EG, the athlete's myocardial response to orthostasis was more effective in terms of heart rate and total power of stroke volume regulation (p <0.05 in all cases). It should be noted that when moving to the upright position, the heart rate of weightlifters in CG is greater than in athletes of the EG (p <0.05), which indicates less efficiency in maintaining minute blood volume at the proper level. Blood SV with a change in body position in all athletes is significantly reduced.

In CG weightlifters, in the horizontal position, LF and VLF fluctuations in the regulation of cardiac activity predominate, which indicates tension (chronic fatigue) (Fig. 1; 2).

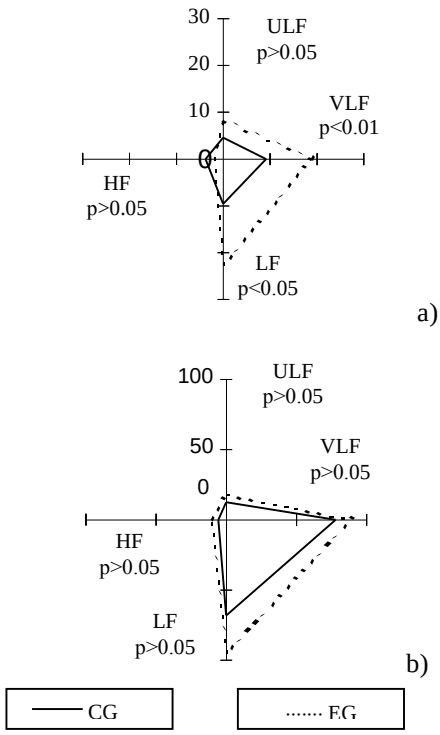

Fig. 1. Spectral characteristics of SV regulation in highly skilled weightlifters (n = 30) at the end of the experiment, a) horizontal position; b) vertical position

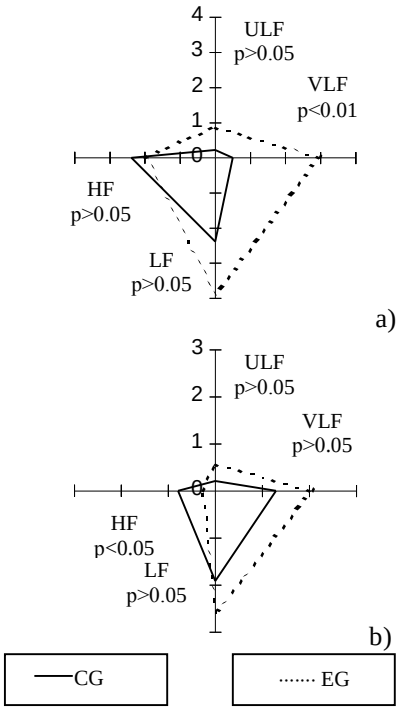

Fig. 2. Spectral characteristics of EF regulation in highly skilled weightlifters (n = 30) at the end of the experiment, a) horizontal position; b) vertical position

Despite the fact that with a change in body position the increase in the total spectrum power (TSP) in weightlifters of both groups occurs mainly due to VLF (humoral-hormonal level of regulation) and NP (sympathetic and parasympathetic systems, baroreflexes), TSP in the regulation of SV in athletes of the EG increases 4 times, in athletes of the CG - more than 7 times.

IV. Conclusion

Thus, the individualization of the pre-competitive training of EG weightlifters ensured an improvement in the functional status of the CVS. In the EG, with a change in body position, less pronounced tension of the mechanisms of regulation of the cardiac contractile function is noted, which indicates an improvement in the adaptive reserves of the body. The individualization of pre-competitive training determined high rates of special fitness and functional status of the EG weightlifters. The resulting shifts determined the high performance at the All-Russian competitions in 2012-2016.

References

[1] E.V. Buchina, V.M. Umarov The comparative characteristic of elektrocardiografic indicators of athletes of high qualification in different types of sports. Sports science bulletin, 2012. vol. 5. Pp. 19-25.

[2] A.P. Isaev, V.V. Ehrlich, V.V. Epishev, J.B. Khusainova Physiological, biomechanical, cellular and molecular, theoretical and methodological features of planning of successful sports activity in endurance sports. Teoriya i Praktika Fizicheskoy Kultury, 2015. Vol. 4, pp. 18-20

[3] V. Potapov, V. Rybakov, E. Antropova, "Individualization in the system of training of elite weightlifters based on biochemical criteria of the body state assessment". Human. Sport. Medicine, vol. 17, no. 1, pp. 87-91.

[4] A. Orlov, "Optimization of training load among weightlifters during pre-basic training", Pedagogics, psychology, medical-biological problems of physical training and sports, vol. 19, no. 1, pp. 57-61

[5] L.V. Tarasova et all Assessment of external breathing in elite weightlifters. Sports science bulletin, 2013. vol. 4. pp. 50-54.

[6] A.K. Talibov, V.P. Aksenov Complex control in training process of top lifters. Uchenye zapiski universiteta imeni P.F. Lesgafta, 2009. vol. 6 (52). pp. 80-83.

[7] R. Khomenko, "Biomechanical testing of the regulation of muscles in highly qualified young weightlifters of middleweight categories using biodex system 4PRO". Human. Sport. Medicine, vol. 18, no. 2, pp. 53-77.