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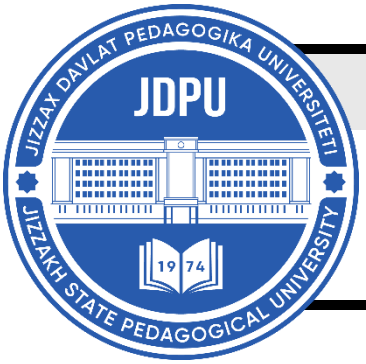

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MEDICAL AND BIOLOGICAL MEANS OF INCREASING WORKING CAPACITY AND RECOVERY OF ATHLETES

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ABOUT ARTICLE

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Abstract: The paper presents an analysis of scientifi c periodicals 2006–2013 biennium, as well as our own experimental data on the use of medical and biological agents that increase performance and speed up the recovery of the sport. We select the most important facts, trends and patterns. The focus of Russian and foreign scientists are paying the development and justifi cation of methods of application of pharmacological and physical effects, as well as the integration of biological rhythms. The effect of caffeine, creatine, carnitine, salbutamol, hyperoxic and hypoxic conditions of the environment on the functional state of the athletes. Conducted their own experimental studies have shown the effi cacy of hyperoxic mixture and transcranial electrical stimulation to increase the effi ciency and improve the functional condition of the athlete. Defi nes the role and relationship of biological rhythms and athletic performance.

INTRODUCTION

The level of loads in modern sports, and even more so in elite sports, is critical. In the course of active sports activity, certain changes in the functional state of the body occur, associated with adaptation to physical and psycho-emotional stress, and, consequently, the degree of tension of regulatory mechanisms. Along with the constant improvement of the pedagogical component of the training process, there is a need to develop new, modern biomedical technologies for optimizing sports training, which allow expanding the range of adaptive capabilities of the human body.

The purpose of the work is to analyze the existing ergogenic means and determine the possibilities of their use in sports.

MATERIALS AND METHODS

An analysis of modern periodicals and our own experimental studies were carried out. When studying the effect of an air breathing mixture with a high oxygen content on the performance and recovery processes of skiers, the functional state was assessed using spirography and analysis of heart rate variability (HRV). The oxygen-air mixture was created using a portable oxygen concentrator Air Sep Life Style (USA), with a capacity of 5 l/min, which creates an oxygen concentration in the output gas mixture of 93 ± 3%. To assess the performance of athletes, a standard protocol for a stepwise test on a treadmill was used [6]. 35 qualified male skiers (MS, CMS, 1 category) were examined. To identify the effect of transcranial electrical stimulation (TES) on the characteristics of recovery after a competitive load, 10 powerlifters (MS and MSMK) underwent a TES session using the TRANSAIR-5 apparatus, the location of the electrodes was fronto-mastoid, the duration was 20 minutes, the pulsed bipolar current, the maximum value was 3 mA . Athletes were examined a week before the competition (background), before the competition after weighing, immediately after the competition and after TES.

RESULT AND DISCUSSION

Analysis of the results of scientific publications in the period from 2006 to 2013 made it possible to determine the main areas in which research work is being carried out.

Scientists identify five different classes of performance-enhancing agents: nutritional, physiological, psychological, pharmacological, and biomechanical. Nutrients as ergogenic agents are necessary to ensure the regulation of energy production processes in the body. Rational nutrition largely determines the performance of athletes [4]. Pharmacological ergogenic drugs are the most widely used and tested in sports. Recent studies by scientists from different countries are primarily devoted to the use of caffeine [22], creatine [11], salbutamol [18]. An increase in the duration of limiting work was established with acute use of caffeine after prolonged use of creatinine [14]. Scientists at the Royal Medical Center of the University of Nottenham are studying the role of carnitine in the energy supply of submaximal power exercises [21]. According to current research, muscle carnitine content can be increased naturally in the human body. In addition, it has recently been theorized that a decrease in muscle coenzyme A and the presence of several key enzymes in the fat oxidation pathway may exert some control over the choice of muscle energy source during exercise. Muscle availability of free carnitine is likely to be a key factor limiting fat oxidation during high-intensity submaximal exercise. Phil Watson from the School of Sports Sciences at Loughborough University (Great Britain) studies the effect of various substances on the performance of the nervous system of athletes [23]. It has long been known that the brain can play a direct role in

the fatigue process, and the possible neurobiological mechanisms involved in this response have recently been explored. Changes in the central synapses that occur during exercise can cause feelings of fatigue, lethargy, and loss of motivation to continue exercising, contributing to the development of fatigue. There is evidence that the use of the neurotransmitters serotonin, dopamine and norepinephrine, through the administration of pharmacological drugs, can delay the onset of fatigue during prolonged exercise. A study has proven the positive effects of caffeine on physical performance, with recent data highlighting the role of central adenosine as a mediator of this response. Scientists assign an important role in improving the results of athletes to biological rhythms. V. Pugacheva with scientists from the universities of Slovakia and the Czech Republic analyzed the relationship between biorhythms and physical performance of biathletes at the beginning and at the end of the main training period [15]. The authors determined the optimal time for the development of speed abilities at 6 pm, for strength abilities - 9 am, and for training shooting - in the afternoon and evening. Thomas Reilly from the Research Institute of Sports and Exercise at John Moores University (Great Britain) deals with the problem of reduced performance during transmeredian movements [16]. He points out that the symptoms of desynchronosis are worse and last longer on eastbound flights compared to westbound ones. Regulation of biorhythms is possible through a behavioral strategy that combines the biological clock and adherence to sleep and rest. Our studies have shown that sports loads themselves have an impact on the rhythmic organization of the physiological functions of athletes. The direction and volume of the load change the chronobiological status of a person, optimizing or disadapting the rhythmic organization of psychophysiological processes, as well as modulating the chronotypological features of the personality [3]. Keith Bahr and Sean McGee from the Department of Molecular Physiology at the University of Dundee (UK) and the Department of Physiology at the University of Melbourne (Australia) investigated the effect of glycogen on training adaptation [8]. Glycogen utilization can be an effective means for endurance athletes during the development of aerobic capacity at the beginning of the season. Due to the fact that training becomes more intense during the competitive season, replenishment of glycogen stores is required. Thus, it is necessary to break up periods of low glycogen training at the beginning of the training period by switching to a carbohydrate-rich diet with increasing training intensity. A large number of works are devoted to the influence of various environmental factors associated with breathing air with a low or high oxygen content. Specialists of the school of sports and health sciences A. Vankhatalo and others determined the effect of hyperoxia on the metabolic reactions of muscles using magnetic resonance [19]. The results showed that the maximum capacity of muscle metabolism during high-intensity exercise is associated with a decrease in the values of intramuscular creatine phosphate and acid-base index. Both the critical power and the hyperbole of the power-duration parameter curve are sensitive to hyperoxic gas consumption. A researcher from the University of Prague, D. Sachi et al., tried using

concentrated oxygen inhalations when performing the Wingate test again [17]. Inhalations of 99.5% oxygen during the recovery period after performing the Wingate test significantly accelerate short-term recovery processes. A significantly ($p < 0.03$) lower decrease in the performance of the second Wingate test after inhalation of 99.5% oxygen compared to air was noted. Similar to the above study was conducted by New Zealand scientists [12]. They used a randomized, randomized, blind test to evaluate the effect of breathing 21% O2, 60% O2, and 100% O2 during a four-minute rest after a 30-second maximum exercise on a repeat exercise cycle. All pairs of Wingate tests were performed by participants who inhaled atmospheric air and used concentrated O2 only during rest. Breathing 100% O2 during a four-minute rest after maximal exercise improves the performance of the subsequent exercise, but fatigue scores are also increased and the transient ergogenic effect is therefore short-lived, perhaps 1–2 seconds. Our study of the effect of an air breathing mixture with a high oxygen content on the performance and recovery of skiers showed that the use of oxygen support before maximum load increases the performance of the oxygen transport system, the overall performance of the heart, and also reduces the limiting capabilities of the respiratory system of skiers. Breathing an air-breathing mixture with a high oxygen content for 20 minutes after the maximum load accelerates the processes of urgent recovery of the cardiovascular and respiratory systems of skiers [5]. A study of the effectiveness of training athletes at different heights and levels of hypoxia was carried out in France [9], it allowed to establish that the height of the training mesocycle should not exceed 3000 m, and its duration should be more than 18 days. Robert F. Chapman and co-authors from the Department of Kinesiology at Indiana University (USA) studied the influence of high altitude natural conditions on the effectiveness of sports training [10]. They concluded that the following conditions must be met: providing additional time for training so that athletes can adapt to changes in the trajectory of the projectile (this is especially true for shooting); allocation of time for acclimatization in endurance sports (3–5 days for low altitude conditions (500–2000 m), 1–2 weeks for medium altitude conditions (2000–3000 m) and a minimum of 2 weeks for high altitude conditions (over 3000 m); increase the ratio of time between training and recovery up to 1:3, the consumption by athletes of additional oxygen between races (in cross-country skiing), which promotes recovery. TES selectively activates the system of endogenous opioid peptides of the brain, primarily β-endorphin, with the help of a pulsed electrical effect applied through the head skin electrodes. The use of TES in sports shows an increase in working capacity, an acceleration of recovery [1, 7], an improvement in the psycho-emotional state, and the removal of pre-start anxiety [1]. The TES sessions we conducted in powerlifters after the competition led to a statistically significant reduction in the time to restore the regulation of the vegetative functions of the body of athletes [13]. Another new non-invasive method of exposure is lymphostimulation. Numerous clinical studies have shown that lymphostimulation has a therapeutic effect in arteriosclerosis and circulatory disorders in ischemic

lesions of various localization [2]. Consequently, hardware lymphatic drainage enhances blood circulation and improves trophic processes in the muscles while accelerating the metabolism of lactic acid, helps to relieve muscle fatigue.

CONCLUSION

Thus, Uzbek and foreign scientists are developing and substantiating methods for the use of pharmacological substances to increase the efficiency and adaptive capabilities of the body. The role and interrelation of biological rhythms and sports performance has been determined. The effect of hyperoxia and hypoxic environmental conditions on the functional state of the body of athletes was studied. Our own experimental studies have shown the effectiveness of using a hyperoxic mixture and transcranial electrical stimulation, as well as taking into account biological rhythms to increase performance and improve the functional state of the body of athletes.

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