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Restoration of Working Capacity of Students after Physical Load in Exercises of a Cyclic Nature

Regeneracja uczniów po ćwiczeniach o charakterze cyklicznym

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SUMMARY

Aim: To investigate the impact of pedagogical means of working capacity restoration on students' results in exercises of a cyclic nature.

Materials and Methods: Research methods: theoretical analysis and generalization of literary sources, pedagogical observation, questionnaire, pedagogical experiment, methods of mathematical statistics. 58 students engaged in kettlebell lifting took part in the pedagogical experiment (28 students formed the experimental group, 30 – the control group). 123 coaches and 139 athletes who specialized in cyclic kinds of sports were involved in the survey.

Results: It was found out that pedagogical means of restoration and improvement of working capacity are the main ones in the process of training athletes in cyclic kinds of sports. It was determined that with the growth of the athletes' qualifications, the level of their knowledge and skills regarding the use of pedagogical means of restoration during the training process increases. It was established that the students of the experimental group achieved significantly better results in competitive exercises.

Conclusions: Scientifically based, purposeful and constant use of pedagogical means of restoration and improvement of working capacity both in the training process and beyond the educational and training process is a mandatory condition for improving competitive results in cyclic kinds of sports and is a good basis for maintaining high working capacity of student-athletes and preserving their health.

Key words: pedagogical means of restoration, working capacity, students, athletes

Słowa kluczowe: pedagogiczne środki odnowy, zdolność do pracy, studenci, sportowcy

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INTRODUCTION

The age characteristics of student youth, the specifics of students' studies and way of life, the peculiarities of their opportunities and conditions for physical exercises make it possible to single out student sports in a special category. Student sports are a component of sports, cultivated in higher educational institutions (HEIs), integrating mass sports and sports of higher achievements [1, 2]. The scientists single out the following organizational peculiarities of student sports: availability and opportunity to engage in sports activities during the hours of mandatory training sessions in the academic discipline of "Physical Education" (an elective course in the main educational department or educational and training sessions in a sports educational department); opportunity to engage in

sports activities during the free time from academic studies in sports sections and groups of HEIs, as well as independently; opportunity to systematically participate in sports competitions of various levels (student competitions between faculties, courses of study, between HEIs, at the national and international levels in the chosen sport) [3, 4]. This whole system provides every practically healthy student with the opportunity to first familiarize himself/herself with and then choose a sport for regular training sessions. According to statistics, from 15 to 20% of students are engaged in student sports in HEIs of various countries [5]. Despite the significant time and energy spent on training, student-athletes, having a higher overall working capacity, can practically keep up with their fellow students in mastering the disciplines of the curriculum. They switch more easily from

one type of activities to another and psychologically are more resistant to stressful situations. As a result, the vast majority of student-athletes completes a full course of study at a HEIs and obtain a higher education [6].

The increase in the level of sports achievements of students is carried out not only due to the qualitative construction of the educational and training process, the selection of special physical training means, the rational technique of performing competitive exercises in the chosen sport, but also due to the effective use of means of working capacity restoration of their body. Restoration is the process of biological balancing of the body (its individual functions, organs, tissues, cells) after intense training and competitive loads [7]. Generally accepted means are used for a fuller and faster restoration of the body combined by scientists into three main groups: pedagogical, psychological and medical-biological [8]. The scientists [9, 10] have proven that pedagogical, psychological and medical-biological (pharmacological, physiotherapeutic) means accelerate the restoration processes of athletes both after individual trainings as well as competitions and after a large total volume of loads, increase general working capacity and provide prevention against over-fatigue. The central place in the restoration and stimulation of the working capacity of student-athletes is given to pedagogical means. During the educational and training process, they can be represented by: load planning and construction of the training process in accordance with the student-athlete's state of readiness; correspondence of loads with physical and psychological capabilities of students; correspondence of means with their volume and intensity of the period or stage of training; rational dynamics of loads in various structural formations of the educational and training process; special use of restoration exercises and training sessions; rational warm-up during training sessions and competitions; rational conduct of the final part of the training session in order to reduce emotional and physical excitement. The process of restoration and improvement of working capacity of athletes is also significantly influenced by the factors of life-sustaining activities, the conditions of the educational and training process as well as recreation. Therefore, the second part of restoration pedagogical means for students consists of: observing the routine of life and the educational and training process; compliance of conditions for training with sanitary and hygienic, ecological, technical requirements; compliance with the conditions for recreation and health protection of the student; harmonious combination of work (study) with sports; a clear and constant schedule of training, study, work and recreation; coordinated and rational use of individual and collective forms of educational and training sessions; preventing students from training sessions and competitions in case of their illness, acute and chronic injuries; taking into account the individual characteristics of students in the process of training, competitions, recreation and life-sustaining activities.

AIM

The aim is to investigate the impact of pedagogical means of working capacity restoration on students' results in exercises of a cyclic nature.

MATERIALS AND METHODS

Research methods: theoretical analysis and generalization of literary sources on the topic of the research, pedagogical observation, questionnaire, pedagogical experiment, methods of mathematical statistics.

The object of the research was the process of training students engaged in cyclic kinds of sports (running, sports walking, swimming, kettlebell lifting, cycling) for competitions. Coaches and athletes of Ukraine in cyclic kinds of sports of various qualifications took part in the survey: 16 – honoured coaches of Ukraine, 12 – head coaches and coaches of expansion teams, 58 – coaches with more than 8 years of experience, 37 – coaches with 1 to 2 years of experience, 22 – masters of sports of Ukraine of the international class (MSUIC), 34 – masters of sports of Ukraine (MSU), 83 – candidate masters of sports (CMS) and first-class athletes. 58 students of various higher educational institutions of the city of Zhytomyr took part in the pedagogical formative experiment, who were engaged in kettlebell lifting (28 students – experimental group [EG] and 30 – control group [CG]). The experiment was conducted in 2019-2021. The organizational and pedagogical conditions for conducting the pedagogical experiment covered the integrity of the process of training students of the EG with the use of scientifically based pedagogical means of restoration and stimulation of working capacity. The training sessions with the CG students did not provide for the accented use of pedagogical means of restoring working capacity.

The questionnaire of coaches and athletes was conducted to study their attitude to pedagogical, psychological, and medical-biological means of restoration, as well as to assess their theoretical knowledge and skills to use pedagogical means of restoration and stimulation of working capacity in the process of training for competitions. The survey was also conducted with the aim of identifying scientifically based implementation of pedagogical means of restoration and stimulation of students' working capacity in the process of their preparation for competitions. Knowledge and skills were assessed by us on the 100-point ECTS scale: high level – 90-100, sufficient – 82-89, average – 74-81, low – 60-73. The first three levels testify to a positive result: formed knowledge and high awareness of the athlete, while the low level requires education and improvement.

RESULTS

Our analysis of the survey of coaches and athletes of various qualifications regarding the importance and value of using means of restoration and improvement of working capacity (pedagogical, psychological, medical-biological) showed both a clear trend towards their importance as well as significance in the process of training athletes in cyclic kinds of sports and a false attitude on the part of novice coaches and competitive sportsmen (Table 1). Highly qualified and experienced coaches as well as MSUIC and MSU clearly understand the importance of restoration means, as evidenced by the 1st ranking place given to pedagogical means. They explain this by the fact that a low level of physical and functional fitness can not be

Table 1. Assessment of the importance of using means of working capacity restoration by coaches and athletes of various qualifications (ranking place)

Qualification of coaches and athletes	Means of restoration of working capacity		
	Pedagogical	Psychological	Medical-biological
Honoured coaches of Ukraine	1	3	2
Head coaches of expansion teams	1	3	2
Coaches with more than 8 years of experience	2	3	1
Coaches with 1 to 2 years of experience	3	2	1
MSUIC	1	3	2
MSU	1	3	2
CMS and first-class sportsmen	3	2	1
Total ranking	1	3	2

Table 2. Athletes' assessment of pedagogical means of working capacity restoration during the educational and training process (points)

Pedagogical means of working capacity restoration	Qualification of athletes		
	MSUIC	MSU	CMS and first-class sportsmen
Correspondence of load planning and training configuration to the athlete's physical state	91.4	83.7	76.5
Correspondence of load to the athlete's state of readiness	92.1	81.9	75.7
Appropriateness of means, their volume and intensity of the training stage	90.2	83.3	74.6
Correspondence of load dynamics in the educational and training process	92.5	84.7	75.3
Use of restorative exercises and sessions in microcycles	93.6	85.2	74.1
Rational warm-up during training sessions and competitions	94.8	86.5	76.9
The use of restoration means during the final part of the training session	92.9	84.6	75.3
Average score	92.5	84.3	75.5

Table 3. Athletes' assessment of pedagogical means of working capacity restoration beyond the educational and training process (points)

Pedagogical means of working capacity restoration	Qualification of athletes		
	MSUIC	MSU	CMS and first-class sportsmen
Compliance with the routine of life and sports training	93.6	89.4	78.6
Compliance with sanitary, hygienic and environmental conditions for training	87.3	84.2	76.3
Conformity of conditions for recreation and health care	85.3	80.9	75.2
Harmonious combination of work (study) and sports	84.7	80.2	76.9
A clear and constant schedule of training, study, work and recreation	89.3	78.8	74.5
Rational use of individual and collective forms of training sessions	95.2	91.4	82.4
Preventing athletes from training sessions and competitions in case of their illness, acute and chronic injuries	98.6	93.2	84.7
Taking into account the individual characteristics of athletes in the process of training, competitions, recreation and life activities	93.5	91.7	80.3
Average score	90.9	86.2	78.6

Table 4. Dynamics of the results in competitive exercises of kettlebell-lifter students during the formative pedagogical experiment (Mean \pm SD, number of lifts)

Competitive exercises (24 kg kettlebell)	Experimental group		Control group		Difference between groups	The validity of the difference	
	Before the experiment	After the experiment	Before the experiment	After the experiment		t	p
Kettlebell push	67.3 \pm 8.32	85.6 \pm 8.93	68.2 \pm 8.41	77.4 \pm 8.75	8.2	2.37	<0.05
Kettlebell jerk	98.7 \pm 9.34	129.8 \pm 9.87	100.3 \pm 9.76	119.7 \pm 9.83	10.1	2.65	<0.05
Double-event	166.0 \pm 9.47	215.4 \pm 9.14	168.5 \pm 9.37	197.1 \pm 9.65	18.3	2.83	<0.05
Long cycle	31.6 \pm 7.43	46.8 \pm 7.74	32.5 \pm 7.40	39.3 \pm 7.49	7.5	2.13	<0.05

Legend: Mean – arithmetical average; SD – standard deviation; t – Student's t-test value; p – the significance of the difference between the students' indicators at the end of the experiment

fully compensated by medical-biological and psychological means. At the same time, novice coaches and competitive sportsmen believe that it is possible to overcome shortcomings in the process of physical, technical, tactical and functional preparation of an athlete with the help of medico-biological and psychological means, which is a false opinion.

Pedagogical means of restoration of working capacity are used directly in the process of educational and training classes and provide for a rational distribution of loads within monthly and weekly cycles and periods of preparation during training sessions. Different restoration methods are used in training sessions including switching muscles from one exercise to another; exercises performed with different regimes and tempos, from different starting positions and in difficult movement conditions, i.e. specially organized muscle activities. The research we conducted showed a high and sufficient level of knowledge and practical application of pedagogical means of restoration of working capacity of the MSUIC and the MSU during the training process, respectively 92.5 and 84.3 points (Table 2). At the same time, the CMS and the first-class sportsmen do not have enough and do not always use the necessary pedagogical means of restoration of working capacity during the training process, as evidenced by the average score of 75.5 points.

An important place in the process of training athletes is occupied by means of working capacity restoration, which are used in life-sustaining activities beyond the educational and training process, namely: compliance with the daily routine, compliance with living and resting conditions; combination of work, study and training process; the use of individual and collective forms of training, compliance with the rules of restoration after injuries and illnesses, etc. The research has confirmed that the qualifications of athletes confirm a high level of possession and application by athletes of pedagogical means of working capacity restoration beyond the educational and training process, respectively, MSUIC showed 90.9 points, MSU – 86.2 points, CMS and first-class sportsmen – 78.6 points (Table 3). This indicates the fact that athletes learn to correctly use pedagogical means of restoration with the improvement of their sports skills.

Possibilities of pedagogical means of restoration were reflected in the sections on configuring the process of training students who specialize in kettlebell lifting. A particularly important role is played by the psychological climate in the course of educational and training sessions and competitions, as well as the organization of recreation and leisure activities, taking into account the specifics of work and educational activities. Pedagogical means of restoration are aimed at increasing general and special physical fitness, improving health, increasing working capacity, the level of development of physical qualities, harmonious physical fitness. During the experiment, we widely used restoration exercises for active stretching (hanging on a crossbar or rings, swinging and rocking the trunk, circular movements with the legs or trunk, body bending with weight, hanging on the bars with weights attached to the legs, extending the arms at the elbow joints, lifting legs hanging on the crossbar, turns of the

body with a barbell on the shoulders, leg lifts while lying on a bench, etc.); exercises for passive stretching (hanging on the crossbar with a narrow or wide grip, lying on an inclined bench with your head down, stretching the front group of thigh muscles (weight on the shins), stretching the extensors of the spine, stretching the body in water, bending the body, etc.); unloading exercises (lying on a bench, barbell leg press, sitting press, barbell push from the chest with alternating legs forward, jumps up with one or two legs push, long jumps from a standing position and from a run); preventive exercises (leaning forward with a light weight on the shoulders, hyperextension, pulling the barbell with a narrow and wide grip, exercises for the abdominal muscles, exercises on the leg machines, raising the torso with a barbell on an inclined bench, head down). The recommended sets of exercises were performed both during the warm-up and in the final part of the training session. The exercises were performed between the sets of exercises with kettlebells during the main part of the training session.

The use of the above sets of exercises and pedagogical means of restoration in the training process and in daily life by the kettlebell-lifters of the experimental group under the coaches' supervision made it possible to significantly improve the results in competitive exercises ($p < 0.05$) (Table 4).

This gives grounds for asserting that in kettlebell lifting, it is quite important that the phase of muscles tension alternates with the phase of their relaxation during the period of intensive cyclic work of muscles for strength endurance. In order to prevent micro traumas, it is necessary that the amount and quality of strength load correspond to the duration of rest (relaxation type). Therefore, it is necessary to use exercises with active and passive stretching, pedagogical means of restoration and active rest in the course of training sessions with strength exercises between sets or at the end of their performance.

DISCUSSION

Fatigue, which occurs during strenuous muscle activities, is formed specifically for each type of training work, depending on the degree of participation in its performance of various functional systems and mechanisms. In such a case, each restorative procedure also has its own specific effect on the body, depending on the nature and method of its application. Therefore, it is very important to combine training effects and restorative procedures, which must strictly take into account their effects on the body. Such changes especially occur when special endurance is detected in athletes in cyclic kinds of sports, namely: water-salt imbalance, consumption of energy substances, decrease in lipolytic functions of the liver, functional proteinuria and hematuria due to insufficient oxygen and blood supply to the kidneys during loads, acidosis, structural disorders of biological membranes, a decrease in the protective functions of the immune system and other phenomena that determine the natural fatigue of important functional systems of the body [11, 12]. At the same time, the main efforts to restore the body's functions should be aimed at promoting the natural restoration of biosynthesizing processes.

According to many scientists [13, 14], the use of restoration means can not only reduce the student's fatigue, but also speed up restoration processes. At the same time, each restorative procedure in itself is an additional burden on the body, which places certain demands on the activities of various functional systems of the body. Ignoring this can result in the reverse effect of additional means i.e. increased fatigue, reduced working capacity, disruption in the course of adaptation processes and the occurrence of other negative reactions. Therefore, it is necessary to take into account training effects and restoration procedures as two sides of a single complex process. Combining means of restoration and training effects into a certain system is one of the main issues of managing working capacity and restoration processes during physical exercises [15].

Regarding the effectiveness of pedagogical means of working capacity restoration, the scientists [16-18] indicate that the correct selection of means and methods of their application in the main part of the training session ensures the necessary level of working capacity and emotional state of athletes. Compensatory work, i.e., exercises that are performed at intensity lower than the threshold of anaerobic metabolism – 30-50% $\text{VO}_2 \text{ max}$ – is of great importance as a pedagogical means of restoration. Such work ensures intensive blood exchange in the muscles and does not lead to the production of lactate, but, on the contrary, contributes to the process of its elimination. Therefore, low cyclic work on endurance is an effective means of rapid restoration of processes between training and competitive exercises [8]. It was proven that training sessions with small and medium loads are active factors in the management of restoration processes after training sessions with heavy loads. At the same time, the intensification of restoration processes after training sessions with heavy loads is observed only in the case when work of a fundamentally different direction is used in the course of additional training sessions, during the performance of which the working capacity is determined mainly by the functioning of other systems and mechanisms.

In general, pedagogical means are closely related to the rational configuration of various links in the process of training a student-athlete, starting from the selection of training exercises to the construction of training sessions that can contribute to the positive course of restoration processes after certain exercises and loads. Herewith, it is necessary to take into account that the positive course of restoration processes is facilitated by a positive psychological microclimate during training sessions and competitions, rational recreation and leisure.

CONCLUSIONS

1. Questionnaires of coaches and athletes of various qualifications confirmed the hypothesis that pedagogical means of restoration of working capacity are the main ones in the process of training athletes. Thus, during the survey, qualified coaches, MSUIC and MSU gave preference to pedagogical means of restoration, commenting on this that deficiencies in physical and functional preparation

can not be fully compensated by medical-biological or psychological means of restoration. At the same time, the majority of novice coaches and athletes having CMS grade and the first-class sportsmen are characterised by false concepts and knowledge that the desired sports result can be achieved due to medical-biological and psychological means. This shows that the training of students i.e. future sports coaches requires necessary corrections to the training programs during the study of the section of "Means of restoration and improvement of working capacity of athletes".

2. The research confirmed that with the growth of the athletes' qualifications, the level of their knowledge and skills regarding the use of pedagogical means of restoration of working capacity during the training process increases, respectively. So, in particular, MSUIC showed a high level of knowledge – 92.5 points, MSU – 84.3 points, CMS and first-class sportsmen – 75.3 points. At the same time, the use of pedagogical means of restoration beyond the training process revealed a number of reasons that do not contribute to the full restoration of the body, namely: the inconsistency of sanitary, hygienic and environmental conditions for training, recreation and health care; lack of opportunity to combine work or study with sports; lack of a constant schedule of training, study, work and recreation; insufficient material and technical equipment of places for training and recreation.
3. The conducted pedagogic formative experiment confirmed that scientifically based, purposeful and constant use of pedagogic means of restoration of working capacity both in the training process and beyond the educational and training process is a mandatory condition for increasing the level of sports achievements in cyclic kinds of sports, is a good basis for supporting the high working capacity of student-athletes and preserving their health. During the experiment, the kettlebell-lifter students of the experimental group achieved significantly better results and showed significantly ($p < 0.05$) better results in competitive exercises, in particular, the rate of growth made 8.2 times in the kettlebell push, the kettlebell jerk – 10.1 times, the sum of the double-event – 18.3 times, the long cycle – 7.5 times. At the same time, the majority of students in the control group preferred passive restoration methods, which involve the use of temperature factors, water procedures and restorative massage.

Prospects for further research are aimed at studying the attitude of student-athletes to the use of psychological means of restoration.

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The Authors declare no conflict of interest

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