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Increasing the Efficiency of Regulation of Training Loads on the Basis of Indicators of the Dynamics of Changes in Energy Consumption of the Cardiovascular and Autonomic Systems in Training Tennis Players

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Annotation: *The article highlights the practical need to create informative means of monitoring the training process and a quantitative assessment of the athlete's energy costs over a long period of training activity.*

Keywords: *tennis, training load, training of tennis players, physical fitness, cardiovascular system, vegetative system, heart rate, energy consumption.*

INTRODUCTION

To increase the level of physical fitness of an athlete, the coach has to develop a methodology for conducting physical exercises and put it into practice. At the same time, it is very important to have means of monitoring the effectiveness of the training process: only with sufficient operational control, the coach can make the necessary corrections in his training methodology. In addition, the means of control should allow the coach to make quantitative assessments of the physical condition of the athlete. This can be achieved by using various technical means, as well as using the latest computer technologies [1,2,9].

Purpose of the study. Increasing the efficiency of normalization of training loads based on indicators of the dynamics of changes in energy costs.

ORGANIZATION OF RESEARCH

In this work, the following tasks were solved:

- to develop a methodology for using indicators of energy costs in monitoring the special training of tennis players and the energy of the body's movement;
- to determine the magnitude and direction of the training loads of tennis players in the competitive period;
- To develop and substantiate, on the basis of the program developed by us, effective options for training loads in inter-game cycles.

The organization of control of training loads for the preparation of tennis players was carried out from March 2021 to November 2022. Members of the youth national team of the Republic of Uzbekistan participating in the championship of the Republic of Uzbekistan took part in the study. In total, 20 highly qualified tennis players were involved in the study.

RESULTS AND DISCUSSION

Study of load dynamics in the training of highly qualified tennis players.

The analysis of the value of training loads was carried out during training camps. The results of periodic observations of the training load in the competitive period showed the following.

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It can be seen that the largest percentage of intergame cycles falls on two and three days. Such a distribution of the competitive load has a negative effect on the growth of sportsmanship of tennis players, because with two and three-day breaks between games, the coach has one task - to prepare the tennis player for the next game. With such a busy schedule of games, it is very difficult to carry out a purposeful process associated with an increase in the level of sportsmanship of tennis players.

Table 1 The number of inter-game cycles with different intervals between games for a team (1st round of the National Championship)

	Number of days between games												
	2	3	4	5	6	7	8	9	10	11	12	13	14-20
%	6 30	7 35	—	2 10	—	1 5	3 15			—	1 5	—	

The most preferable for improving the preparedness of tennis players are inter-game cycles lasting six or seven days.

So, in the first round of the championship, the ratio of training loads was as follows: - by orientation.

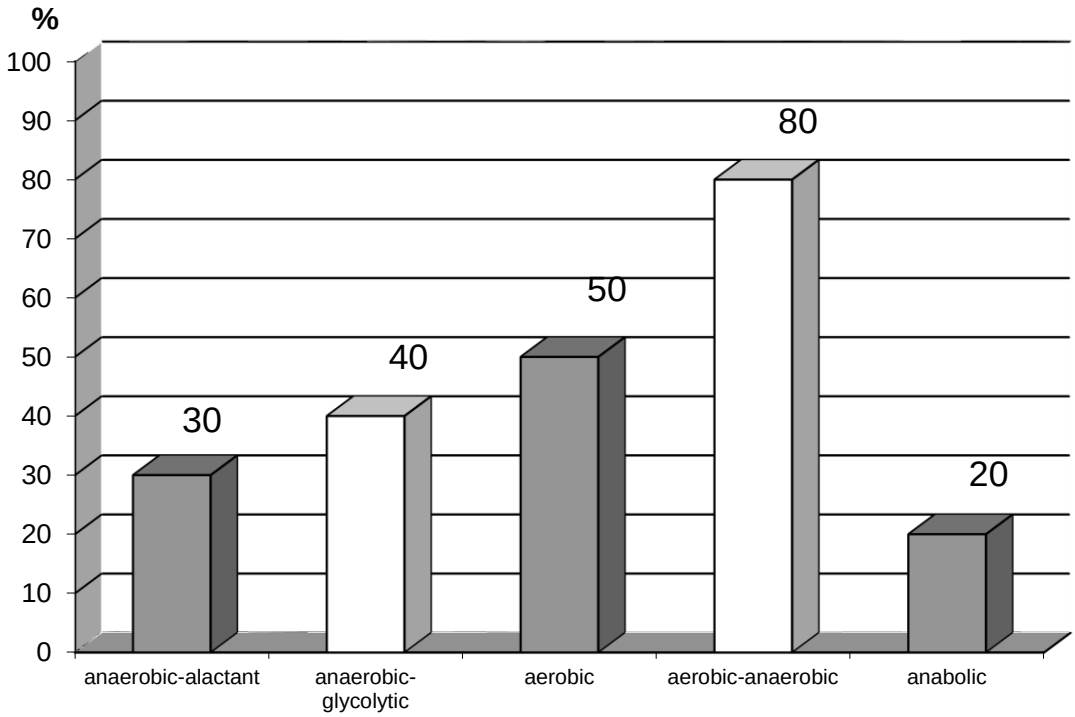

Figure No. 1. The ratio of training loads by direction

The next component of physical activity is value. On this basis, the distribution of loads was as follows:

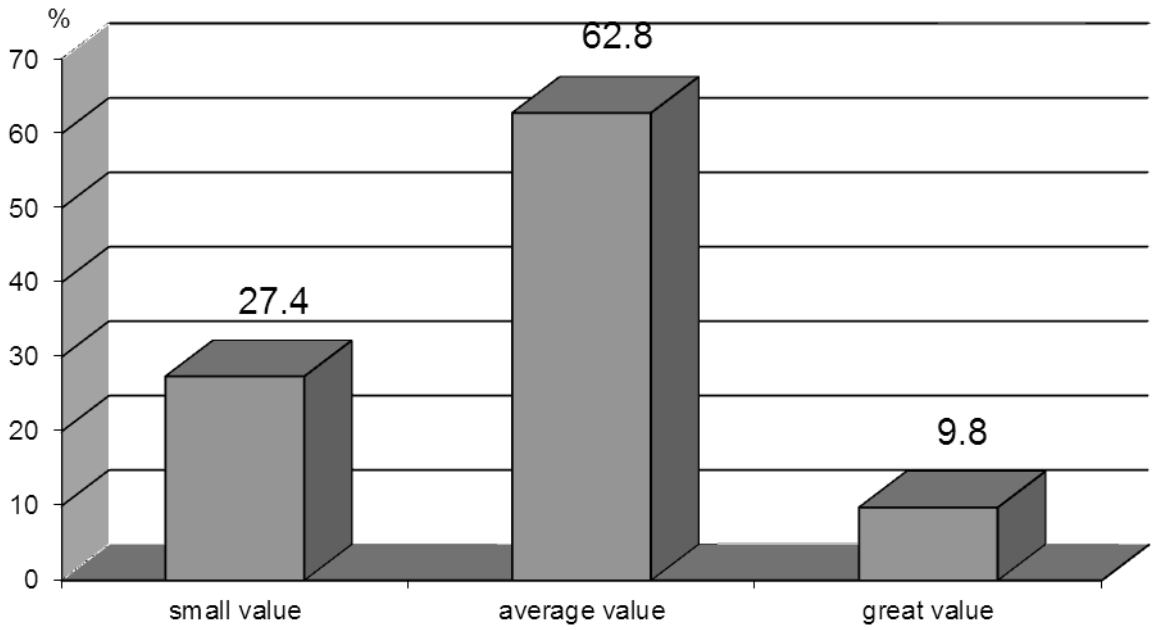

Figure No. 2. The magnitude of the distribution of loads

It can be seen that the proportion of large training loads is not high - 9.8% of the total volume. The largest share in the training of tennis players falls on medium loads - 62.8% and small loads - 27.4%. This dynamic value does not meet the requirements of the educational process.

It is known that in order to achieve high results in the competitive activity of tennis players, it is necessary to solve the following tasks: improvement of motor and volitional abilities and skills; maintaining and improving sports performance; expanding the functional capabilities of the body [3,4,6,7].

Only the rational distribution of means and methods in the training process, the methodically correct combination of loads and rest, determine the effectiveness of the above tasks.

The next feature that characterizes the load of a training exercise is its "specialization", that is, a measure of similarity with a competitive exercise. Analyzing the data obtained, it was found that only 28.3% of the exercises used in the training of tennis players meet the requirements of "specialization", and the remaining 71.7% only approximately meet these requirements. This is due, in our opinion, to the fact that most of the exercises used in the preparation of tennis players only outwardly simulate the conditions of competitive activity. An analysis of the reactions of various body systems of tennis players (cardiovascular, respiratory, muscular, etc.) obtained using modern computer techniques shows that practically most exercises do not correspond to the training effect, that is, external physical activity, and those functional and biochemical changes. That occur in the body of an athlete when performing one exercise, a series or a whole block of training aids.

Experimental program of training loads with a seven-day inter-game cycle.

For the experiment, a 28-day program was developed, including four seven-day microcycles, each of which consisted of five training days with one-time sessions, the sixth day was a calendar game, and the seventh day was rest.

It was taken into account that after three microcycles, a decrease in the level of fitness or its relative stabilization may begin. Therefore, the proposed training program provided for the inclusion of one maintenance microcycle after three developmental microcycles. Schematically, it looks like this (Figure 3):

6+1; 6+1; 6+1; -developing

6+1 - supporting.

For the practical implementation of the methodical system of training at this stage, an approach was used, the distinguishing feature of which is the focus on a limited stage of loads of one predominant direction and the sequence of introducing exercises into training, the use of which would provide favorable conditions for the manifestation of the training effect of subsequent means [5].

Testing the level of physical fitness and the functional state of the cardiovascular system	→ 6-Day MC-1→ Calendar Game→
Testing the physical condition of the cardiovascular system	→ 6-Day MC-2→ Calendar Game→
Testing the physical condition of the cardiovascular system	→ 6-Day MC-3→ Calendar Game→
Testing the physical condition of the cardiovascular system	→ 6-day PMC-4→ Calendar game→

Figure No. 3. Scheme of the pedagogical experiment.

It has been established that in the process of developing the speed-power abilities of tennis players, it is advisable to use up to 50% of the time for the development of abilities by special means, and 50% in the form of games. In other ratios, the growth of speed-strength indicators is manifested to a lesser extent [8].

The structure of loads at the experimental stage is presented in Table 2.

The volume of anaerobic loads increased gradually from the first to the fourth microcycle.

It was assumed that the use of technical-tactical exercises of speed-strength orientation would increase the efficiency of high-speed technique in the conditions of competitive activity. In addition, in the training of tennis players, exercises specific to tennis were used, namely jerks, running uphill and downhill, isometric exercises with rapid development of effort up to 50-60% of the maximum tension.

Table 2 The structure of loads at the experimental stage. (%)

Load Direction	I MCC 6 + 1	II MCC 6 + 1	III MCC 6 + 1	IV PMCC 6 + 1
- aerobic	15	12	13	33
- mixed (all types of ndurance and motor qualities)	35	28	27	50
- anaerobic-holicolytic	10	15	10	-

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-anaerobic-alactate	40	45	50	17

Tennis players performed exercises with the ball in two modes: normal and intensive. In the usual mode, exercises of mixed aerobic orientation were used, in pauses between series, where the task was to improve individual elements of the game, as well as details of the rhythmic-coordination structure of the main technical techniques. The intensive mode was used when performing serial work of a technical and tactical nature of a speed-strength orientation.

The structure and content of the training program included 24 practical sessions in 24 working days. The volume of training work was 36 hours, not counting hours of theory and recovery activities.

Most of the training sessions were conducted with an emphasis on the development of speed-strength qualities. Exercises of this orientation were performed after a twenty-minute warm-up, which consisted of a slow run, a series of general developmental and specially preparatory stretching exercises, and running accelerations.

In the process of training with the help of POLAR heart rate monitors, the physical load of the exercises was assessed.

At the beginning and at the end of the experiment, control tests of the level of physical fitness of tennis players were carried out (Table 3)

Analysis of the test results allowed us to conclude that a significant increase in motor abilities was observed after the first two microcycles. At the same time, an improvement in physical fitness was observed both in tests evaluating speed-strength abilities and speed endurance ($p < 0.05$)

We should also note the positive dynamics in terms of indicators characterizing the functional readiness of tennis players (Fig. 4). It can be seen that after the implementation of the two-week program, the adaptation to physical activity improved in the majority of tennis players.

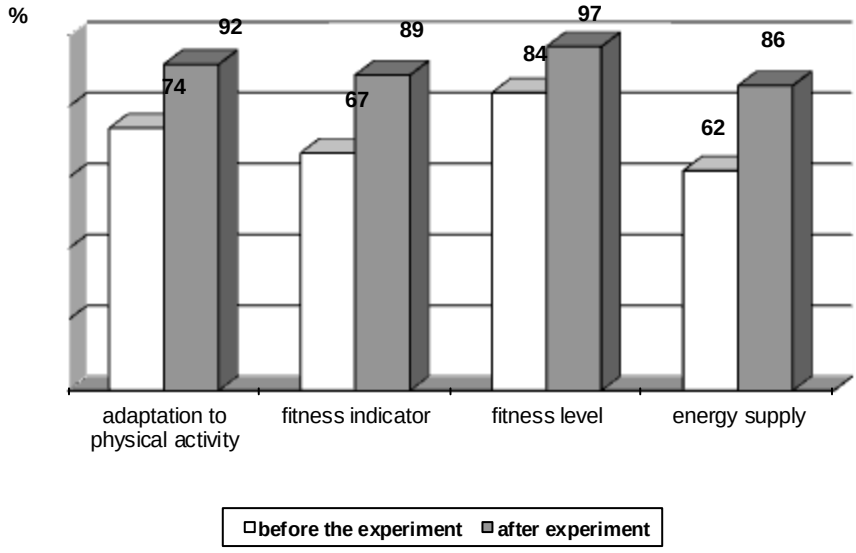

Figure 4. Indicators of physical condition during the pedagogical experiment.

A significant increase in the indicator of sports form was noted ($p<0.05$).

Most tennis players showed a significant increase in indicators characterizing the "training level" ($p<0.05$), as well as the level of "energy supply".

Table 3 Tennis Players' Physical Fitness Dynamics in the Course of the Pedagogical Experiment

($\overline{X} \pm \delta$, n=18)

Testing terms	Tests

	Run 30 m (s)	Run 7x 50 m (s)	Five-step multi-hop
At the beginning of 1 MCC	4,32 ± 0,03	65,3 ± 0,82	12,85 ± 0,10
At the beginning of 2 MCC	4,30 ± 0,03	64,4 ± 0,91	13,0 ± 0,15
At the beginning of 3 MCC	4,28 ± 0,02	62,6 ± 0,84.	13,10 ± 0,11
At the end of the experiment	4,20 ± 0,01	61,8 ± 0,93	13,20 ± 0,11
The magnitude and significance of differences			
II-I	t=2,02, p>0.05	t=3,13, p<0.05	t=3,51, p<0.05
III - II	t=2,36, p<0.05	t=6,22 p<0.05	t=2,28, p <0.05
IV - III	t=15,45, p<0.05	t=2,72, p <0.05	t=2,87, p <0.05
IV -I	t=16,45, p<0.05	t=ll,99, p<0.05	t=10,55, p<0.05

An analysis of the results of the experimental program made it possible to conclude that the loads of a predominantly speed-strength orientation led to significant functional changes in the body of tennis players. A significant increase in the integral indicator of the level of physical fitness occurs as a result of the application of loads of the first and second developing microcycles. Further use of training effects of a speed-strength nature leads to the inhibition of motor abilities, or rather, functional systems that provide special physical fitness for tennis players. At the same time, it should be noted that the use of speed-strength work during three developing seven-day microcycles and one three-day maintenance one contributes to an increase in speed (special) endurance.

The conducted experiment confirmed the hypothesis about the positive impact of speed-strength exercises on the effectiveness of technical and tactical techniques in competitive activity.

All of the above allows us to speak about the need to use in the competitive period, especially in the second half of the two-week stages of speed-strength orientation. The considered dynamics of physical fitness during the experiment confirms the conclusion about the inexpediency of using speed-strength loads for more than 14 days, and allows us to talk about the need to change the modes, structure and methods of performing exercises after two weeks of speed-strength work.

The content of the training program for maintaining the optimal structure of preparedness in the second half of the competitive period is characterized by the following values of pedagogical parameters: the number of training days - 26, the number of games - 4, the load orientation in percent: aerobic - 24%, aerobic-anaerobic - 27%, anaerobic-alactate - 12%, anaerobic-glycolytic - 2%, competitive - 35%: training methods in percentage: variable - 73%, repeated - 16%, uniform - 8%, interval-serial - 3%.

After maintaining the mode of training work, it is methodically justified to conduct one seven-day microcycle of speed-strength orientation. The rational structure of loads in such a microcycle is as follows: aerobic (general endurance) - 12%, aerobic-anaerobic (mixed) - 40%, anaerobic-alactic (speed-strength) - 48% The ratio of specialized and non-specialized loads is 50/50%.

CONCLUSIONS

1. It was found that for the operational control over the dynamics of the special preparedness of tennis players, the most informative are the performance indicators obtained by using the computer program we created to determine the energy consumption of tennis players based on the POLAR heart rate monitor.
2. It has been established that the level of special preparedness has intergroup and interindividual differences:

- 75% have a low level of BMD;

− 60% have a low level of "ANNO";

− 65% have a low level of "training";

− 45% have a low level of "energy" provision.

3. The analysis of training loads made it possible to establish that 71.7% of the loads do not meet the requirements for specialization, focus, and magnitude. Most of the exercises only outwardly simulate the conditions of competitive activity. It has also been established that 28.3% of training aids cause adequate physiological changes in the body.
4. Analysis of the dynamics of the states of the organism of tennis players in intergroup cycles of different duration showed that training loads of a large magnitude of anaerobic-alactate and anaerobic-glycolytic orientation lead to fatigue, the degree of which depends on the level of training. The higher the level of training, the faster the recovery processes.
5. The options for planning loads of inter-game cycles of different durations are substantiated, in particular, with a seven-day cycle, it should be as follows:

− Private volume of specific funds - 80%;

− Non-specific - 20%;

− Complex means - 65%;

− Simple -35%;

Such a distribution of training means led to the fact that the volume of ITTD increased from 596 to 714 actions; the volume of high-speed work increased from 1125 to 1921m.

7. Experimentally substantiated training program with the following focus:

− Anaerobic - 24%;

− Anaerobic-anaerobic - 27%;

− Anaerobic-alactate - 12%;

− Anaerobic-glycolytic - 2%;

− Competitive-35%;

Functional indicators have also increased:

− "MPC" increased in 26% of athletes;

− "ANNO" increased in 73% of tennis players;

- "tolerance" of loads in 81%;

− the level of energy supply improved in 56%;

- the level of "training" increased in 88%.

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