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რეზიუმე

საჩხერის რაიონის სოფლების მოსახლეობაში მიკრო-ბირთვიანი ბუკალური უჯრედების დონეთა ნარეგების ალბათური განაწილების ბაიესური ანალიზი

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კვლევის მიზანი წარმოადგენდა ორგანიზმზე გარემოს მანეჟ (გენოტოქსიური) ფაქტორების ზემოქმედების ბიომარკერის, ბუკალურ ეპითელიუმის უჯრედებში მიკრო ბირთვების დონის (მბდ), განაწილებების სპექტრის დადგენა და ანალიზი საჩხერის რაიონის (საქართველო) სოფლების პოპულაციებში.

საჩხერის რაიონის (სოფლები სარეკი, საირხე და ჭორვილა) მკვიდრებში (ორივე სქესი, 50-65 წ.), განისაზღვრა ბუკალური ეპითელიუმის უჯრედებში მიკრობირთვების დონე. გამოვლენილ იყო ბუკალური ეპითელიუმის მბდ-ის სხვაობა შესწავლილ პოპულაციებში, რაც შეიძლება გამოწვეული იყოს გარემოს ფაქტორების ზემოქმედებით: სარეკში გარკვეული (დაუდგენელი) გენოტოქსიკური ფაქტორის მოქმედება (როგორც ინტენსივობის, ასევე მასშტაბის მიხედვით) აისახება მბდ-ის ზრდაში, ხოლო ჭორვილასა და საირხეში მაინდუცირებული ფაქტორის არსებობა არ დაფიქსირდა და მბდ- პრაქტიკულად ნორმების ფარგლებში რჩება.

APPROACHES TO PHARMACOLOGICAL CORRECTION OF PSYCHOPHYSIOLOGICAL STRESS IN ATHLETES

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The pharmacology of sports medicine (or sports pharmacology) is a relatively new, but very actively progressing in recent years, direction of clinical and experimental pharmacology [20,29]. In connection with the improvement and tightening of the doping control system, it is extremely important that medications and special food supplements widely used in sports do not contain substances belonging to the Prohibited List of the World Anti-Doping Agency (WADA), while at the same time not only providing pronounced ergogenic effect, but also without negatively affecting the health of athletes [13].

At present, the system of training in sports of high achievement is characterized by exceptionally high training and competitive loads, which are accompanied by high-level emotional stress with the formation of pre-start excitement and pre-start fever [2,21]. Already only these factors can have a significant negative impact on the competitive result of an athlete and become the basis for long-term dysfunctional changes in the body and the development of various pathological conditions on the part of the cardiovascular, respiratory, immune and digestive systems [15,21].

In the practice of sports pharmacology, the use of monoterpenes obtained from various medicinal plants such as sage (*Salvia officinalis*) and peppermint (*Mentha piperita*), diterpene-rich extracts of ginkgo biloba (*Ginkgo biloba*) and triterpene-containing extracts of plants such as ginseng (*Panax ginseng*) and globulous eucalyptus (*Eucalyptus globules Labill.*), and it has been shown that they improve relevant aspects of cogni-

tive function and attention [26]. It is not surprising, therefore, that among pharmacological drugs for stimulating both physical and mental working capacity of athletes not only known plant substances occupy a special place (first of all, alkaloids, polyphenols, triterpenoids) [31]. However, herbal substances for maintaining the functional state of the central nervous system, although they are often quite effective, can have a cumulative and toxic effect [11], and also belong to substances prohibited in sports [24].

Therefore, the consolidated position of sports pharmacologists is the use of metabolitotropic drugs, which are not on the WADA Prohibited List, which have a minimum number of side effects and can provide adequate conditions for intensive physical loads for the functioning of the basic, limiting the physical and mental working capacity of organism systems [19].

Such preparations include, for example, eneryon, which by structure is a sulbutiamine (derivative of thiamine) but which has an open thiazole cycle, an additional disulfide bond and a lipophilic ester [1]. The drug regulates metabolic processes in the CNS, accumulates, according to immunofluorescence histological studies, in cells of reticular formation, hippocampus and serrated gyrus, in Purkinje cells and in the glomeruli of the granular layer of the cerebellar cortex. Placebo-controlled clinical trials using psychometric tests and evaluation scales show that the drug is highly effective in symptomatic therapy of functional asthenic conditions [10]. Sulbutiamine intensively reduces the severity of the state of functional asthenia, and in almost half

of the cases, it completely removes from it [3]. The drug has a positive influence on the subjective feeling associated with intellectual and mental activity, the feeling of vital tone, the comfort of exercising arbitrary intellectual activity and motor skills; improves vegetative visceral regulation and reduces meteosensitivity [22], however, it has a wide range of side effects, primarily from the gastrointestinal tract, which limits its use in sports.

In recent years, the attention of sports pharmacologists has been actively drawn to the use of the substance L-arginine (in the form of salts and compositions with other amino acids) [12]. It is known that L-arginine has multifaceted physiological effects on the body under conditions of intense muscle activity [16]. Arginine is indispensable for protein synthesis in the muscles by amino acid; a precursor of creatine, which potentially implies the presence of anabolic properties in muscle tissue; serves as a modulator for the formation of an endogenous growth hormone followed by indirect stimulation of anabolic processes; has an indirect stimulating effect on the synthesis of one of the most important natural nitrogen oxide endothelioprotectors – nitric oxide (NO), plays a significant role in the exchange of adenylyl nucleotides, which is accompanied by the expansion of blood vessels, including skeletal muscle and myocardial vessels, with a decrease in tissue oxygen demand, reduced fatigue and accelerated recovery; is a powerful cardioprotective agent [27, 32]. All of the above metabolic properties of L-arginine positively influence different aspects of physical efficiency and endurance of athletes.

The representative of such substances is the drug of tivortin®aspartate, one of the important functions of which, as shown earlier, is to maintain vascular tone, as well as membrane stabilizing, detoxifying, antihypoxant and antioxidant effects inherent in this substance when used in clinics [7] and in sports [4]. With regard to the influence of this substance on the psychophysiological condition of athletes, for example, a double-blind placebo-controlled study shows that the use of L-arginine-based food additives positively affects cognitive functions, critical to successful long-term work in cyber sport [35]. The study found that the level of self-esteem significantly increased in athletes, the manifestations of aggressiveness (unsportsmanlike) decreased, and the number of errors during the exercise TMT-B (Trail Making Test-B) decreased in the main group after taking a dietary supplement with L-arginine compared with the results in the placebo control group (in all cases, $p < 0.05$). Also when used supplement reduced players fatigue, TMT-B performance time and TMT B-A score from baseline ($p < 0.05$). The number of side effects was minimal and did not differ between the two groups. It should be noted, however, that, in general, studies on the use of L-arginine-based substances in practice in training athletes to correct their psychophysiological status are, unfortunately, very rare [8].

The above-mentioned has determined the relevance of the topic of work and the choice of the drug to conduct a study of its influence on the change of psychophysiological status of qualified representatives of different sports at the stage of preparation for competitions.

The aim of this study was to assess the effectiveness of the influence of the drug tivortin®aspartate on the psychophysiological characteristics of qualified athletes at the stage of pre-competition training.

Material and methods. Studies of the safety and efficacy of using the drug tivortin®aspartate carried out among 83 athletes specializing in athletics and weightlifting (all men aged 18 to 26 years; average age – 21.8 ± 4.6 years) and who are at the pre-

competitive stage of training. At the time of the study, the athletes did not exhibit any manifestations of acute respiratory viral infections and in the history of cardiorespiratory, endocrine, digestive, excretory systems with clinical manifestations, except for functional shifts, related to professional activity. All participants of the study were qualified (first-rate and candidates for the master of sports of Ukraine). The study was conducted taking into account bioethical principles, for which participants signed «Informed consent», in which athletes confirmed their voluntary consent to participate in the study after being acquainted with all its features that could influence their free decision. «Informed consent» provided a guarantee that the given pharmacological drug was not included in the list of substances prohibited by WADA, as well as the athlete's obligations to regularly take the drug in the prescribed dosage during the entire period of observation and adherence to the sports regimen.

The design study was randomized blind placebo-controlled. Randomization of athletes within samples (strata) was carried out before signing «Informed consent». By simple randomization method, out of a total of 83 participants, 4 subgroups of athletes were formed (2 main and 2 control) which did not have statistically significant differences in initial clinical-anamnestic, anthropometric, pedagogic (performance indicators) qualifications. The main subgroup of athletes 1A included 20, in the control 1K there were 16 athletes; respectively in the group of weightlifters the ratio of participants in the main (2A) and control (2K) subgroups was 24:23.

The athletes of the main subgroups used tivortin®aspartate in the form of a 20% solution for oral application at a daily dose of 40 ml, divided into two intakes of 20 ml, immediately after meals for 14 days of the study [11]. The athletes in the control subgroups received placebo (3% glucose solution) in identical dosage, multiplicity and duration of usage. In the course of the study, its participants did not use other neurometabolic, nootropic, adaptogenic drugs.

Since psychophysiological stress is one of the essential factors in reducing the effectiveness of competitive activity, changes of severity under the influence of tivortin®aspartate on the basis of a modified by us [5] test by V.A. Ivanchenko [6] were assessed in the athletes. For this purpose, from standard questionnaire by V.A. Ivanchenko, 10 questions were selected to determine the psychological component of stress and 10 – to determine the physiological component of stress in an athlete. During the test, the following indicators were determined: the sum of the points of the severity of psychological stress, the sum of the points of the severity of physiological stress, the total amount of points (the severity of psychophysiological stress). If the total amount is 30 points and less, this indicates an insufficient level of nervous system arousal, with the predominance of both psychological and physiological components of stress, resulting in pre-start apathy, reducing explosive forces and negatively affecting the results of competitive activity. The norm (the optimal level of severity of psychophysiological stress), according to our data [5], is the number of points from 31 to 45. The presence of significant total indicators of the severity of stress (from 46 to 60 points) characterizes a high level of stress (chronic stress), and more than 60 points – an overestimated level of stress, which indicates its deep psychosomatic negative character. For the calculation of psychological and physiological stress level, the assessment is made, respectively: 15 points and less – low stress level; 16 to 22 points – average stress level; 23 points and higher – high stress level (chronic stress). With the predominance of the physiological component of stress, a state of starting fever is

observed, which is of compulsive nature (unproductive hyperactivity, deterioration of pulmonary ventilation), which is a factor in the deterioration of the competitive result. With the predominance of the psychological component of stress, the athlete's reactions have an obsessive character (the predominance of the intensity of mental actions over motor activity), which is accompanied by a decrease in mental performance and also leads to a deterioration in the results of competitive activity.

The received data were processed with the help of «Statistica 8.0» software package and «GraphPadInStat» licensed computer program (USA). The difference between the dynamic data of the cores and control subgroups was considered statistically reliable at $p \leq 0.05$; a two-way critical area was used to evaluate the results. Compliance with the normal distribution was checked using the Shapiro-Wilk test. Comparison of sample values was carried out using nonparametric Wilcoxon and Mann-Whitney tests.

Results and discussion. The primary reasons for the formation of psychophysiological stress in athletes are quite diverse and are associated with the peculiarities of the training process built by different coaches, with the predominant type of athletes' temperament (melancholic and choleric people have higher manifestations of stress than sanguine and phlegmatic people do, which could not be taken into account during randomization and was not included in the tasks of the study at this stage), as well as with the power of the own antioxidant system of various athletes, which plays an important role in the formation of further psychophysiological restructuring under the stressful influence of the training process itself, especially at the stage of direct preparation for the competition. Therefore, at the first stage of the study as for the assessment of the effectiveness of the influence of the drug tivortin®aspartate on the severity of psychophysiological stress and its individual components, only the resulting

values of the indicators of this state were taken, to a greater or lesser extent present in all athletes and due to the specifics of professional activity [15].

During the course of usage of tivortin®aspartate, there was a decrease in the severity of psychophysiological stress, as well as separately - its components, as one of the important factors that determine the effectiveness of training and competitive activity of athletes (table 1).

As can be seen from table 1, track and field athletes in major group 1A show significant changes in the severity of psychophysiological stress and its constituents in the direction of decreasing. The control group 1K, who did not have any pharmacological support in the dynamics of the training process (placebo control), shows an increase in psychophysiological stress and its components, which is understandable from the point of view of increasing psychological tension by the end of the studied pre-competitive training mesocycle [2].

Weightlifters in the main subgroup as a whole show a significant decrease in the severity of psychophysiological stress and both of its constituents in the course of tivortin®aspartate application. In the control group of placebo-receiving weightlifters, no significant positive change has been recorded, on the contrary, the severity of psychophysiological stress and its components, although not very significantly, increased (table 2).

It can be assumed that in the athletes of subgroup 2K who did not receive pharmacological support, an increase in the intensity of psychophysiological stress in the dynamics of the period of preparation under investigation, over a period of 14 days, may in the future be a factor in the decrease not only of physical efficiency, but also of the competitive result.

Important both for athletes and weightlifters is not only the absolute reduction of the manifestations of psychophysiological stress, but also the transition from the stress stage «high» to the stage «medium», which increases the level of psychological

Table 1. Changes in the severity of psychophysiological stress and its components under the influence of tivortin®aspartate in athletes

Parameter	Research term	M±m	Mediane	Min.	Max.	p
Main subgroup 1A (n=20)						
Psychological stress, points	start	25.00±0.46	31	22	28	p<0.001
	ending	20.05±0.56 [#]	22	16	23*	
Physiological stress, points	start	23.67±0.47	23.5	21	26	p<0.001
	ending	19.08±0.23 [#]	19.0	16	23*	
Psychophysiological stress, points	start	48.67±0.70	49.0	45	52	p<0.001
	ending	39.17±1.06 [#]	40.5	33	44*	
Control subgroup 1K (n=16)						
Psychological stress, points	start	19.33±0.86	19.0	15	26	p>0.009
	ending	21.00±0.94	20.5	17	28	
Physiological stress, points	start	18.75±0.73	19.0	14	23	p>0.017
	ending	20.67±0.37	20.5	16	25	
Psychophysiological stress, points	start	38.08±1.38	39.0	37	44	p>0.113
	ending	41.67±1.71	42.5	36	48*	

Notes. 1. * – changes are significant between data of subgroups before and after the study;

2. # – changes are reliable between the data before and at the end of the study; 3. nonparametric tests are used.

Table 2. Changes in the severity of psychophysiological stress and its components under the influence of tivortin®aspartate in weightlifters

Parameter	Research term	M±m	Mediane	Min.	Max.	p
Main subgroup 2A (n=24)						
Psychological stress, points	start	21.27±0.78	22.3	17	25	p<0.001
	ending	19.55±0.75	20.4	16	23	
Physiological stress, points	start	21.36±0.92	21.0	16	26	p=0.002
	ending	20.09±0.96	19.3	15	25	
Psychophysiological stress, points	start	42.64±1.62	42.0	34	51	p<0.001
	ending	39.64±1.68	40.4	31	48	
Control subgroup 2K (n=23)						
Psychological stress, points	start	19.55±0.45	18.6	18	23	p=0.056
	ending	21.00±0.72	21.0	18	25	
Physiological stress, points	start	20.18±0.46	19.8	18	24	p<0.161
	ending	21.91±0.88	22.0	17	28	
Psychophysiological stress, points	start	39.73±2.86	38.4	37	44	p=0.140
	ending	42.91±3.11	44.1	36	48	

notes: 1. * – changes are significant between data subgroups before and after the study;

2. # – changes are reliable between the data before and at the end of the study; 3. nonparametric tests are used

Thus, the observed decrease in the severity of psychophysiological stress under the influence of the drug tivortin®aspartate indicates its pronounced neuroprotective effect in qualified athletes under conditions of a real training process, which has its experimental confirmation when using food supplements based on L-arginine [30]. The data obtained on the reduction of psychophysiological stress create prerequisites for the justified usage of tivortin®aspartate in athletes as an authorized mean of stimulating mental efficiency, especially in the phase of direct preparation for competitions, when psychophysical disorders of athletes are maximally expressed.

From our point of view, the explanation for the ambiguous manifestation of the effect of the studied drug based on L-arginine in comparison with the control lies in the plane of the mechanisms of energy supply of the contractile ability of skeletal muscles in representatives of different sports – cyclic and power [32], which include runners and weightlifters respectively. In the first case, the mechanism of energy supply is predominantly aerobic, which requires an increase in the oxygen transport function of the blood under conditions of intensive contractile work of skeletal muscles [18].

The effect of tivortin®aspartate, the structural basis of which is L-arginine, has the ability not only to increase the donation of nitric oxide, but also to accelerate the processes of physiological angiogenesis in skeletal muscles, myocardium, and the brain [23, 36], which is why it is manifested in runners, firstly, in a significant improvement of aerobic endurance and, secondly, in optimizing the blood supply to the brain, which is reflected in the improvement of psychophysiological characteristics [28].

In weightlifters, the increase of special mental (and physical) working capacity mainly lies not in the plane of improving the anaerobic mechanism of energy supply. Intermuscular and neuromuscular interactions [25] are of primary importance for the representatives of this sport. In this case, the provision of reduced psychophysiological stress is largely related to the directed influence of L-arginine, and therefore to the drug based on it, to tivortin®aspartate on metabolic processes in the central and autonomous nervous system [17]. Improving the psychophysiological characteristics of athletes in the course of this drug administration is one of the indirect mechanisms for improving the competitive results of weightlifting representatives [34], which determines that it is advisable to use the drug tivortin®aspartate in the practice of training athletes.

Conclusion. Thus, the course of usage of the metabolitotropic drug tivortin®aspartate is justified to be included in the pharmacological support schemes of athletes in order to increase psychological stability on the eve of competitions and improve psychophysiological characteristics of athletes, specializing in sports with different energy supply mechanisms.

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SUMMARY

APPROACHES TO PHARMACOLOGICAL CORRECTION OF PSYCHOPHYSIOLOGICAL STRESS IN ATHLETES

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The aim of the study was to assess the effectiveness of the influence of the medical drug tivotin®aspartate (drinking solution of L-arginine aspartate) on the psychophysiological characteristics and the severity of psychophysiological stress in qualified athletes at the stage of direct preparation for the competition.

Methodologically, the studies, which are randomized, blind, placebo-controlled, during the course (14 days) of drug usage in a daily dose of 40 ml were carried out in compliance with bioethical principles. The athletes in the control subgroups received placebo (3% glucose solution) in identical dosage, multiplicity and duration of usage. The assessment of the severity of psychophysiological stress and its individual components was carried out in a technology modified by us according to the standard questionnaire of V.A. Ivanchenko.

The results obtained showed that in both control subgroups by the end of the observation period, although not too significant, but nevertheless, a significant increase in the value of the magnitude of psychophysiological stress was observed (from 38.08±1.38 to 41.67±1.71 points and from 37.52±1.24 to 39.94±0.99 points for athletes and weightlifters, respectively; in both cases changes are valid, $p < 0.05$) and its individual components. On the contrary, in the athletes who used tivotin®aspartate in the dynamics of the study, the indicators of the severity of psychophysiological stress very significantly and reliably (from 48.67±0.69 to 39.17±1.07 in athletes and from 41.14±0.46 to 39.97±0.79 in weightlifters; in both cases changes are valid, $p < 0.05$) decreased, which indicated an improvement in psychological stability and a corresponding increase in mental stability to the forthcoming impact of competitive loads.

In this way, the data obtained indicate an improvement in the mental readiness of athletes for the upcoming competitions and substantiate

the advisability of using pharmacological substances based on L-arginine to improve psychophysiological characteristics during physical exertion with a different mechanism of energy supply.

Keywords: elite sport, psychophysiological stress, competitive result, L-arginine, pharmacological correction.

РЕЗЮМЕ

ФАРМАКОЛОГИЧЕСКАЯ КОРРЕКЦИЯ ПСИХОФИЗИОЛОГИЧЕСКОГО СТРЕССА У СПОРТСМЕНОВ

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Целью исследования явилась оценка эффективности влияния препарата тивортин®аспартат (питьевой раствор L-аргинина аспартата) на психофизиологические характеристики и выраженность психофизиологического стресса у квалифицированных спортсменов на этапе непосредственной подготовки к соревнованиям.

Методологические исследования, по дизайну представляющие собой рандомизированные слепые плацебо-контролируемые, в динамике курсового (14 дней) применения препарата в суточной дозе 40 мл проводили с соблюдением биоэтических принципов. Плацебо (3% раствор глюкозы) спортсмены в контрольных подгруппах получали в идентичной дозировке, кратности и длительности применения. Оценку выраженности психофизиологического стресса и его отдельных компонентов проводили по модифицированной авторами технологии по стандартному вопроснику В.А. Иванченко.

Полученные результаты показали, что в обеих контрольных подгруппах к концу периода наблюдения выявлено хотя и не слишком значительное, однако достоверное увеличение значения величины психофизиологического стресса (с 38,08±1,38 до 41,67±1,71 баллов и с 37,52±1,24 до 39,94±0,99 балла у легкоатлетов и тяжелоатлетов, соответственно) и его отдельных компонентов, а у спортсменов, применявших в динамике исследования тивортин®аспартат, показатели выраженности психофизиологического стресса весьма значительно и достоверно снижались с 48,67±0,69 до 39,17±1,07 у представителей легкой атлетики и с 41,14±0,46 до 39,97±0,79 – у тяжелоатлетов, что указывает на улучшение психологической стабильности и соответствующее повышение психической устойчивости к предстоящему воздействию соревновательных нагрузок.

Таким образом, полученные данные указывают на улучшение психологической готовности спортсменов к предстоящим соревнованиям и обосновывают целесообразность применения фармакологических субстанций на основе L-аргинина для улучшения психофизиологических характеристик при физических нагрузках с разным механизмом энергообеспечения.

რეზიუმე

ფსიქოფიზიოლოგიური სტრესის ფარმაკოლოგიური კორექცია სპორტსმენებში

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¹უკრაინის ფიზიკური აღზრდისა და სპორტის ეროვნული უნივერსიტეტის ოლიმპიური ინსტიტუტი, კიევი; ²უკრაინის ივანე ჩერნიახოვსკის სახ. თავდაცვის ეროვნული უნივერსიტეტის ფიზიკური კულტურისა და სპორტულ-გამაჯანსაღებელი ტექნოლოგიების სასწავლო-სამეცნიერო ინსტიტუტი, კიევი; ³შავი ზღვის პეტრე მოჰილას სახ. ეროვნული უნივერსიტეტი; ⁴საპოროუიეს სახელმწიფო სამედიცინო უნივერსიტეტი; ⁵სუმის სახელმწიფო უნივერსიტეტი, სამედიცინო ინსტიტუტი, უკრაინა

კვლევის მიზანს წარმოადგენდა პრეპარატ ტივორტინთან სპარტატის (L-არგინინის ასპარტატის დასაღვეი ხსნარი) მოქმედების ეფექტურობის შეფასება ფსიქოფიზიოლოგიურ მახასიათებლებზე და ფსიქოფიზიოლოგიური სტრესის გამოხატულებაზე კვალიფიციურ სპორტსმენებში შეჯიბრებისათვის უშუალო მზადების ეტაპზე.

ბიოეთიკური პრინციპების დაცვით ჩატარებულია რანდომიზებული ბრმა პლაცებო-კონტროლირებადი დიზაინის კვლევა პრეპარატის კურსის (14 დღე) გამოყენების დინამიკაში, დღელაშური დოზით 40 მლ. საკონტროლო ქვეჯგუფების სპორტსმენები პლაცებოს

(გლუკოზის 3%-იანი ხსნარი) იღებდნენ იგივე დოზირებით, ჯერადობით და ხანგრძლივობით.

ფსიქოფიზიოლოგიური სტრესის და მისი ცალკეული კომპონენტების გამოხატულების შეფასება ხორციელდებოდა ავტორების მიერ მოდიფიცირებული ტექნოლოგიით ვივანჩენკოს სტანდარტული კითხვარის მიხედვით.

მიღებული შედეგები მიუთითებს, რომ ორივე საკონტროლო ქვეჯგუფში დაკვირვების პერიოდის ბოლოს გამოვლინდა ფსიქოფიზიოლოგიური სტრესის ცალკეული კომპონენტებისა და ფსიქოფიზიოლოგიური სტრესის მაჩვენებლის არც თუ მნიშვნელოვანი, მაგრამ სარწმუნო ზრდა ($38,08 \pm 1,38$ -დან $41,67 \pm 1,71$ ქულამდე და $37,52 \pm 1,24$ -დან $39,94 \pm 0,99$ ქულამდე მძლეოსნებსა და ძალოსნებში, შესაბამისად); ხოლო სპორტსმენებში, რომლებიც დინამიკაში იღებდნენ პრეპარატს ტივორტინთან სპარტატი ფსიქოფიზიოლოგიური სტრესის მაჩვენებლები მნიშვნელოვნად და სარწმუნოდ შემცირდა - $48,67 \pm 0,69$ -დან $39,17 \pm 1,07$ ქულამდე და $41,14 \pm 0,46$ -დან $39,97 \pm 0,79$ ქულამდე მძლეოსნებსა და ძალოსნებში, შესაბამისად, რაც მიუთითებს მომავალი შეჯიბრებითი დატვირთვის მიმართ ფსიქოლოგიური სტაბილურობის და ფსიქიკური გამძლეობის მატებაზე.

ამრიგად, მიღებული შედეგები მიუთითებს ფსიქოლოგიური მზაობის გაუმჯობესებაზე მომავალი შეჯიბრების მიმართ და ასაბუთებს L-არგინინის საფუძველზე დამზადებული სუბსტანციების გამოყენების მიზანშეწონილებას ფსიქოფიზიოლოგიური მახასიათებლების გაუმჯობესებისათვის ენერგეტიკული უზრუნველყოფის სხვადასხვა მექანიზმის მქონე ფიზიკური დატვირთვის დროს.

PHYSICAL AND FUNCTIONAL CHANGES IN MIDDLE AND LONG DISTANCE RUNNERS UNDER VARIOUS CONDITIONS

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Before every competition, the sportsmen engaged in all types of sports examine their own physical and functional data and considering them, they plan tactic action for achieving high sport results.

As is known, among many types of athletics, middle and long distance running induces many problems for the organism, such are: requirement for oxygen and its acceptance, which are directly related to lung vital capacity, respiration and heart rate, systolic and minute levels, a timely delivery of oxygen, and corresponding connection between muscular activity and functional shifts [6].

The fulfilling all above-said requirements at a high level appears to be the guarantee for achieving the targeted sport results.

The regulations accepted in these two types of sport, the methods of training, functional capabilities, and physical norms in the training process are in close interconnection. For example, the 800 and 1500 meters run is included in the middle distance

running, the physical and functional indices of which obtained during the 800 m running are close to the functional indices of the sportsmen, obtained during 400 m running. However, the loading is twice as much. The explanation of this phenomenon is the following: it is a maximum level of heart rate obtained in 20 seconds after the starting 400 m exercise and lasts during the period of further physical activity [2].

The training of middle and long distance runners requires the providing of appropriate conditions, particularly, based on specific sports type, it is necessary to elaborate many complex skills, to develop of their optimal capabilities in one complex and their realization in the conditions of planned competition. For this it was necessary to clarify: 1) how a sportsman was preparing in the pre-start period; whether the sportsman was aware of the action strategy and tactics of his/her opponent. Based on this, what were the possibilities of the sportsman for the realization of sports training and successful solution of this issue.