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2. Improving the training of athletes of different qualification.
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CONTENT

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ASSESSMENT OF INDICATORS OF RANGE OF MOTION AND STRENGTH OF INDIVIDUAL MUSCLE GROUPS IN CHILDREN WITH CONSEQUENCES OF HIP DYSPLASIA

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Purpose: to determine the features of functional disorders of the hip joints, formed as a result of dysplasia in preschool children.

Material and methods: 131 children of preschool age (average age 5,6 ± 0,5 years) participated in the research, which was conducted during 2014-2019. Participants were divided into two main groups: the main group (MG, n = 68) – children with a history of developmental hip dysplasia (DDH) (identified by the analysis of medical records) and a comparison group (CG, n = 63) – children without hip joint disorders. To evaluate the results, we used the method of strain dynamometry (manual muscle tester with a mechanical force sensor "EXPANDER") and the method of goniometry.

Results: the research results of electrotensodynamic measurements of lower extremities muscles in children of MG indicate a significant decrease in the strength of the muscles-abductors of the thigh (m. gluteus medius, m. gluteus minimus, m. tensor fasciae latae) of the injured limb relatively intact (intact – 85,8 ± 6,8 and affected 54,5 ± 4,9 ((± S), ($p \leq 0,05$)) and hypertonicity of the thigh-adductor muscles (m. gracilis, m. adductor longus, m. adductor brevis) from the affected limb

relative to the intact limb (intact – 68,2 ± 4,4, affected – 95,8 ± 4,1, (± S), ($p \leq 0,05$). The research of the indicators of tensodynamometry of children with DDH revealed a strong direct correlation between the state of the muscular system and the development of the adduction contracture of the hip joint (correlation coefficient between the strength indicators of the muscles-abductors of the thigh and the amplitude of abduction ($r = 0,7$ (strong straight ligament, $p < 0,05$)).

Conclusions: tensodynamometric examination of the muscles revealed a decrease in the tone of the abductor muscles of the thigh, biceps femoris, m. semitendinosus, m. semimembranosus, m. quadriceps femoris, m. sartorius. The result of the functional activity of the muscles is the formation of a torsion-valgus deformity of the hip joint, which requires a step-by-step individual implementation of rehabilitation and corrective interventions.

Keywords: dysplasia of the hip joints, preschool age.

Introduction

Congenital hip dysplasia (CHD) is a genetically determined complex of pathological anatomical and functional abnormalities, including underdevelopment of the acetabulum, proximal thigh, lack of ligaments, which may be accompanied by impaired joint relations [1]. The "insidiousness" of dysplasia is that without clinical and instrumental screening of newborns, it can be undetected by parents and contribute to the vascular disorders in the femoral head (Perthes' disease) of preschool children resulting in necrosis of the femoral head, pain, lameness and disability [1 - 3].

Epifanov V.O. and coauthors note that the deformation of the lower limb is a consequence of diseases at an early age, birth defects or dysplastic changes in the skeletal system as a result of significant static loads [4]. Statistical data of the Ministry of Health of Ukraine show that 17-20% of preschool children have the consequences of hip dysplasia in the form of lower limbs valgus and varus deformity [2, 5]. Other clinical signs that occur as a result of HJD include limited movement in

the HJ, contracture of the thigh and leg muscles, shortening of the limb, and, as a consequence, a violation of the normal walking stereotype [2, 5, 6].

Zinchenko V. V. pays attention to the fact that shortening of the lower limb, which is determined visually, can be observed not only with obvious unilateral dislocation, but also with dysplasia, even bilateral one with different location of the thighs in height [3].

Despite the importance of the topic and summarizing the literature, we have uncertain points in the development of pathology and treatment of disorders. As a result, a number of unresolved issues arise: for example, it is quite deeply researched what functional disorders occur in newborns with HJD, but it is unknown what disorders are characteristic of children, whose pathology was not detected in time or the period for treatment from the moment of diagnosis was missed; what are the functional disorders that in preschool children with HJD have, and can these disorders be influenced to improve the functional state of the musculoskeletal system and such patients quality of life?

The purpose of the reseach is to determine the features of functional disorders of the hip joints, which were formed as a result of dysplasia of preschool children.

Material and Methods of the research

The research was conducted on the basis of Sumy special preschool educational institution (kindergarten) №20 "Smile" and Sumy preschool educational institution (kindergarten) №39 "Tower" during 2014-2019. The study included 131 preschool children (average age 5,6 ± 0,5 years). Two groups were formed to conduct research: the main (MG, n = 68) - children with unilateral HJD in the anamnesis (identified by the results analysis of medical records) and the comparison group (CG, n = 63) - children without disorders of the hip joints. The studies were conducted in accordance with the ethical standards that are written in the Helsinki Declaration of the World Medical Association "Recommendations for Physicians in Human Biomedical Research" (as amended in 2013). Written informed parental consent was also obtained from all persons involved in the study. The tensodinamometry method

(manual muscle tester based on the mechanical force sensor “EXPANDER”) and goniometry method were used to evaluate the results.

The materials of the study are formalized according to generally accepted principles and summarized in data matrix using an Excel 13.0 Microsoft Office software. Statistical analysis was performed in the software packages STATISTICA for Windows and IBM SPSS Statistics 22.

Results of the research

Underdevelopment of anatomical structures, weakness of the joint and ligament apparatus, which remain until the beginning of the child's walk, even with timely treatment in 5-20% of cases of HJD do not contribute to stable retention of the femoral head in the acetabulum and in 60% of cases instability is combined with joint damage, as well as ischemic disorders due to the use of ineffective (inadequate) orthopedic and restorative treatment [5, 6]. Among the negative consequences of hip dysplasia, special attention is paid to limiting the amplitude of movements in the hip joint, as in the future it causes walking disturbances and contributes to the progression of atrophy of the muscles of the lower limb.

To detect functional disorders of children with dysplasia, a reseach using goniometry was conducted. The amplitude of passive movements in the hip joint was measured in children, because the volume of passive movements in the state of joint hip dysplasia gives the most complete idea of the state of joint mobility. The results of the analysis of goniometry of the hip joints of children from MG and CG are presented in table 1.

According to the results of research it was found out that the indicators of the volume of movements during extension of the affected limb in the hip joint of children of the MG did not correspond to the norm: at normal volume of movement (equal to 0-10°) there was flexion contracture of children from MG (affected limb (-9,5± 4,3°($\bar{x}$ ±S)) compared to a healthy limb (3,3 ± 3,9 ($\bar{x}$ ±S)), which is 12,8° less than on the intact side ($p < 0,05$). Indicators of CG were normal (9,1 ± 4,1 and 8,5 ± 4,1 ($\bar{x}$ ±S) and were statistically different from the results of MG ($p < 0,05$).

Table 1

The results of goniometry of the hip joints of children from MG and CG at the stage of the ascertaining experiment

Movement	Normative meanings, degree	Main group (n = 68)		Comparison group (n = 63)		Comparison of indicators of affected and intact limbs (unilateral) MG and GP t-cr. Student
		intact limb	affected limb	dex limb	sin limb	
Bending	130-140	130,3± 3,4	128,2± 4,2	131,1± 3,5	128,08± 6,8	**p > 0,05**
		p > 0,05		**p > 0,05**		
Extension	0-10	3,3± 3,9	-9,5± 4,3*	9,1± 4,1	8,5± 4,1	**p ≤0,05**
		p ≤0,05		**p > 0,05**		
Withdrawal	40-45	40,1± 5,5	28,7± 3,5*	43,8± 4,45	42,4± 5,3	**p ≤0,05**
		p ≤0,05		**p > 0,05**		
Internal rotation	30-40	40,8± 4,1	43,2± 3,9	40,2± 3,1	39,2± 3,5	**p > 0,05**
		p > 0,05		**p > 0,05**		
External rotation	40-50	39,2± 5,3	25,7± 3,7*	36,3± 5,2	32,1± 6,05	**p ≤0,05**
		p ≤0,05		**p > 0,05**		

Note:
** - the significance of differences between groups at (p <0,05);*
MG - main group (children with a history of unilateral hip dysplasia)
CG - comparison group (healthy children)

According to the results of research it was found out that the indicators of the volume of movements during extension of the affected limb in the hip joint of children from MG did not correspond to the norm: at normal volume of movement (equal to 0-10°) of children from MG was flexion contracture (affected limb) 4,3° ($\bar{x}$ ±S)) compared to a healthy limb (3,3 ± 3,9°($\bar{x}$ ±S)), which is 12,8° less than on the intact side) (p <0,05). Indicators of CG were normal (9,1 ± 4,1 and 8,5 ± 4,1°($\bar{x}$ ±S) and were statistically different from the results of MG) (p <0,05). Obtained results confirm the presence of flexion contracture in the HJ of children

with HJD, which can be caused by asymmetry in the development of muscle strength of the lower limbs, namely hypotonia of the extensor muscles of the thigh (biceps femoris, m. semitendinosus, m. semimembranosus), which leads to the formation of walking of such children with half-bent legs.

Bending rates among children from CG and MG corresponded to the norm (in CG (131,1 ± 3,5 and 128,08 ± 6,8 ($\bar{x}$ ±S)) and in MG (intact – 130,3 ± 3,4 and damaged - 128,2±4,2 ($\bar{x}$ ±S)). Statistically significant differences between CG and MG were not detected (p> 0,05).

During the assessment of the volume of movements during the removal of the affected limb in the hip joint of children, a significant limitation of the volume of movements in the affected limb was found. Thus, the indicators of the available volume of movement during the removal of the affected limb in the HJ were among children of MG – 28,7 ± 3,5° ($\bar{x}$ ±S) and intact – 40,1 ± 5,5° ($\bar{x}$ ±S). Accordingly, the amplitude of withdrawal was less than normal and corresponded to 71,7% of normal range of motion in the affected joint, while the recorded values between intact and affected limbs differed significantly (p ≤0,05). Comparing the indicators (limb of the same name) between MG and CG statistically significant differences were traced (28,7 ± 3,5 in OG and 42,4 ± 5,3 in GP, ($\bar{x}$ ±S)), (p ≤0,05), which is a confirmation that movements in the hip joint of children with HJD are also limited due to the drive contracture, which may depend on the degree of displacement of the femoral head and the shortening of the drive muscles of the thigh of such children.

A similar trend was observed while estimating the amplitude of external rotation movements in the HJ of children with HJD of the main group. Thus, the results of goniometry of the hip joint showed that the available external rotation of the affected limb in the MG was 25,7 ± 3,7° ($\bar{x}$ ±S) and intact – 39,2 ± 5,3° ($\bar{x}$ ±S), (p ≤0,05). Accordingly, in the affected joint, the amplitude of external rotation was less than normal and corresponded to 64,3% of normal range of motion. The registered parameters between intact and affected limbs differed significantly (p ≤0,05). Restriction of external rotation is explained by muscle contracture, in

particular hypertension m. adductor magnus, which performs the reduction and internal rotation of the thigh. Restriction of external rotation can also be caused by the presence of pain during the performance of external rotation, which is confirmed by a number of specific tests, such as variations of the Kalchschmidt test [10].

Comparison of the results of the amplitude of internal rotation of children from MG revealed a slight increase in the amplitude on the affected side (40,8 ± 4,1 and 43,2 ± 3,9 ($\bar{x}$ ±S), (p> 0,05). But registered indicators of children from MG, so as from CG corresponded to the norm and did not differ significantly from each other (p> 0,05). Our results confirm the data from literature sources: in most cases, this excessive antetoria is accompanied by a violation of the centering of the femoral head relative to the acetabulum and is manifested by the peculiarity of the child's walking - walking with internal rotation of the leg [7-9].

Research of Mirzoeva A.M., Dombrovskaya L.V. on determining the bioelectrical activity of the muscles surrounding the hip joint shows that children (under fifteen years of age) with congenital hip dislocation have the lowest muscle electrogenesis. The percentage of the ratio of bioelectrical activity of the muscles of the diseased leg in relation to the healthy one is on average 40%, which certainly has a negative effect on the formation of stable ratios in dysplastic joints as a whole [3, 10].

The results of the study of electrotensodynamometry of the muscles of the lower limbs of children from MG indicate a significant decrease in the strength of the abductor muscles of the thigh (m. gluteus medius, m. gluteus minimus, m. tensor fasciae latae) of the injured limb relative to the intact one (p <0,05) in the hip joint (intact – 85,8 ± 6,8 and affected 54,5 ± 4,9 ($\bar{x}$ ±S), (p ≤0,05)) and hypertonicity of the adductor muscles of the thigh (m. gracilis, m adductor longus, m. adductor brevis) from the affected limb relative to the intact limb (intact – 68,2 ± 4,4, affected – 95,8 ± 4,1, ($\bar{x}$ ±S), (p ≤0,05).

Comparing the results of tensodynamometry of children from MG and CG, it was found out that the indicators of the comparison group corresponded to the

average values of the intact limb of children from MG and did not differ significantly statistically (p> 0,05). Thus, the strength of the abductor muscles of the thigh in CG corresponded to the meanings (89,2 ± 3,8 and 87,8 ± 5,5, ($\bar{x}$ ±S), (p> 0,05) and had no statistically significant differences from indicators of intact limb of children from MG (85,8 ± 6,8, ($\bar{x}$ ±S)). Evaluating the strength of the adductor muscles of the thigh among children from MG and CG it was found that the indicators on the side of the lesion were higher. This fact is connected with pathological drive contracture of children with HJD (table 2).

Table 2

Indicators of thigh muscle strength (according to electrotensodynamometry data) of children from MG (n = 68) and CG (n = 63) at the stage of the ascertained experiment

Indicators	Limb	MG affected / intact	CG dex/ sin	Comparison of indicators between MG and CG t-cr. Student
		x ± S	x ± S	
The strength of the thigh muscles during abduction, (N) (thigh abductor muscles)	Affected	54,5±4,9*	89,2±3,8	**p ≤0,05**
	Intact	85,8±6,8	87,8±5,5	**p > 0,05**
t-cr. Student		**p ≤0,05**	**p > 0,05**	
The strength of the thigh muscles during reduction (N) (thigh adductor muscles)	affected	95,8±4,1*	70,5±4,8	**p ≤0,05**
	intact	68,2±4,4	72,4±3,6	**p > 0,05**
t-cr. Student		**p ≤0,05**	**p > 0,05**	
The strength of the thigh muscles during flexion in the hip joint (N)	affected	75,9±4,1*	120,6±6,2	**p ≤0,05**
	intact	91,2±4,2	124,3±5,1	**p ≤0,05**
t-cr. Student		**p ≤0,05**	**p > 0,05**	
The strength of the thigh muscles during extension in the knee joint, (N)	affected	65,4±6,2*	99,3±4,7	**p ≤0,05**
	intact	80,2±4,2	101,4±5,1	**p ≤0,05**
t-cr. Student		**p ≤0,05**	**p > 0,05**	

*Note: * - differences are valid at p <0,05*

Our tensodynamometric reseach among patients with hip dysplasia revealed a strong direct correlation between the condition of the muscular system and the development of drive contracture of the hip joint. Thus, there is a pronounced drive contracture in the hip joint of children with HJD, which is associated with hypotonia of the thigh abductor muscles (m. gracilis, m. adductor longus, m. adductor brevis) from the affected limb (correlation coefficient between indicators strength of the abductor muscles of the thigh and the amplitude of the withdrawal r = 0,7 (strong connection, p <0,05).

According to the results of the assessment of the strength of the flexor muscles of the thigh (m. quadriceps femoris, m. sartorius) it was found out that the indicators of CG (120,6 ± 6,2 and 124,3 ± 5,1 ($\bar{x}$ ±S)) exceeded the results among children from MG (intact – 91,2 ± 4,2, affected 75,9 ± 4,1 ($\bar{x}$ ±S)), (p ≤0,05). The same trend was found out while assessing the strength of the extensor muscles of the thigh (m. biceps femoris, m. semitendinosus, m. semimembranosus) of children from MG and CG. Low muscle strength in the MG (affected 65,4 ± 6,2 and intact 80,2 ± 4,2 ($\bar{x}$ ±S), (p ≤0,05)) may be caused by violation of the normal functioning of the hip joint, which causes the development of asymmetry of muscle tone, resulting in violation of the walking pattern and, consequently, less activity of children with HJD, which may affect physical development of such children.

Thus, our reseach proves that there is an asymmetry in the development of muscle strength of the lower extremities (tone of adductor muscles exceeds the tone of thigh abductor muscles, there is an asymmetry of muscle tone of flexors and extensors of the thigh when compared with the intact limb) and pronounced rotational-drive and flexion contracture of the affected hip joint of the limb among preschool children with HJD. Also, the muscle tone of the extensor muscles of the thighs among children with HJD is still lower than among healthy children, which may be due to low activity of children with HJD.

Our future research work will be aimed at study of the level of physical development of children with HJD and their comparison among healthy children.

Conclusions / Discussion

In the scientific and methodological literature it is often noted that the severity of treatment of children with hip dysplasia is caused not only by the high degree of pathological changes in the cartilaginous structure but also by the fact that the soft tissue component of the hip joints is affected and it leads to the contractures of the muscles of the thigh and lower leg, shortening of the limb, and, as a consequence, - a violation of the normal stereotype of walking.

Extended and supplemented information includes the facts that children of preschool age with HJD have an asymmetry in the development of muscle strength of the lower limbs. The obtained results of electrotensodynamometry indicate a significant decrease in the strength of the thigh abductor muscles (m. gluteus medius, m. gluteus minimus, m. tensor fasciae latae) of the injured limb relative to the intact ($p < 0,05$) in the hip joint (intact - 85,8 ± 6,8 and affected 54,5 ± 4,9 ($\bar{x}$ ±S), ($p \leq 0,05$)) and muscle adductors of the thigh hypertonia (m. gracilis, m. adductor longus, m. adductor brevis) from the affected limb relative to the intact limb (intact – 68,2 ± 4,4, affected – 95,8 ± 4,1, ($\bar{x}$ ±S), ($p \leq 0,05$).

Thus, the result of the established imbalance of functional activity of muscles is the formation of torsional-valgus deformity of the hip joint, which requires a gradual individual rehabilitation and correction interventions.

Prospects for further research in this area are the development and implementation of a targeted program of rehabilitation interventions, taking into account identified disorders of the musculoskeletal system among children with hip dysplasia in SMART-format.

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References

1. Kalmykova, Y. S. (2014), Metody doslidzhennia u fizychnii reabilitatsii doslidzhennia fizychnoho rozvytku [Research methods in physical rehabilitation: research of physical development]. Kharkiv, KhDAFK, 104 p. (in Ukr.)

2. Holka, H. H. (2013), Travmatolohiia ta ortopediia [Traumatology and orthopedics]. Pidruchnyk dlia stud. vyshchykh med. navch. Zakladiv/ za red.: H. H. Holky. Vinnytsia: Nova knyha, 400 p. (in Ukr.)

3. Zynchenko, V. V. (2012), Osoblyvosti formuvannia kulshovykh suhlobiv u ditei pershoho roku zhyttia z oznakamy dysplazii spoluchnoi tkanyny [Features of the formation of the hip joints in children of the first year of life with signs of connective tissue dysplasia]. K.: DU«YTO AMNU», 20 p. (in Ukr.)

4. Epyfanov, V. A. (1999), Lechebnaia fyzycheskaia kultura y sportyvnaia medytsyna [Therapeutic physical culture and sports medicine]. Ucheb. lyt. dlia stud. med. vuzov. M.: Medytsyna, 304 p. (in Rus.)

5. Roi, I. V., Bila, I. I., Vovchenko, A. Ia., Zinchenko, V. V. (2005), "Manifestations of connective tissue dysplasia in newborns", Ortoped., travmatol. y protezyr, No. 3, pp. 69-73. (in Ukr.)

6. Bossard, F. (2015), "Diagnosis by hip sonography in an infant", Ultraschall Med, Vol. 26, № 2, P. 170-171 (in Eng).

7. Byrd, J. W. (2012), Operative Hip Arthroscopy Heidelberg. Springer, 217 p. (in Eng).

8. Vaquero-Picado, A., González-Morán, G., Garay, E.G, Moraleda, L. (2019), "Developmental dysplasia of the hip: update of management", EFORT Open Rev. 4(9), P. 548-556. (in Eng).

9. Paton, R. W. (2017), "Screening in Developmental Dysplasia of the Hip (DDH)", Surgeon, 15(5), P. 290-296. (in Eng).

10. Gkiatas, I., Boptsi, A., Tserga, D., Gelalis, I. (2019), "Developmental dysplasia of the hip: a systematic literature review of the genes related with its occurrence", EFORT Open Rev, 4(10), P. 595-601. (in Eng).

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INCREASING PHYSICAL FITNESS OF SHORT-DISTANCE BARRIER RUNNERS AT THE STAGE OF PRELIMINARY BASIC TRAINING

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Purpose: to determine the development of the overall preparedness of young athletes aged 12-13 years engaged in barrier sprint running.

Material and methods: the reseach involved 30 athletes (14 girls and 16 boys) aged 12-13 years engaged in Children and Youth Sports Schools of Kharkiv region. In the process of the pedagogical experiment the following methods were used: analysis of scientific-methodical literature, pedagogical testing; pedagogical observations of training activities for young runners, specializing in the hurdles at short distance, pedagogical experiment, and mathematical statistics.

Results: it was revealed that the average values of physical fitness indicators among girls and boys correspond to the standards of the educational-training group of initial basic training according to the results of testing the physical fitness of hurdler for short distances. The experimental group worked on this program where were included some speed and speed-power exercises in the training sessions. The growth rates of the indices of special physical fitness in girls and boys is shown in the table 2 and 3, the analysis of which allows detecting positive changes of indices of physical preparedness of hurdlers for short distances during the experiment.

Conclusions: the data of scientific-methodical literature on physical training of hurdler-runners on short distances are analyzed and summarized. The level of general physical fitness of young athletes at the age of 12-13 years old, engaged in hurdles running for short distances, was determined and assessed. The influence of the means of speed-power orientation on special physical fitness of hurdler-runners for short distances has been experimentally confirmed.

Keywords: physical training, hurdles, special physical fitness.

Introduction

Improving the physical fitness is the key to improving results in many athletics disciplines. The improvement of motor abilities occupies an important place in sports training of young sportsmen. If you purposefully influence motor abilities during the period of age-old development, and speed qualities develop, it is at an early age, and then the pedagogical effect will be significantly better than in other periods. Therefore, overall physical training of young sportsmen plays a significant role in the subsequent development of physical qualities and physical perfection.

This determines the need to develop such selective means of training loads that correspond to the laws of development of those systems of the body that interact with loads that directly affect the development of speed.

Increasing the physical fitness of sprinters-hurdlers is one of the important conditions for improving the sports training process. High indicators of general physical fitness are the basis for the development of special physical fitness of sprinters-hurdlers, and are also the basis for improving the technical, tactical, psychological training of athletes.

The research of overall physical fitness of 12-13 years old young sportsmen who are engaged in sprint hurdling makes it possible to assess the level of perception of load and assimilation of special motor exercises of an athlete, as well as to test experimentally the influence of high-speed and power direction on the special physical fitness of sprinters-hurdlers.

Modern scientific and methodological literature on the problems of sprint hurdling is quite large. However, most of the works are devoted to training of adults, qualified athletes. References on the training of young sprinters-hurdlers, as a rule, consider different aspects of the development of motor qualities at individual stages of training sportsmen. At the same time, there isn't enough work that considers the system of physical fitness of sprinters-hurdlers at the stage of initial training [2].

The analysis of scientific methodical literature indicates that many researchers studied physical training of runners [5, 8, 11], technical preparation of athletes [6, 12] and means of their improvement in the training process [9, 13]. However, only some works reveal the features of physical training of runners at the stage of previous basic training [3, 4].

Data of scientific and methodical literature and sports practice show that the development of high-speed and power abilities is carried out mainly by methods of interval and combined exercise [7, 14].

V.K. Vlasov believes that study precedes improvement - this is the first stage of the previous basic training, while improvement is its continuation. Study should be considered as a process of constant qualitative change in the system of motor actions in sprinting [3].

The number of works is quite limited and doesn't allow you to consider the problem finally solved for sprinters of the base group (12-13 years). Despite the presence of a number of scientific developments of this problem, the recommendations on physical fitness of sprinters-hurdlers at the stage of the previous basic preparation of the annual training cycle are quite contradictory and not always experimentally proved. Quite often there is a significant difference in the views of specialists on the issue of applying the methodology for introducing motor actions in the minimum time period for these conditions [10].

Special physical training provides for the development of functions of all organs and systems necessary for successful mastery of technique and improvement of sportsmanship. It is carried out primarily by performing special and preparatory exercises close to the coordination structure of the main sports exercises [2, 4].

The practical significance of the results of speed development lies in the early manifestations of abilities. Speed manifests itself through human abilities such as downtime rates and complex responses; speed of separate motor action, frequency of movements (tempo). [7]. The application of new approaches will provide an opportunity to coordinate the content of the training process aimed at the development and improvement of physical training of young track and field runners who are engaged in sprint hurdling at the stage of previous basic training [4].

The purpose of the research is to determine the level of development of overall physical fitness at 12-13 years old young sportsmen who are engaged in sprint hurdling.

Material and Methods of the research

The following methods were used during the pedagogical experiment: analysis of scientific and methodological literature, pedagogical testing; special pedagogical observations on training activities of young runners who specialize in sprint hurdling, pedagogical experiment, mathematical statistics.

Two homogeneous groups were formed by age and level of physical fitness, control and experimental groups, which are engaged in initial training groups of CYSS. Training lessons in the control group were conducted according to the generally accepted program on athletics for the sports school of the previous basic training.

The experimental group additionally included exercises of speed, high-speed and power character in training lessons (running on segments at speed, running on the track, serial repeated runs on the sand, using encumbrances on the shins, exercises on simulators and more).

Results of the research

For the results of testing the physical fitness of sprinters-hurdlers, it was found that the average values of physical fitness indicators at girls and boys (Table 1), in general, meet the standards for the training group of the previous basic training.

Table 1

Physical fitness indicators of 12-13 years old sprinters-hurdlers ($\bar{x} \pm m$)

Tests	Girls (n=7)	Boys (n=8)
Run 30 m (s)	5,32±0,31	4,95±0,77
Run 30 m from the move (s)	4,14±0,67	3,98±0,52
Shuttle run 4x9 m	11,4±0,32	10,5±0,67
Run 60 m (s)	9,32±0,46	8,85±0,54
Hurdling 60 m (s)	13,52±0,84	11,62±0,74
Standing long-jump, cm	210±0,38	225±0,16
Run 300 m (s)	58,0±0,46	48,2±0,36

Results of run 30 m, 57% of girls and 43% of boys, showed lower than the standards. Results of the test run 30 m from the move found that 72% of girls and 64% of boys have lower indicators from the standards. Results of run 60 m indicate that 50% of girls and 71% of boys showed results lower than the standards for this group. As a result of performing test exercises of run 300 m to 43% of girls and boys have indicators lower than standards ones.

Performing standing long-jump test exercise, which characterizes the manifestation of high-speed and power abilities, made it possible to find that girls and boys have results within the limits of the standards.

Considering the results of the research, comprehensive speed-force exercises were developed to increase special physical fitness as well as exercises from other sports to increase overall physical fitness. The reseach was carried out during September - October of the preparatory period.

The performance of sportsmen at the beginning of the 1st year of initial basic training indicates that 86% of runners have lower sports result from the standards one, requires the search for new means and methods of sports training to achieve high indicators of physical fitness.

The growth rate of special fitness at girls is shown in table 2, the analysis of which reveals positive changes during the experiment: in run 30 m 7.9% in the experimental group (EG) and 2.6% in the control group (CG); run 30 m from the move 13.5% in the EG and 3.9% in the CG; shuttle run 4x9m 13.8 in EG and 5.3% in CG; run 60 m 3.4% in EG and 1.9% in CG; hurdling 60 m 5.0% in the EG and 2.7%

in the CG; run 300 m 2.7% in the EG and 1.7% in the CG; standing long-jump 9.3% in the EG and 2.4% in the CG ($p<0.05$). Statistically unreliable data ($p>0.05$) were found in run 30 m in the EG, hurdling 60 m in the EG and CG.

Table 2

Rate of growth in special physical fitness indicators of girls-hurdlers by the results of the pedagogical experiment

Tests	Groups	Test results		Confidence assessment	Changes in indicators %
		Before the experiment $\bar{x} \pm m$	After the experiment $\bar{x} \pm m$	t; p	
Run 30 m (s)	CG (n=7)	5,32±0,64	5,18±0,28	t=2,00; p>0,05	2,6
	EG (n=7)	5,30±1,58	4,88±0,44	t=2,56; p>0,05	7,9
Run 30 m from the move (s)	CG (n=7)	4,12±0,92	3,96±0,36	t=2,18; p<0,05	3,9
	EG (n=7)	4,14±0,92	3,58±1,12	t=3,86; p<0,05	13,5
Shuttle run 4x9m	CG (n=7)	11,4±1,24	10,8±0,86	t=3,98; p<0,05	5,3
	EG (n=7)	11,6±0,58	10,0±0,24	t=2,55; p<0,05	13,8
Run 60 m (s)	CG (n=7)	9,30±1,34	9,12±0,56	t=1,24; p>0,05	1,9
	EG (n=7)	9,32±1,18	9,0±0,16	t=2,69; p>0,05	3,4
Hurdling 60 m (s)	CG (n=7)	13,52±0,56	13,16±0,84	t=3,51; p>0,05	2,7
	EG (n=7)	13.54±0,44	12,86±1,22	t=5,24; p>0,01	5
Standing long-jump, cm	CG (n=7)	210±0,62	215±1,34	t=3,38; p>0,01	2,4
	EG (n=7)	215±2,58	235±1,64	t=6,54; p<0,001	9,3
Run 300 m (s)	CG (n=7)	58,0±0,54	57,4±1,38	t=4,05; p>0,01	1,7
	EG (n=7)	58,2±2,36	56,6±0,68	t=6,51; p<0,001	2,7

For the results of the pedagogical experiment, the growth rates in indicators of special physical fitness at boys are presented in Table 3.

Reliable changes were established ($p<0.05$) was found: in run 30 m 10.4% in the experimental group (EG) and 4.6% in the control group (CG); run 30 m from the move 9.5% in the EG and 3.8% in the CG; shuttle run 4x9m in CG 2.9 and EG 7.7 ($p>0.05$); run 60 m 6.2% in EG and 1.7% in CG; hurdling 60 m 5.7% in EG ($p>0.01$) and 1.5% in CG; run 300 m 2.5% in EG and 1.7% in CG ($p>0.01$); standing long-jump 6.8% in the EG and 2.4% in CG.

Table 3

Rate of growth in special physical fitness indicators of boys-hurdlers by the results of pedagogical experiment

Tests	Groups	Test results		Confidence assessment	Changes in indicators %
		Before the experiment $\bar{x} \pm m$	After the experiment $\bar{x} \pm m$	t; p	
Run 30 m (s)	CG (n=8)	4,95±0,58	5,18±0,22	t=3,71; p<0,01	4,6
	EG (n=8)	5,0±1,84	4,88±1,12	t=2,41; p<0,05	10,4
Run 30 m from the move (s)	CG (n=8)	3,95±0,28	3,80±0,54	t=2,47; p<0,05	3,8
	EG (n=8)	3,98±1,18	3,60±0,48	t=2,98; p<0,05	9,5
Shuttle run 4x9m	CG (n=8)	10,5±1,34	10,2±0,64	t=2,02; p<0,05	2,9
	EG (n=8)	10,4±1,46	9,6±0,58	t=5,09; p>0,01	7,7
Run 60 m (s)	CG (n=8)	8,85±0,46	8,70±0,52	t=2,16; p>0,05	1,7
	EG (n=8)	8,9±0,62	8,35±1,38	t=3,64; p<0,01	6,2
Hurdling 60 m (s)	CG (n=8)	11,62±0,68	11,45±0,14	t=2,45; p<0,05	1,5
	EG (n=8)	11.65±1,34	11,00±0,46	t=4,59; p>0,01	5,7
Standing long-jump, cm	CG (n=8)	225±1,62	235±2,46	t=3,39; p<0,01	2,4
	EG (n=8)	220±3,34	240±2,88	t=3,40; p<0,01	6,8
Run 300 m (s)	CG (n=8)	48,2±1,36	47,4±1,62	t=3,78; p<0,01	1,7
	EG (n=8)	48,0±2,36	46,8±0,54	t=4,96; p>0,01	2,5

Therefore, in order to determine the effectiveness of the introduced training means with additional power burdens, running exercises on speed, running exercises on a sloping track, running and jumping exercises on sand, exercises on mysterious simulators, the reliable ($p<0.05$) increase in most indicators of special physical fitness of sprinters girls-hurdlers and boys-hurdlers was established.

Conclusions/Discussion

As a result of the research, it was found that the average values of physical fitness indicators of the training group of athletes meet the standards for the reseach group of the previous basic training, but for the results of hurdling 60 m to 56% and

in jumping tests to 32% of boys and girls have results, which are lower for this training group, which in turn encourages the search for effective means of sports training in order to increase physical fitness of sprinters-hurdlers at the stage of previous basic training.

The results of the experiment showed the reliable increase in results of girls (7.9%) and boys (10.4%) in run 30 m, 13.5% at girls and 9.5% at boys in run 30 m from the move, in standing long-jump 6.8% at boys, 9.3% at girls and 5.3% at boys; 3.4% for girls and 6.2% for boys in run 60 m; 13.8% girls and 7.7% boys in shuttle run 4x9m; 5% girls and 5.7% boys in hurdling 60 m in the experimental group.

There were no statistically significant differences in run 300m ($p>0.05$), indicating that there were no significant differences in the level of speed endurance at the studied hurdlers.

Consequently, the results of the research found that the use of high-speed and power means in the training process of sprinters girls-hurdlers and boys-hurdlers at the stage of previous basic training positively affect the increase in special physical fitness of sportsmen.

The perspective of subsequent researches will be aimed at determining the relationship between indicators of special physical fitness and technical of runners at the stage of specialized basic training.

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References

1. Artyushenko, O. F. &Stetsenko, A. I. (2006), Lehka atletyka [Athletics]: navchal′nyy posibnyk dly astudentiv f-tivfiz. kul′tury. Cherkasy : Vyd. Vovchok O. YU, 424 p. (in Ukr.).
2. Akhmetov, R. F. Maksymenko, H. M., &Kutek, T. B. (2010), Lehka atletyka [Athletics] : pidruchnyk. Zhytomyr, 320 p. (in Ukr.).

3. Vlasov, V. K. (2002), " Innovatsionnyie tehnologii: metodologiya, obuchenie i sovershenstvovanie ratsionalnoy sistemyi dvigatelnyih deystviy v sprinterskom bege", Teoriya i praktikafiz. kul'tury, No. 9, pp. 16-17. (in Ukr.).

4. Vovchenko, I. I. Hedzyuk, D. O., & Filina, V. A. (2018),"Search for ways to improve the physical training of athletes", Fizychna kul′tura, sport ta zdorov'ya natsiyi, Vinnytsya, pp. 180-186. (in Ukr.).

5. Holovko, D. (2001), "Correction of speed and strength training of highly qualified sprinters", Moloda sportyvna nauka Ukrayiny, Vol. 5, No. 1. pp. 315–317.(in Ukr.).

6. Gura, N. O. (2007), «Evaluation of test results in determining the features of the development of anthropomotor abilities of children and adolescents ", Slobozhanskyi naukovo-sportyvnyi visnyk, Harkov No. 12, pp. 57-59. (in Ukr.).

7. Kutek, T. B. (2015),"Research of informativeness of special physical and technical parameters of preparation of qualified sportsmen", Slobozhanskyi naukovo-sportyvnyi visnyk, Harkov, No. 2(46), pp. 98-102. (in Ukr.).

8. Manzhos, N. V.,Gorlov, A. S., & Yushko, B. N. (2002), Novyye universal'nyye metody otsenki begovoy trenirovochnoy nagruzki u legkoatletov razlichnoy kvalifikatsii [New universal methods for assessing running training load among athletes of various qualifications]: uchebno-metodicheskoye posobiye. Harkov, 113 p. (in Ukr.).

9. Mulik, V. V. & Harchenko, T. P. (2007), "Determination of the level of development of motor qualities among young figure skaters of the group of initial training", Slobozhanskyi naukovo-sportyvnyi visnyk, Harkov, No. 12, pp. 100-102. (in Ukr.).

10. Tereshchenko, V. I. & Lutsenko, R. L. (2003), Metodolohichni osnovy spetsial′noyi fizychnoyi ta tekhnichnoyi pidhotovky lehkoatleta [Methodological bases of special physical and technical training of an athlete]: navch. posib. Kyiv, 248 p. (in Ukr.).

11. Svyshch, Y. A. S. &Sybil′, M. H. (2009), "Dynamics of indicators of special physical fitness of runners on short distances under the influence of the author's

technique of hypoxia training", Slobozhanskyi naukovo-sportyvnyi visnyk, Harkov, No. 2, pp. 34-38. (in Ukr.).
12. Stepanenko, D. (2007),"Relationship between physical and technical fitness of sprinters of different qualifications ", Slobozhanskyi naukovo-sportyvnyi visnyk. Harkov ,No. 12, pp. 70-72. (in Ukr.).
13. DeWeese, B. H., Hornsby, G., Stone M., Stone, M. H. (2015), "The training process: Planning for strength–power training in track and field. Part 1: Theoretical aspects", Journal of Sport and Health Science, 1-10 (in Eng.)
14. Borresen, J., & Lambert, M. I. (2008), "Quantifying training load: a comparison of subjective and objective methods", International journal of sports physiology and performance, 3 (1), 16-30 (in Eng.)

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OPTIMIZATION OF PHYSICAL TRAINING PROCESS OF 10-11 YEARS OLD ATHLETES WITH HEARING IMPAIRMENT INGAGED IN JU-JITSU

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Purpose: to determine the changes in the level of physical fitness of athletes 10-11 years old with hearing impairment under the influence of ju-jitsu classes.

Material and methods: 12 young athletes with hearing impairments (10-11 years old) - representatives of the Poltava Regional Center for Physical Culture and Sports of Disabled People "Invasport" of the Poltava Regional Council took part in the study. The research was carried out on the basis of the sports hall of the Poltava Training Center from September 2019 to February 2020. To solve the set research tasks, the following complex of methods was used: analysis of scientific and methodological literature; pedagogical observation; pedagogical testing; methods of mathematical statistics. Determination of changes in the level of physical fitness of young athletes with hearing impairments, engaged in ju-jitsu, during the experiment, was carried out using a block of control tests.

Results: using a comparative analysis of the average test indicators, a statistically significant increase in the results was revealed: speed-strength qualities ("Standing long jump", (t = 7.24) strength qualities ("Push ups"; t = 7.19, "Pulling up "; t = 5.93) speed ("30 m run"; t = 6.63) agility and coordination abilities ("Shuttle run 4x9 m"; t = 6.46) flexibility ("Tilt of the trunk forward from a sitting position"; t = 5.00).

Conclusions: the construction of the training sessions taking into account the specific characteristics of athletes with hearing impairment, namely the use of acrobatic exercises in the preparatory part of classes and the use of special means for correcting body functions, correcting and developing coordination abilities; balance function correction; correction of vestibular function, contributed to the creation of conditions for improving the physical fitness of children 10-11 years old, engaged in ju-jitsu.
Keywords: jiu-jitsu, young athletes, physical preparedness, athletes with hearing impairments.

Introduction

Physical training takes a special place in the system of sports training, since only under the condition of a proper level of development of physical qualities, athletes can quickly and efficiently master techniques and tactical actions, and also effectively apply them in the process of intense competitive activity [6, 7, 12, 21].

The physical preparedness of athletes, according to the definition of many specialists, is of particular importance in the field of adaptive sports [8, 9, 20, 22, 23].

Numerous scientific studies show that dysfunction of the auditory analyzer leads to a negative impact on the entire process of human development. It is noted that with complete or partial impairment of hearing functions in athletes, not only a lag in their physical development is manifested, but also a decrease in indicators of physical development in comparison with healthy athletes [3, 4, 13, 18].

An important direction and urgent are the issues of improving the physical condition and health of children with hearing impairments, improving physical development, prevention and correction of disorders in the process of their development [5, 10, 15].

It should be noted that one of the best ways to strengthen and restore health is playing sports, and especially ju-jitsu, as one of the most popular modern systems of martial arts, the purpose of which is to achieve physical and moral improvement [1, 2, 14, 19].

Ju-jitsu training improves physical status, contributes to the harmonious development of motor qualities, increases the emotional state, creates the necessary conditions to ensure the correction of motor changes and increase the performance of the body of athletes with hearing impairments.

At the same time, the training of young athletes with hearing impairments in ju-jitsu requires further research on the features of the organization of educational and training sessions, methods of developing physical qualities, the development of the optimal dosage of loads, the duration and nature of rest, and predetermines the relevance and social significance of the chosen research topic.

The purpose of the reseach is to determine the changes in the level of physical fitness of young athletes of 10-11 years old with hearing impairments under the influence of ju-jitsu classes.

Material and Methods of the research

The study involved 12 young athletes with hearing impairments (10-11 years old) - representatives of the Poltava Regional Center for Physical Culture and Sports for Disabled People "Invasport" of the Poltava Regional Council. The reseach was carried out on the basis of the sports hall of the Poltava Training Center from September 2019 to February 2020. The following complex of methods was used for the reseach: analysis of scientific and methodological literature; pedagogical observation; pedagogical testing; methods of mathematical statistics.

Results of the research

During the research, a new structure of training lessons was introduced into the training process of young athletes with hearing impairments (Table 1).

Educational and training sessions for young athletes with hearing impairments who practice ju-jitsu were built according to a scheme with a total duration of 90 minutes using the preparatory (20 minutes), main (60 minutes) and final (10 minutes) parts.

Table 1

Scheme of a training lesson for young athletes with hearing impairments 10-11 years old who practice ju-jitsu

	Content	Dosage, min.	Methodical instructions
Preparatory part, 20 minutes	Line up. Announcement of lesson tasks.	2	Performed by the whole group
	Running exercises	3	
	General and developmental exercises	5	
	Special exercises	5	
	Acrobatic exercises	5	
Main part, 60 minutes	Acquaintance or training in technical actions	14	Pay attention to mistakes when performing exercises
	Recreation	4	Performed by the whole group
	Special means of correction of body functions or simulation exercises with a partner	10	Pay due attention to differentiated and individual approaches
	Recreation	4	Performed by the whole group
	Development of physical qualities	14	Differentiated approach
	Recreation	4	Performed by the whole group
	Moving games or relays	10	The content of the game must correspond to the age characteristics of physical and mental development
Final part, 10 minutes	Relaxation exercises, flexibility exercises, breathing exercises	6	Performed by the whole group
	Summing up, analysis of the lesson	4	Perform the tasks of the lesson, point out mistakes, mark the most successful

According to the definition of specialists R.V. Chudnoi [16] and L. V. Shapkova [17], to overcome the negative consequences of the influence of a sensory defect on the social and physical development of athletes with hearing impairment, specially organized physical culture and adaptive sports classes help their physical preparedness. Therefore, in the preparatory part of the training session, in addition to the general part of the warm-up, which was aimed at an effective transition to the main work due to the activation of the functions of the central nervous system and other body systems, a special part was used using exercises as close as possible in structure and effect on the athlete's body to upcoming training activities, where the mandatory component was the use of acrobatic exercises. These

exercises were divided into two groups. The first group included dynamic exercises associated with partial or complete overturning over the head in different directions, namely rolls, somersaults, overturns, arc movements. The second group included static exercises that were associated with keeping the body in balance in various positions: stands, bridges, splits.

In the main part of the lesson, exercises were performed in accordance with the tasks determined for each lesson individually, but had to adhere to a certain logical sequence regarding: technical training, exercises of correctional and rehabilitation orientation, development of physical qualities.

In order to increase the motor density of the training session to 60-70%, when changing the type of training, active rest was used: a set of exercises to relax the muscles of the arms, muscles of the legs, muscles of the trunk, since switching from one type of activity to another favorably affects the acceleration of recovery processes.

In the process of developing physical qualities, they mostly adhered to the principle of gradualness and consistency, multiple repetitions of the same technique.

A feature of the planning of individual training sessions was their complex nature, providing for the simultaneous development of various qualities and abilities of an athlete, since they are more emotional, have a versatile effect on the functional and mental sphere of a young athlete and to a greater extent contribute to the preferential development of individual properties and abilities of an athlete and correspond to the task of training young athletes with hearing impairment.

The main principles of constructing classes for young athletes with hearing impairments were: the universality of the tasks, the choice of means and methods in relation to all pupils, compliance with a differentiated and especially individual approach and a deep study of the characteristics of each athlete.

On the basis of the analysis of the results, which were shown in the repeated testing, in general, the positive dynamics of the development of physical preparedness of young athletes with hearing impairments, who go in for ju-jitsu, were determined (Table 2).

Table 2

Physical preparedness indices of young athletes with hearing impairments, practicing ju-jitsu at the beginning and at the end of the study (n=12)

№	Control tests	Term of testing	$\bar{x} \pm m$	t	p
1	Pull-ups, number of times	At the beginning	4,1±1,2	5,93	<0,001
		At the end	5,4±1,2		
2	Standing long jump, cm	At the beginning	123±8,1	7,24	<0,001
		At the end	133±10,5		
3	Push-ups, number of times	At the beginning	10,8±3,3	7,19	<0,001
		At the end	13,25±3,8		
4	Running for 30 m, s	At the beginning	6,6±0,3	6,63	<0,001
		At the end	6,4±0,3		
5	Shuttle run 4 x 9 m, s	At the beginning	12,5±0,5	6,46	<0,001
		At the end	12,2±0,4		
6	Tilt of the trunk forward from a sitting position, cm	At the beginning	3,5±1,5	5,00	<0,001
		At the end	4,8±1,4		

Analysis of the data using a paired two-sample t-test for average indicators revealed that the greatest changes in indicators occurred in the development of speed-strength qualities when using the test "Standing long jump"; t = 7,24; p <0,001. This was facilitated by the use of special means of correction and the use of various types of jumps in training sessions.

The use of acrobatic exercises, special means of correcting body functions, complexes for the development of physical qualities, outdoor games and relay races when organizing classes for young athletes with hearing impairments contributed to a higher statistically significant growth of indicators in other tests. Thus, a significant improvement in the results was obtained in the tests: "Push-ups"; t = 7,19; p <0,001; "Pulling up on the bar"; t = 5,93; p <0,001; "Running for 30 m"; t = 6,63; p <0,001; "Shuttle run 4x9 m"; t = 6,46; p <0,001; "Tilting the trunk forward from a sitting position"; t=5,00; p<0,001, (Table 2).

The greatest gains in performance were found in the development of flexibility and strength. Thus, the average group results in the test "Tilt of the trunk forward from a sitting position" increased from 3,5 cm to 4,8 cm, which amounted to an increase of 37,1%. In the test "Pulling up on the bar" from 4.1 to 5.4 times (31,7%), and in the test "Push-ups " from 10,8 to 13.3 times (23,1%). This is due to the use of

directed work to simultaneously correct and develop strength and flexibility, which ensured a more effective development of strength and flexibility.

The smallest percentage of results increase is observed in the tests: "Shuttle run 4x9 m", according to the definition of the development of dexterity and coordination abilities, the indicators of which improved from 12,5 s to 12,2 s (2,5%); "30 m run", according to the definition of the development of speed qualities, the indicators of which improved from 6,6 s to 6,4 s (3,1%); as well as in the development of speed-strength qualities using the test "Standing long jump", the average indicators of which improved from 123 cm to 133 cm and amounted to 8.1%. The lower development of quickness, dexterity and coordination abilities and speed-strength qualities can be explained by the peculiarities of functional disorders of persons with hearing impairments, namely: insufficient coordination and uncertainty of movements; low level of development of spatial orientation; an increase in the time of motor reaction and reaction to choose; lagging behind in jumping ability; low rate of movement; deterioration of motor memory.

At the same time, a correlation analysis was carried out between the results that were shown in tests during the experiment, it was revealed that there is a high connection between speed-strength qualities and speed qualities (r = 0.89), speed-strength qualities, manifestations of dexterity and coordination abilities (r = 0.65), speed qualities and agility and coordination abilities (r = 0.70) (Table 3).

Table 3

Value of the correlation between the test scores of young athletes with hearing impairments who practice ju-jitsu (n=12)

№	Test	1	2	3	4	5	6
1	Pull-ups, number of times	1,00					
2	Standing long jump, cm	0,51	1,00				
3	Push-ups, number of times	-0,31	-0,15	1,0			
4	Running for 30 m, s	-0,18	**-0,89**	0,03	1,00		
5	Shuttle run 4 x 9 m, s	-0,29	**-0,65**	0,01	**0,70**	1,00	
6	Tilt of the trunk forward from a sitting position, cm	0,17	-0,09	-0,05	0,19	0,02	1,00

Determination of the correlation between test indicators thoroughly proves the effectiveness of the use of correctional work in training sessions with the help of special means, for the purpose of directed individual development, which included: 1) means of correction and development of coordination abilities: long and high jumps from a place and from a run to maximum result or a given distance, jumping over barriers of different heights and distances between them (overcoming the feeling of fear); 2) means for correcting the balance function: running along a straight line, jumping on one leg, running with objects on outstretched arms (ball, gymnastic stick) 180 °, 360 ° (the same with jumps).

Conclusions / Discussion

According to research by Yu.A. Peganov and A.G. Spitsyn [11] sports programs and methods of physical education for athletes with hearing impairment should be focused not only on general physical development, but to a greater extent on elimination of physical disabilities. In this regard, for the physical development of deaf children, strength exercises are used with weights of their own weight with the implementation of a targeted effect on the development of the main muscle groups, exercises for the correction and development of flexibility (sitting, exercises with objects; at the support; in pairs), the simultaneous development of strength and flexibility, as well as the circuit training method. The basis of the methodology of physical development is the cross use of general developmental and special exercises, organized according to the rule of “cross load” on muscle groups and assumed the implementation of exercises that contribute to the consistent inclusion of relatively autonomous muscle groups in the work.

To optimize the process of physical training of young athletes of 10-11 years old with hearing impairments, practicing ju-jitsu, the structure of the training lesson was built, which had its own specific features, namely, the use of acrobatic exercises in the preparatory part of the lesson and the use of special means of correcting body functions: means of correction and development of coordination abilities; balance function correction means; means of correction of vestibular function.

The construction of the structure of training sessions, taking into account the specific features, which was aimed at the development of the basic physical qualities and functional systems of young athletes with hearing impairments, contributed to the creation of conditions for a sufficiently appropriate improvement of the physical fitness of children, confirms the data of A.V. Mutyeva [10].

Therefore, at each lesson, the play method of training was used, since in the process of playing children not only master many motor skills and abilities useful for life, but play is also an excellent means of developing physical qualities and forming a sustainable interest in sports.

According to A.V. Podulibinoi [13], active movements due to the content of outdoor games and relay races, cause positive emotions in children with hearing impairment and create psychological comfort in the classroom, strengthening all physical and mental processes. The game exercises and tasks that we used in the preparation process contributed not only to the development of communication skills, but also to social adaptation, favorably influenced the psychomotor and communication skills of children with hearing impairments.

In the final part, relaxation exercises, flexibility exercises, breathing exercises were used, which made it possible to reduce the body's response to the presented load.

A statistically significant increase in the average group results was revealed: speed-strength qualities, test "Standing long jump" from 123 cm to 133 cm (t=7,24) development of strength qualities, test "Push-ups" from 10,8 to 13,3 times (t=7,19); development of speed, test "Running for 30 m" from 6,6 s to 6,4 s (t = 6.63) development of dexterity and coordination abilities, test "Shuttle run 4x9 m" from 12.5 s to 12,2 s (t = 6.46) development of strength qualities, test "Pulling up on the bar" from 4,1 to 5,4 times (t = 5.93) development of flexibility, test "Tilt of the trunk forward from a sitting position" from 3.5 cm up to 4.8 cm (t=5,00).

The prospect for further research are in the development of the construction of educational and training programs in various types of adaptive sports.

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References

1. Agafonov, G. G. (2003), Dzhiu-dzhitsu. Sovremennaia tekhnika drevnego boevogo iskusstva [Jujutsu. Modern techniques of ancient martial arts], M.: Feniks, 288 p. (in Russ.).
2. Ashikaga, K. (2013), Zhiu-zhitsu: (Dzhiu-dzhitsu) [Jiu-jitsu: (Jiu-jitsu)], M.: Kniga po trebovaniiu, 240 p. (in Russ.).
3. Baikina, N. G., Mutev, A. V., Kret, Ia. V. (2002), "Impact of hearing loss on the adaptation and rehabilitation processes of deaf adolescents", Adaptivnaia fizicheskaia kultura, № 4., pp. 14-19. (in Russ.).
4. Gubareva, N. V. (2009), "Justification of a differentiated approach in the physical education of schoolchildren with varying degrees of hearing impairment": elektronnyi resurs, Vestnik Tomskogo gosudarstvennogo universiteta, № 319, pp. 161-164. (in Russ.).
5. Hurinovych, Kh. Ye., Trach, V. M. (2005), Metodyka vykorystannia zasobiv fizychnoho vykhovannia dlia korektsii rukhovoi funktsii hlukhykh ditei molodshoho shkilnoho viku [Methods of using means of physical education for correction of motor function of deaf children of primary school age]: navchalnyi posibnyk, L.: DP Skhid Sontsia, 105 p. (in Ukr.).
6. Kyiko, A., Mulyk, V. (2017), "Influence of interval hypoxic training on indicators of physical fitness of qualified climbers", Slobozhanskyi naukovo-sportyvnyi visnyk, №5 (61), pp. 59-63, doi:10.1531/snsv.2017-5.010. (in Ukr.).
7. Kostiukevych, V. M. (2014), Teoriia i metodyka sportyvnoi pidhotovky (na prykladi komandnykh ihrovykh vydiv sportu) [Theory and methods of sports training (on the example of team games)]: navchalnyi posibnyk, Vinnytsia: Planer, 616 p. (in Ukr.).

8. Mishyn, M. V. (2017), "Preservation of balance and stability of a body of basketball players with disturbance of the musculoskeletal system taking into account parameters of the sports cart", Zdorove, sport, reabylytatsyia, № 2, pp. 55-59. (in Ukr.).

9. Mulyk, V. V., Nesterenko, A. Yu. (2015), "The influence of the use of complexes of strength exercises on the indicators of the special strength of the shoulder girdle muscles of athletes of the Paralympic team of Ukraine in cross-country skiing and biathlon during the preparatory period", Slobozhanskyi naukovo-sportyvnyi visnyk, №3(47), pp. 69-74, dx.doi.org/10.15391/snsv.2015-3.012. (in Ukr.).

10. Mutiev, A. V. (2002), "Correction of the motor sphere of deaf students in the group of initial sports training in taekwondo", Pedahohika i psykholohiia formuvannia tvorchoi osobystosti: problemy i poshuk, Zbirnyk naukovykh prats, Kyiv-Zaporizhzhia, Vyp. 22, pp.330-333. (in Ukr.).

11. Peganov, Iu. A., Spitcyn, A. G. (1998), "Ways to improve the level of physical fitness of deaf and hard of hearing senior schoolchildren", Defektologiia, № 2, pp. 37-49. (in Russ.).

12. Platonov, V. N. (2017), Dvigatelnye kachestva i fizicheskaia podgotovka sportsmenov [Motor qualities and physical fitness of athletes], K.: Olimpiiskaia literatura, 656 p. (in Russ.).

13. Podulybina, A. V. (2012), "Physical education of students with hearing impairment", Vestnik Volzhskogo universiteta im. V.N.Tatishcheva, № 3, pp. 160-166. (in Russ.).

14. Saienko, V. H. (2012), Sportyvno-pedahohichne vdoskonaliuvannia zi skhidnykh yedynoborstv [Sports and pedagogical improvement in martial arts]: navch. posib. dlia stud. vyshch. navch. zakl. fizychnoho vykhovannia i sportu, Derzh. zakl. Luhan. nats. un-t imeni Tarasa Shevchenka, Luhansk: Vyd-vo DZ „LNU imeni Tarasa Shevchenka”, 432 p. (in Ukr.).

15. Sermieiev, B. V., Kotsan, I. Ya., Karabanov, A. H. (1997), Prohramy z fizychnoho vykhovannia u shkoli dlia hlukhykh ditei (5-11 klasy) [Physical education programs at school for deaf children (grades 5-11)], K.: IZMN, 56 p. (in Ukr.).
16. Chudna, R.V. (2003), Teoriia adaptyvnoho fizychnoho vykhovannia [Theory of adaptive physical education]: pidruchnyk, K.: Nauk. dumka, 270 p. (in Ukr.).
17. Shapkova, L. V. (2005), Chastnye metodiki adaptivnoi fizicheskoi kultury [Private methods of adaptive physical culture], M.: Sovetskii sport, 464 p. (in Russ.).
18. Ianchuk, K., Tykhorskyi, O., Petrenko, I. (2020), "Analysis of shock techniques of highly qualified karate girls with hearing impairments", Slobozhanskyi naukovo-sportyvnyi visnyk, № 2(76), pp. 91-103, doi:10.15391/snsv.2020-2.006. (in Ukr.).
19. Boguszewski, D., Torzewska, P. (2011), "Martial arts as methods of physical rehabilitation for disabled people", Journal of Combat Sports Martial Arts, 1(2), Vol. 2, pp. 1–6. (in Eng.).
20. D'isanto, T. (2020), "Sports skills in sitting volleyball between disabled and non-disabled people", Journal of Physical Education and Sport, Vol.20 (3), Art 194, pp. 1408–1414, doi:10.7752/jpes.2020.03194. (in Eng.).
21. Mishyn, M., Kamaiev, O., Mulyk, V., Taran, L., Grashchenkova, Zh., Tarasevich, O., Hradusov, V., Mulyk, K., Pomeshchikova, I. (2018), "Problems and features of technique in the development of coordination abilities of players specializing in wheelchair basketball", Journal of Physical Education and Sport, 18 Supplement issue 2, Art 150, pp. 1016 – 1020, doi:10.7752/jpes.2018.s2150. (in Eng.).
22. Richardson, E.V., Smith, B., & Papathomas, A. (2017), "Crossing boundaries: The perceived impact of disabled fitness instructors in the gym", Psychology of Sport and Exercise, 29, pp.84–92. doi:10.1016/j.psychsport.2016.12.006. (in Eng.).
23. Shirazipour, C., Blair Evans, M., Leo, J., Lithopoulos, A.r, Martin Ginis, K. & Latimer-Cheung, A. (2020), "Program conditions that foster quality physical activity participation experiences for people with a physical disability: a systematic review",

Disability and Rehabilitation, Vol. 42(2), pp. 147–155, doi: 10.1080/09638288.2018.1494215. (in Eng.).

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INDICATORS OF TECHNICAL AND TACTICAL ACTIONS (SINGLE COMBAT) OF THE «METALIST-1925» TEAM IN THE UKRAINIAN CHAMPIONSHIP 2019

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Purpose: to determine the dynamics of indicators of technical and tactical actions (single combats) of the Metalist-1925 team in the Championship of Ukraine for 10 calendar games at home.

Materials and methods: theoretical analysis and generalization of scientific and methodological literature data, methods of pedagogical observations, methods of mathematical statistics. Registration and analysis of technical and tactical actions (single combats) were carried out in the games of the Championship of Ukraine in the first league of the team "Metalist-1925". 10 games, held in Kharkov, were analyzed.

Results: the dynamics of quantitative and qualitative indicators of technical and tactical actions (single combat) of the Metalist-1925 team for 10 games of the Championship of Ukraine, for the first and second halves within 15 minute segments was determined. During the first half, the Metalist-1925 team performed 154 technical and tactical actions, 57 of which were negative, the rejection rate was 37%. The number of single combats in the second half was 192 of which 100 with a negative indicator, scrap rate was 58.3%, which is significantly higher than in the first half. This is primarily due to the fact that fatigue builds up in the second half, so

players make mistakes more often. Analyzing the dynamics of technical and tactical actions (single combats) over 15 minute intervals, we can conclude that the largest number of single combats in 10 games was performed by players in the period from 76 to 90 minutes (71 actions), and the smallest number was performed from 1 to 15 minutes (37 actions). The largest number of negative actions was recorded from 46 to 60 minutes (35 actions), where scrap rate was 60.3%, and the smallest number from 1 to 15 minutes (11 actions), where the scrap rate was 27.9%.

Conclusions: the obtained quantitative and qualitative indicators of technical and tactical actions (single combat) of the players of the Metalist-1925 team in the Ukrainian Championship in the most games do not correspond to the reference models of highly qualified football players, which gives grounds for adjusting the educational and training process.

Keywords: technical and tactical performance, single combat, football, scrap rate.

Introduction

In sports, the concept of control is inextricably linked with the concept of "management", because you can effectively manage the training process only on the basis of information. Obtaining information is nothing more than control, one or more components that reflect the state of the various aspects of training [4, 15].

The control of technical readiness is associated with the use of specific indicators for each sport, which allow you to collectively assess the technical skills of the athlete. The control of competitive activity is based on the comparison of sports results with the planned or already shown and is aimed at identifying the strengths and weaknesses of the athlete's training, in order to further improve it [8].

Monitoring and analysis of technical and tactical actions of players and teams in football is one of the main research methods used in the process of pedagogical observations. In the process of control over the competitive activity of football players, certain goals and objectives are always set and the parameters of the competitive activity of football players that need to be studied are determined. Quite

often during tournaments, to obtain operational information, an objective and simple method of pedagogical observation of competitive activities is used, recording technical and tactical actions (TTD) on a dictaphone with subsequent transfer of sound symbols to special forms [5].

The main purpose of controlling the actions of football players with the ball in training and competitive games is to obtain optimal information, based on which you can adjust the construction of the team game, the training of individual players and the team as a whole. Controlling the actions of players with the ball involves three main areas [9, 13]:

1. Control of game activity, which allows tracing the dynamics of technical and tactical actions in competitions.

2. Control of technical readiness of players, which allows assessing their level of technique of possession of the ball and the ability to work with the ball in different conditions.

3. Control of the construction and quality of ball exercises.

The main criteria of informativeness in monitoring the actions of football players is an indicator of the effectiveness of a particular technical and tactical action. The technique of performing the same techniques on different parts of the field and their "contribution" to the result of the game is different, so the division of the football field into zones when registering the actions of players with the ball in competitive games is necessary. Therefore, many experts conditionally divide the football field into an attack zone, a middle zone, a defense zone.

One of the features of modern football is the growing importance of each game episode. The most important is martial arts, because the quantity and quality of this indicator largely determines the success of the team [11].

Martial arts at the top is a fight for a ball in the air. The result of the game depends on how the players of the team master the game in defense and attack [2, 14].

Head game is a technique that is used only in football, in no other game the head is used to move the ball, despite the fact that most of the game takes place on the ground, the head game remains an integral part of football [10, 14].

Head kicks are performed in all areas of the field, but the ability to play with the head in the penalty area is of particular importance. Every fourth goal scored in the penalty area (except for goals scored from the penalty spot) is scored with a head [3, 12].

Doing the research with the team “Metalist” it was concluded that the highest number of martial arts in the game was recorded in the middle zone, which shows that most often the fight for the top ball is in the middle of the football field. In other parts of the field (zones) the number of indicators is almost the same [6].

When conducting pedagogical observations of the game activity of football players, the total number of TTDs performed by players is of some interest. Thus, from the point of view of Arestov Yu., Godik M. [1], for successful actions in the game the defender must perform - 130 TTD, with an efficiency factor of 85%, the midfielder - 140 TTD, with an efficiency factor of at least 80%, the striker - 80 TTD , with an efficiency factor of 70%. Analyzing the TTD (single combats) of the team "Metalist", which took part in the games of the Europa League, the following indicators were obtained [7]. The best rate of single combat was recorded in the first half with the team "Zelburg" Austria - 20/5 scrap rate was - 25%. The worst indicator was registered in the game with the team "Olympiacos" Greece in the second half - 20/20, the scrap rate was - 80%.

The reseach was performed in accordance with the Consolidated Research Plan of the Department of Football and Hockey, Department of Sports and Mobile Games and the Department of Martial Arts of the Kharkiv State Academy of Physical Culture for 2016-2020 on the topic: "Psycho-sensory regulation of motor activity of situational athletes".The purpose of the reseach is to determine the dynamics of indicators of technical and tactical actions (single combat) of the team "Metalist-1925" in the Championship of Ukraine for 10 calendar games on their field.

Material and Methods of the research

Registration and analysis of technical and tactical actions (martial arts) were carried out in the games of the Championship of Ukraine in the first league of the team "Metalist-1925". 10 games that took place in Kharkiv were analyzed. Research methods: theoretical analysis and generalization of data of scientific and methodical literature, methods of pedagogical observations, methods of mathematical statistics.

Results of the research

The effectiveness of the training process depends on the information that the coach receives as a result of the analysis of training and competitive activities. In the table. 1 presents the indicators of TTD (single combat) for the first and second halves of the players of the team "Metalist - 1925" for 10 games in the Championship of Ukraine (first league).

Table 1

Quantitative indicators of technical and tactical actions (single combat) of the team "Metalist-1925" for the 1st and 2nd halves

№	Teams	1 half number of actions / quality of execution	Scrap rate, %	2nd half number of actions / quality of execution	Scrap rate, %	Total number of actions / quality of execution	Scrap rate, %
1	Inhulets	19/6	31,5%	36/19	52,7%	55/25	45,4%
2	Rukh	18/8	44,4%	17/10	58,8%	35/18	51,4%
3	Ahrobiznes	11/4	36,3%	17/4	23,5%	28/8	28,5%
4	Volyn	16/7	43,7%	27/16	59,2%	43/23	53,4%
5	FK Mykolaiv	12/9	75,0%	16/9	56,2%	28/18	64,2%
6	Obolon Brovary	13/6	48,1%	19/9	47,3%	32/15	48,8%
7	Balkany	6/4	66,6%	8/3	37,5%	14/7	50%
8	Dnipro-1	15/4	26,6%	10/5	50%	25/9	36%
9	Kolos	19/5	26,3%	17/12	70,5%	36/17	47,2%
10	Hirniak Sport	25/4	16,6%	25/13	52%	50/17	34%
Total:		154/57	37,01%	192/100	58,3%	346/157	45,3%

In total, during the first half, the Metalist-1925 team performed 154 technical and tactical actions, 57 of them with a negative indicator, the scrap rate was 37%. The largest number of single combats was recorded in the game with the team " Hirniak Sport" - 25 with a negative indicator - 4, with a scrap rate - 16.6%. This is the

best indicator for 10 games of the team in the quantity and quality of the fight for the top ball. At the same time, the lowest rates in the number of single combats were recorded with the team " Balkany " - 6, in terms of scrap rate, the worst rate of single combats was registered with the team "IFC Nikolaev" - 75%.

The number of single combats in the second half was 192, of which 100 with a negative indicator, the scrap rate was - 58.3%, which is much higher than in the first half. This is primarily due to the fact that fatigue accumulates in the second half, so players are more likely to make mistakes. The largest number of martial arts was recorded in the game with the team " Inhulets " -36 of which negative actions - 19, the scrap rate - 52.7%. The lowest number of martial arts was registered in the game with the team " Balkany " - 8, negative actions - 3. The lowest coefficient of scrap was recorded in the game with the team " Ahrobiznes " - 23.5%, at the same time the worst indicators were recorded in the game with the team "Kolos" - 70.5%.

Table 2

Dynamics of technical and tactical actions (single combat) of the team "Metalist-1925" in 15-minute segments

№	Teams	1-15 min. of the game	Scrap rate, %	16-30 min. of the game	Коеф. Браку %	31-45 min. of the game	Scrap rate, %
1	Inhulets	4/0	0	9/3	33,3	6/3	50
2	Rukh	4/0	0	6/4	66,6	8/4	50
3	Ahrobiznes	3/1	33,3	4/2	50	4/1	25
4	Volyn	4/1	25	7/4	57.1	5/2	40
5	FK Mykolaiv	0/0	0	5/4	80	7/5	71,4
6	Obolon Brovary	5/3	60	6/1	16,6	2/2	100
7	Balkany	2/2	100	1/1	100	3/1	33,3
8	Dnipro-1	4/1	25	5/1	20	6/2	33,3
9	Kolos	4/2	50	6/2	33,3	9/1	11,1
10	Hirniak Sport	7/1	14,2	10/0	0	8/3	37,5
Total:		37/11	29,7	59/22	37,2	58/24	41,3

Analyzing the dynamics of technical and tactical actions (single combat) for 15-minute segments (Tables 2, 3), we can conclude that the largest number of single combats in 10 games was performed by players in the period from 76 to 90 minutes (71 actions), and the smallest was performed from 1 to 15 minutes (37 actions). The

great number of actions were registered in the game with the team "Inhulets" (16 actions), and the smallest in the game with the team "Balkany" (1 action). The highest number of negative actions was registered from 46 to 60 minutes (35 actions), where the scrap rate was 60.3%, and the lowest number from 1 to 15 minutes (11 actions), where the scrap rate was 27.9% (Fig. 1).).

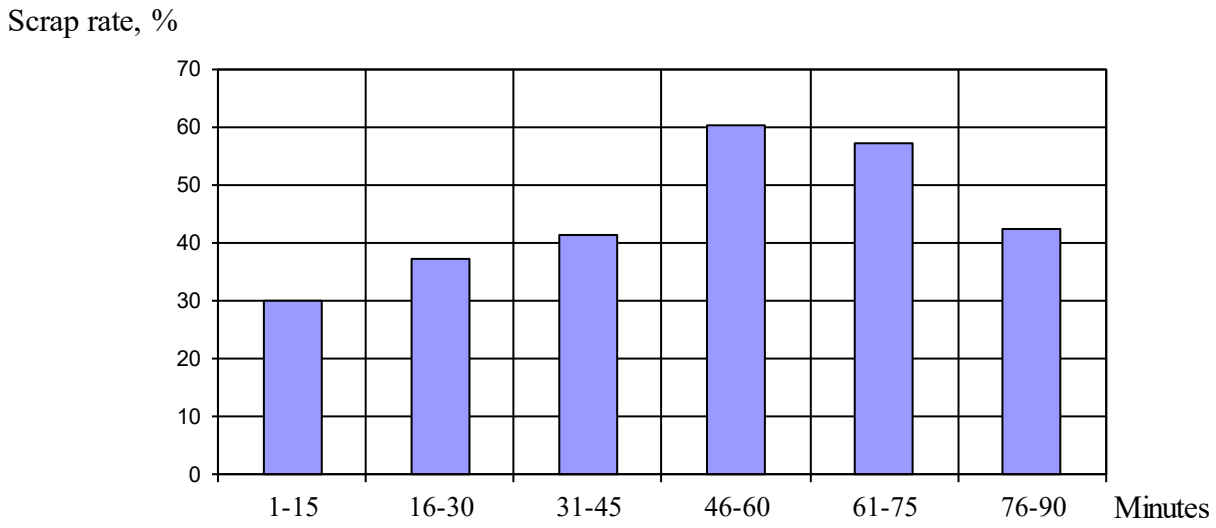


Fig. 1. Dynamics of average indicators of the coefficient of lack of technical and tactical actions (single combat) of the Metalist-1925 team in the Championship of Ukraine 2019

As for the game actions of the players of the Metalist-1925 team in different zones of the playing field, for 10 games, on average their number does not differ except for the first 15 minutes.

The scrap rate from 1 to 75 minutes gradually increases and does not decrease significantly from 76 to 90 minutes, although the number of actions is the highest (Fig. 2).

These indicators largely depend on the following factors:

– with which opponent did the Metalist-1925 team play;

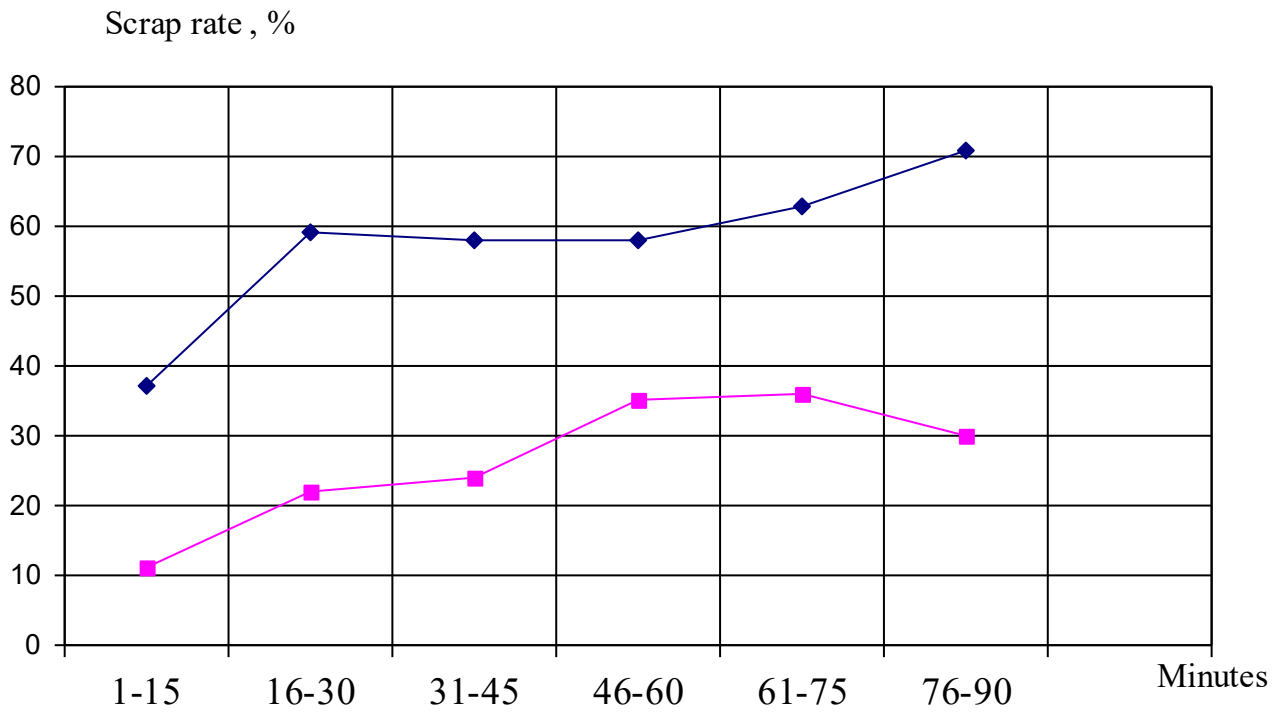
– teams staffing;

– technical and physical fitness of the opponent's players;

– psychological condition of the players of the Metalist-1925 team;

– team readiness for a specific game;

– optimal composition of teams in the game.



1 - the total number of martial arts: 2 - negatively performed martial arts.

Fig. 2. Dynamics of average indicators of technical and tactical actions (single combat) for 10 games of the Championship of Ukraine of the first league of the Metalist-1925 team

Conclusions / Discussion.

The obtained quantitative and qualitative indicators of technical and tactical actions (single combat) of the Metalist-1925 team in the Championship of Ukraine testify that during the first half the Metalist-1925 team performed 154 technical and tactical actions, 57 of them with a negative indicator, the scrap rate was - 37.01%. The largest number of single combats was recorded in the game with the team "Miner Sport" - 25 with a negative indicator - 4, with a scrap rate - 16.6%.

At the same time, the lowest indicators in the number of single combats were recorded with the team "Balkany" - 6, in terms of scrap rate, the worst rate of single combats was registered with the team "IFC Mykolaiv" - 75.0%.

The number of single combats in the second half was 192 of them 100 with a negative indicator, the scrap rate was - 58.3%, which is much higher than in the first half. This is primarily due to the fact that fatigue accumulates in the second half, so players are more likely to make mistakes.

The largest number of single combats was recorded in the game with the team "Inhulets-36", of which 19 were negative actions, the scrap rate was 52.7%. The lowest number of single combats was registered in the game with the team "Balkany" - 8, negative actions - 3.

The lowest scrap rate was recorded in the game with the team " Ahrobiznes " - 23.5%, while the worst indicators were recorded in the game with the team "Kolos" - 70.5%.

Analysis of the dynamics of technical and tactical actions (single combats) for 15 minutes shows that the largest number of single combats for 10 games was performed by players in the period from 76 to 90 minutes (71 actions), and the smallest number from 1 to 15 minutes (37 actions).

The great number of negative actions were registered from 46 to 60 minutes (35 actions), and the scrap rate was 60.3%, while the lowest number was from 1 to 15 minutes (11 actions), where the scrap rate was 27.9%.

The scrap rate from 1 to 75 minutes gradually increases and does not decrease significantly from 76 to 90 minutes, although the number of actions is the highest.

Thus, it can be stated that the quantitative and qualitative indicators of technical and tactical actions (single combat) of the players of the team "Metalist-1925" do not allow effective action during the game and depend on the physical, technical, psychological readiness of the team players, which gives grounds for educational and training process.

Prospects for further research. The prospects for further research are considered in the study of the ball selection of players of the team Metalist-1925 in different areas of the playing field.

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References

1. Arestov, Ju., & Godik, M. (1980), Podgotovka futbolistov [Training of football players], Moscow: Vestnik, 69 p. (in Russ).
2. Buznik, A., & Dzhus, O. (2001), Instrukcija po rabote nauchno-metodicheskih grupp v neamatorskih futbol'nyh komandah [Instructions for the work of scientific and methodological groups in non-amateur football teams], Kiev, 39 p. (in Ukr.).
3. Golomazov, S., & Chirva, B. (2000), Futbol. Anatomicheskie zakonomernosti vzjatija vorot: metodicheskoe posobie [Football. Anatomical patterns of goal scoring], Moscow: RGAFK, Vypusk 14, 31 p. (in Russ.).
4. Guba, V. P., & Shamardin, A. A. (2015), Kompleksnyj kontrol' funkcional'noj podgotovlennosti futbolistov [Complex control of the functional fitness of football players], Moscow: Sovetskij Sport, 284 p. (in Russ.).
5. Kostjukevich, V. M. (2019), Modeli taktiki igry v futbole [Models of tactics of playing in football], Vinnytsia: TOV «Tvory», 168 p. (in Ukr).
6. Perevoznyk, V. I., Mulyk, V. V (2006), "Research of individual technical and tactical actions (single combats) of the players of the "Metalist" team", Slobozhans'kyj naukovo-sportyvnyj vistnyk, no.9, 52-54 (in Ukr.).
7. Perevoznik, V., & Paevskij, V. (2018), "Features of technical and tactical actions of the "Metalist" team in the games of the Europa League", Slobozhans'kyj naukovo-sportyvnyj vistnyk, no.1 (63), 61–64 (in Ukr.).
8. Platonov, V. N. (2015), Sistema podgotovki sportsmenov v olimpijskom sporte. Obshhaja teorija i prakticheskoe prilozhenie [The system of training athletes in Olympic sports. General theory and practical application], Kiev: Olimpijskaja literatura, 680 p. (in Ukr.).
9. Chirva, B. G. (2015), Koncepcija tehnicheskoj i takticheskoj podgotovki futbolistov [Concept of technical and tactical training of football players], Moscow: TVT Divizion, 352 p. (in Ukr.).

10. Shalenko, V., & Percuhov, A. (2007), ″Analysis of the heading of highly qualified football players", Slobozhans'kyj naukovo-sportyvnyj vistnyk, no. 11, pp. 45-47 (in Ukr.).
11. Bolotin, A. & Bakayev, V. (2017), "Pedagogical conditions required to improve the speed-strength training of young football players", Journal of Physical Education and Sport, No. 17(2), pp. 638-642. (in Eng.).
12. Gero, Bisanz & Gerisch, Gunnar (2008), Fussball. Kondition-Technik-Taktik und Coaching. Aachen : Verlag Meyer&Meyer, 560 p. (in Eng.).
13. Kopera, K., Sledziewski L. (1997), Pilka nożna : unificacja procesu szkolenia dzieci i mlodziezy. Warszawa, 134 p. (in Eng.).
14. Szyngier, W., Gumola W. (2009), "Monitorowanie treningu piłkarzy nożnych o rożnym poziomie zaawansowania sportowego", Teoretyczne i praktyczne aspekty nowoczesnej gry w pilkę nożną. Opole, pp. 177 – 192. (in Eng.).
15. Szwarc, A. (2003), Metody oceny techniczno-taktycznych działań piłkarzy nożnych: AWFiS, 158 p. (in Eng.).

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MODERN METHODS OF FATIGUE ASSESSMENT

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Purpose: to determine the general and modern methods of fatigue assessment. **Materials and methods:** analysis and generalization of scientific and methodical literature on the topic of study of fatigue processes; generalization of experience of practical work of the coaching contingent working with children in groups of dancesport; modified method of M.Ya.Breitman's clinical anthropometry; natural pedagogical experiment, methods of mathematical statistics and mathematical modeling.

Results: it should be noted that the improvement of information technology and the use of more efficient electronic devices allows for more promising development of mathematical modeling, provided its application in theoretical and practical studies of various processes in the human body, including processes such as fatigue. Therefore, in the further process of diagnosing the stages of fatigue, it is possible to apply mathematical models that already exist, as well as to continue the search for other options (in particular, using the theory of self-organizing systems).

Conclusions: the application of existing theories of fatigue makes it possible to consider the variety of causes of fatigue in the human body in terms of physiology. Understanding the causes of the fatigue process allows to develop systems that can restore the human body, using the possibility of additional feeding with the necessary substances for activity or imposing restrictions on the intensity and timing of actions. For more effective diagnosis of the degree of fatigue process, it is possible to use

methods of mathematical modeling and forecasting, as well as consideration of the fatigue process in terms of stability of selforganizing systems (including applying the Volterra equations, flow cultivator). Modern research methods of using mathematical apparatus and information tools allow for better and faster processing and analysis of large data sets.
Keywords: fatigue, fatigue theories, mathematical model, Breitman method, dancesport.

Introduction

The level of modern training of sportsmen provides for the increase in physical and mental loads, which in turn will increase the degree of fatigue. The ability to overcome the fatigue that occurs in the process of competitive activity largely leads to the achievement of sports results.

Significant loads withstand by sportsmen require an intensive search for means to resume their working capacity in the conditions of optimizing the training process, as well as in preparation for competitions and during their conducting. Therefore, knowledge of the patterns of fatigue development and the resumption of the sportsmen body is of important theoretical and practical importance.

Among the most common manifestations of the state of fatigue, there is a decrease in muscle strength and endurance, a deterioration in the coordination of movements, an increase in the energy value of the same work, a slowdown in the speed of processing information, a deterioration in memory characteristics, attention, a feeling of discomfort, and a rejection of activity.

There are many formulations of the fatigue period. “Fatigue” is a special type of functional state of a person, which temporarily occurs under the influence of prolonged or intensive work, which is accompanied by a decrease in its effectiveness.

Several aspects of the fatigue problem stand out: nature of fatigue; diagnostics; forecasting; ways to fight against fatigue and stimulate working capacity.

The purpose of the research is to determine the general and modern methods for assessing fatigue.

Material and methods of the research

The work was performed on the basis of the sports club “Ideal”. Dancers in the number of 20 sportsmen, who are engaged in dancesport at the initial training stage, took part in the research. In solving the tasks, the following methods were used: analysis and synthesis of scientific and methodological literature under the topic of studying fatigue processes; summarizing the experience of the practical work of the coaching contingent, which works with children in sports dance groups; modified method of clinical anthropometry of M.Ya. Breitman; pedagogical experiment, methods of mathematical statistics, and mathematical modeling.

Results of the research

Historically, since the middle of the 19th century, many physiologists were interested in this topic. So, at this time such theories were defined:

1) The fatigue theory of M. Schiff (1868 p) - was based on the fact of the decrease in glycogen reserves in muscles that were exhausted.

2) The poisoning theory of E. Pfluger (1872) - associated the development of fatigue with unacceptable (poisonous) growth of metabolic products in muscles, in particular lactic acid.

3) The strangulation theory of M. Fervorn (1901) – the model for the development of fatigue due to the lack of oxygen in muscles was proposed.

V.V. Rosenblatt (1975) identifies this group of theories and marks as a group of humoral-localist theories that are based on researches of isolated muscles. Another group of theories, called by V.V. Rosenblatt as the central-nervous theory, connects mechanisms of fatigue with structures of the central nervous system. One of the founders of the central nervous theory of fatigue is A. Masso, who published the monograph “Fatigue” in 1893. This work presents the results of the research of muscular activity on a person and the shown role of central mechanisms in the formation of a state of fatigue.

Rosenblatt V.V (1975, 1983) identifies four main areas within the framework of the central-nervous theory.

1) The development of the first direction is primarily associated with the name of L.L. Vasiliev (1926) and M.I. Vinogradov (1935) - the leading role in the development of fatigue is assigned to the processes of inhibition in the central nervous system. The main factors contributing to this braking state are: working dominant attenuation, excessive afferent flow (a constant flow of nerve impulses that enter the central nervous system from sensory organs, which perceive information both from external irritants (extroreception), and from internal organs (interoception), which is directly dependent on the number and strength of the influence of irritants, as well as on the state – individual's activity or passivity) from working muscles and the effect on nerve centers of biochemical disorders in the blood that occur with active muscle work.

2) The representative of the second direction of the central nervous theory of fatigue was V.A. Levytskyi (1926) - with his theory of the development of the imbalance occurs in the interaction of the cortex of large hemispheres and centers of the autonomic nervous system. At the same time, vegetative activity support centers act as protective concerning the cortex and performing organs, sending brake signals to them, thus preventing the possible undesirable consequences of excessive physical activity. In other words, we are talking about "conflicts between conscious - strong-willed and autonomic-vegetative spheres" (V.V. Rosenblatt, 1983, 230 p.).

3) The third direction, which has the largest number of supporters, is developed from the position of the theory of dominant of A.A. Ukhtomskyi (1934). At the heart of fatigue, proponents of this approach see a violation of the coordination of processes that ensure an active state, and primarily in the central nervous system.

4) In the fourth direction, K.Kh. Kecheiev (1949) considers the development of muscle fatigue in connection with the weakening of the adaptation-trophic influence of the sympathetic on the somatic nervous system.

V.V. Rosenblatt himself proposed the central cork theory of human muscle fatigue. He believes that the primary link of fatigue should be sought in the cork limb of the motor analyzer while noting that the shift in all other links of the musculoskeletal system and other systems of the body is secondary. According to

V.V. Rosenblatt, changes that arose for the second time in autonomic, endocrine, and muscle systems, and are accompanied by changes in biochemical parameters, in turn, affect the primary link of fatigue (motor cortex and motor centers of the central nervous system), enhancing the state of the latter one.

Vinogradov M.I. (1958, 1966) also identifies two types of fatigue - primary and secondary. According to M.I. Vinogradov, primary fatigue, which acutely occurs, develops as a result of unusual or excessive work, and secondary (slowly develops) - as a result of although usual, but long-term activity. It provides less value to biochemical shifts in the working body, linking the development of both primary and secondary fatigues with disorganization processes mainly in the central nervous system.

I. M. Siechenov (1952,1955), as the founder of the theory of nervism, made a significant contribution to the physiology of work not only by the one who substantiated the role of the central nervous system in the formation of fatigue during physical work but also by the fact that he was one of the first (after A. Masso) who used the shoulder Ergograph to study the processes of muscular activity, which imitated the work of a hand during “sawing” movements. It was with the help of Ergographer, I. M. Siechenov were obtained well-known facts of a faster resumption of the functioning of a tired hand in conditions of load on other muscles. This phenomenon was designated as the phenomenon of “active” rest. I.M. Siechenov connects the phenomenon of “active” rest with the activation of tired centers with the flow of afferent impulses from other muscles, that is, through other nerve centers.

The subsequent research in this direction was also carried out by I.V. Muravov (1055-1991). In Ukraine, under his leadership, programs of active recreation, industrial gymnastics, as well as physical education for people of different ages were developed.

It is usual to distinguish two main types of fatigue - physical and mental, although such a separation is quite conditional.

Also, some sources describe other types of fatigue - general, local, muscle, visual, mental, and so on. Highlighting these types of fatigue, the brightest shifts are

noted in those systems that are most “loaded” in the process of work. The limits between the indicated types of fatigue are conditional because it’s difficult to imagine the isolated functioning of individual systems in a holistic organism. However, such an approach is proved in terms of prevention and control of fatigue.

Fatigue may differ in severity. It is customary to distinguish four degrees of fatigue: from little expressed (the 1st degree) to very expressed (the 4th degree). The attribution of the state of fatigue to one or another group depends on the severity of shifts of the corresponding physiological, psychophysiological, and other indicators of activity.

Based on existing ideas about the causes, mechanisms, and consequences of fatigue, it is customary to distinguish several approaches to its diagnosis:

- performance assessment;
- assessment of the state of physiological systems of the body;
- assessment of psychophysiological characteristics;
- subjective assessment of the state.

Researchers usually use all of the listed approaches to fully diagnose fatigue. This is due to the understanding of the nature of the state of fatigue and, first of all, to the fact that fatigue is based on the non-coordination of functional systems. One shouldn’t forget about the role of fatigue as a protective reaction to the excess load of the body.

Considering this issue, A.O. Navakatikyan (1993) notes that fatigue and working capacity are closely interconnected, and, adhere to certain terms of decrease of working capacity under the influence of work, characterizes the degree of fatigue. He proposed a conceptual mathematical model in which the mapped foundations of the relationship of working capacity (P) and fatigue (Y) with labor efficiency (e), the nature of the work performed, including its aims (W), the conditions of the production environment (C), the state of physiological systems, which consist of subsystems I (information), E (energy) and M (motivation). Labor efficiency is determined by the formula:

$$e = W * C * I * M * E, (1)$$

where all indicators are expressed in relative values. Working capacity is assessed according to physiological and production parameters when performing a specific work (Ws) under the optimal conditions:

$$P = e_{max} = Ws * C_o * I_{max} * E_o * M_o, \quad (2)$$

where the indices "max" та "o" mark the maximum and optimal values of the functions respectively. At the same time, changes in working capacity between two points of time (t1 and t2) caused by operation reflect the degree of fatigue (Y);

$$Y = P_{t1} - P_{t2} \quad (3)$$

The proposed model can be used at optimal and stable levels of working conditions, motivation, and activation of systems. As these conditions aren't most often met, then the standardized indicators C, E, I, and M. should be used. The author believes that the proposed approach allows to a certain extent to more correctly interpret many of the available data on the problem of fatigue and working capacity.

The huge material was accumulated regarding disorders in the body systems during the development of fatigue in the physiology of labor. The most fully studied cardiovascular, respiratory, musculoskeletal, excretory, endocrine, and central nervous systems. Metabolic and energy indicators, a function of oxygen supply, and dynamics of blood indicators are widely used to diagnose the state of fatigue. Features of neuroendocrine regulation and intersystem interactions are less studied.

The assessment of the state of systems and functions in the dynamics of working capacity and fatigue dynamics has two main aims. The first is to detect the degree of implementation of the reserve capabilities of the system in conditions of labor load. It's known that different systems have different adaptive capabilities. The second aim, which was to study the behavior of systems in the process of work, is to determine "the factor that limits", which leads to a significant decrease in working capacity, to the development of fatigue. The function or system that has the greatest workload during operation is most often the "factor that limits". In this regard, the practice of labor physiology adopts the principle of the previous analysis of activities

in order to identify the functions of the most “loaded”. This makes it possible to create a reasonable minimum of directions and a set of research methods.

Historically, this approach to assessing the functional state, including fatigue, arisen relative to professions where information interaction between human beings and the environment prevails. Performance indicators of analyzers (visual, auditory, tactile), integral functions – visual-motor and audio-motor coordination, regulation of motor acts, processing of information, memory, attention, decision-making process were studied. Recently, psychological methods have been increasingly used in the physiology of labor - testing personality properties, psychological processes.

Diagnostic value is only those indicators that show a disturbance in systemic reactions during the activity. It’s important to evaluate intersystem interactions, especially in the field of central regulation of motor and visceral functions.

There are the most controversial thoughts about the possibility of using a feeling of fatigue as indicators of fatigue, but they reflect rather unsuccessful attempts at modern psychology than the present state of affairs. Still, S.G. Gellerstein (1926) noted that subjective manifestations are nothing more than the display of objective processes in human sensations or consciousness. On the other hand, a feeling of fatigue (subjective assessment) can also appear in conditions of light, not stressful labor, next to its absence, most often, with a fairly significant workload. This indicates that the causes of fatigue don’t always coincide with such when a state of fatigue develops.

The questionnaire doesn’t quantify the results. This disadvantage is overcome with the help of methods of subjective assessment of the state on a scale. The person tested correlates his feelings with a number of polar signs, for example: “tired - not tired”, “cheerful – sluggish” or with individual statements such as “weakness”, “rested”. The results of the responses are compared to an assessment scale compiled by empirical or expert means. The status level is diagnosed in points. In the known WAM test proposed by S.A. Doskin et al. (1973), 30 pairs of polar value signs are proposed to the test. The person tested should evaluate his condition for each of the pairs of signs on a seven-point scale. The conclusion about the state is given by the

average scoring of well-being, activity, and mood (hence the name of the test - WAM), and the nature of the relationship between them.

There are different modifications of this test regarding individual activities. It should be noted that the subjective assessment of the state of fatigue is considered only as of the previous stage of the study of the functional state. A complete picture of the state can only be drawn up taking into account all approaches that determine the “active” state of a person.

At this stage of the development of science, a certain limit has already been reached on the possibility of revealing the research problem from the point of view of physiology. Currently, the task of identifying methods for determining the state of fatigue and searching for methods for resuming the human body system is differentiated. There are separate fields of science in which research is based on fundamentally new research methods. The use of mathematical modeling methods leads to the process of integrating knowledge from different fields of scientific research, thereby forming the only theory of the development and formation of self-organization processes.

If we accept that the human body is the system that self-organizes and adds to this the capabilities of mathematical modeling and forecasting the development of systems, then we can get a new approach to methods for assessing fatigue.

Several mathematical methods for analyzing empirical data developed at the end of the 19th century deserve special attention, which includes:

1. The method of A. Quetelet “average person structure”. The essence of the method is that each link of the body (to the same age and sex) is taken in its absolute dimension and the average value of its size is obtained. They give the average values of a person combined into a single whole. In practice, the reusable accumulation of similar is manifested in a clearer expression of the structure characteristic of the corresponding residence environment [4].

Any parameters are taken separately, such as body length, weight, individual biokinematic link or body organ, or the type and mode of their activity, lead to the average value of the structurally functional construction of the “average person” as

the most pronounced, relative to all directions of the three-dimensional representation of the body. If the “average person” is taken as the standard or limit of the reference (conditional zero) and used to analyze the considered object, then you can determine a measure of deviation from the “derived norm or conditional zero”. When compiling the relations of each of the compared body parts among themselves or each of them as a part to the whole, the ratio coefficient loses dimension and compares characteristics and is expressed in parts of one or in percentage, or in established units of normalized space.

In this case, the structure of the “average person” as a unit of measure displays the qualitative structure of the image structure. The uniform blur of the contour “Middle” towards the proportional measurement ±% from X constitutes the zone of the universality of the “middle” structure. Any deviation of the real image from the standard in any direction with the clarity of the expression and the distance of its manifestation is a pathological representation of something that violates the relationship of other parts of the whole. Within the limits of the manifestation of the versatility of the functioning of each of the parts of the whole, their stress and wear occur, which determines the duration of maintaining an equilibrium stable ratio.

Practically, the method of the “average person” revealed the essence of a factor that strengthens a holistic structure, which consists of a “universal” equalization of the distribution of energy-mass exchange between the constituent components of an entire organism and a “specialized” distributive energy mass exchange. However, at that time, this discovery didn’t find a proper understanding of its entire significance due to insufficient preparation for its perception.

2. The method of F. Galton, associated with the structure of “collective photography”. The essence of the method of “collective photography” in its content is close to the method of A. Quetelet in the structure of the “average person”. In this case, according to the established rule of this process, the total value of a large number of photographs is superimposed on one photographic plate. As a result, the features of the characteristics that are mostly found in the compared lens are drawn out. By the measure of distance from a clear image, blur increases, which

proportionally loses clarity to the output circuit. This can be characterized as a "universal" measure of the persistence of the image, which is observed in the process of comparing the proportionality of a large number of photographs. Also, in addition to the clear image of the standard, some distortions of it as an increase, in contrast, were quite pronounced [8].

Using the method of Galton, Sheldon, when studying thousands of photographs, noted that such distortions have a certain orientation in three strictly defined directions with a clearer blur among these directions.

Almost simultaneously with the method of Sheldon, the method of clinical anthropometry by M.Ya. Breitman appears. This method introduced the classification of somatotypes taking into account hormonal ratios in the humoral medium of organisms and the influence of this composition on the formation of somatotype structure. The introduction of fifteen elements of the construction of the somatotype depicts various variants of his constitutional structure and the accompanying nosological interdependence of the structure of the corresponding type of structure, as well as a measure of the viability of a particular somatotype, to the environment of his environment [1, 2].

M.Y. Breitman introduces into the basis of clinical anthropometric diagnostics the separation of the qualitative structure of the formation and the general characteristic of the absolute size of the body.

The modification of his technique consists in establishing not only the structure of the relations between the partial sizes of the body to the total length of the body but also their rank of value, as well as the order of passing the value in the ranked series. This makes it possible to establish the features of biological development and its deviation from the standard, both in the qualitative direction and in the magnitude of their manifestation.

The possibility of changing the value of any parameter and its order of the ranked series of interacting functional structures in the structure determines the level of universality of the holistic structure of the organism in ensuring adaptive behavior. In some cases, this is interpreted as an indicator of the plasticity of an integral system,

which has the characteristics of the speed of this process, the strength of its severity, and the expansion limit. These processes are most effective in the area of indicators of “average person”.

The level of universality manifestation is determined by the possibility of changing the order limits in the ranked structure of share participation of each of the component components within the limits of possible variation of its functional activity from the maximum permissible minimum to the maximum possible maximum. The range of boundaries from minimum to maximum determines the variability of the change in the structure of the restructuring of the ranked series, which displays the qualitative rebirth of functional activity.

The modification of this method made it possible to find a new opportunity regarding the definition of the individual's somatotype and obtaining a code from a number of primes, after which you can determine a structure of fifteen indicators.

It should be taken into consideration that the metabolic processes of human activity take place in the general internal environment of the body, but with different directions of expression. This feature is manifested in the essence of anabolic and catabolic components of metabolism, which gives rise to a complex multi-component structure of relations “request-pleasure” of the whole complex of “flowing Chemostats” or “cultivators”. The performance of any activity is associated with energy consumption, the potential of which requires systematic replenishment. Regardless of the level of this process, its mechanism is represented by the flow system of energy-mass exchange. Such a process leads to a saturation of the need for them. The optimal state meets the equal demand and satisfaction of this demand. Such dependence, in addition to the quantitative relationships “demand-pleasure”, has a characteristic of the speed of its flow.

The main task of maintaining the persistence of the integral mutual relations of these phenomena in the flow system is to synchronize their interaction.

In general, this process found its mathematical description in the expression of the mathematical model of Volterra-Lotka, which describes the relations of “pleasure–demand”. Subsequently, Kolmogorov extended this model to an unlimited

number of interchangeable processes that have a consistent interaction “demand-pleasure”.

Thus, the main characteristics in the flow systems, which, first of all, act: blood, respiratory, intestinal-gastric system, there is a volumetric flow of the initial mass exchange, its concentration, the rate of transformation of the mass exchange material, the level of saturation with metabolic products, the coefficient of the economy of using the initial mass exchange.

In fact, the question can only be about the circulatory system as a flowing “Chemostat”. All others can be considered as specialized organ-making or flow “Chemostats”, in which differentiated metabolic processes are carried out with completely different directions of anabolic and catabolic processes. The whole variety of these relationships in the system of a holistic organism is described by the equations of the flow “Chemostat”, which in some cases are defined as a flow cultivator.

When the biological maturity limits are reached as an indicator of the mastery of the medium interaction (the possible level of adaptation behavior complexity), which determines the viability of the integral system, its subsequent equilibrium state depends on maintaining the accuracy of synchronizing the specialized “Chemostats” on the energy supply flow. The limit in energy supply leads to the emergence of the highest cost-effectiveness of the structure of the dynamic stereotype of adaptive behavior. Violations of the correspondence between the statistical structure of the environment stay and the statistical stereotype of individual adaptive behavior lead to energy costs that cannot be replenished beyond the total requirement, which consists of the need to eliminate debt and the need to replenish the exchange in order to maintain the baseline level of vitality of a holistic organism.

Conclusions / Discussion

The results of the analysis of the existing theories regarding the causes of fatigue as a physiological process confirm the authors' opinion that the problem of timely diagnosis of the beginning of this process in the human body doesn’t lose its

relevance [4, 6, 8]. Especially when it comes to the process of training for the highest sporting achievements.

Using the existing fatigue theories makes it possible to consider the variety of causes of the fatigue process in the human body from the point of view of physiology.

Understanding the causes of the fatigue process allows you to develop systems that can resume the human body, using the possibility of additional feeding with the necessary substances for the activity or introducing the restriction on the intensity and time of action.

For more effective diagnosis of the degree of fatigue process, the possible use of mathematical modeling and prediction methods, as well as consideration of the fatigue process from the point of view of the persistence of systems that are self-organized (in particular, the use of the equations of Volterra, the flow cultivator). Modern research methods using the mathematical apparatus and information means to give the possibility for better and faster processing and analysis of large amounts of data.

The prospects for further research. It should be noted that the improvement of information technologies and the use of more efficient electronic devices provides an opportunity for a more promising development of mathematical modeling, provided its application in theoretical and practical studies of various processes in the human body, and in particular such a process as fatigue. Therefore, in the subsequent process of diagnosing fatigue stages, you can use mathematical models that already exist, as well as continue to search for other options (in particular, using the theory of systems that are self-organized).

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References

1. Brejtman, M. Ya. (1949), Klinicheskaya semiotika i differencialnaya diagnostika endokrinnyh zabolevanij [Clinical semiotics and differential diagnosis of endocrine diseases]. L.: Medgiz., 568 p. (in Russ)

2. Brejtman, M. Ya. (1926), Tablicy dlya klinicheskoj antropometrii [Clinical Anthropometry Tables]. L.: Izd-vo «P.P. Sojkin», 82 p. (in Russ)

3. Brin, V. B., Zonis, B. Ya. (1984), Fiziologiya sistemnogo krovoobrasheniya [Physiology of systemic circulation]. Rostov-na-Donu: RGU, 88 p. (in Russ)

4. Vinogradov, M. I. (1966), Fiziologiya trudovyh processov [Physiology of labor processes]. - M.: Medicina, 367 p. (in Russ)

5. Gorshkov, S. I., Zolina, Z. M., Mojkin, Yu. V. (1974), Metodiki issledovanij v fiziologii truda [Research methods in the physiology of labor], 280 p. (in Russ)

6. Danilova, N. N. (1992), Psihofiziologicheskaya diagnostika funkcionalnyh sostoyanij [Psychophysiological diagnostics of functional states]. M.: MGU, 192 p. (in Russ)

7. Donskoj, D. D. (1971), Biomehanika s osnovami sportivnoj tehniki [Biomechanics with the basics of sports technology]. M., 288 p. (in Russ)

8. Dumbaj, V. N. (1996), Osnovy fiziologii truda [Fundamentals of Labor Physiology]: Uchebnoe posobie. Rostov-na-Donu: RGU, 160 p. (in Russ)

9. Zagryadskij, V. P., Sulimo-Samujllo, Z. K. (1976), Metody issledovaniya v fiziologii truda [Research methods in the physiology of labor]. L., 220 p. (in Russ)

10. Isaev, G. G. (1990), Regulyaciya dyhaniya pri myshechnoj rabote [Regulation of respiration during muscular work]. L.: Nauka, 207 p. (in Russ)

11. Leonova, A. B. (1984), Psihodiagnostika funkcionalnyh sostoyanij cheloveka [Psychodiagnostics of human functional states]. M.: MGU, 200 p. (in Russ)

12. Meerson, F.Z., (1993), Koncepciya dolgovremennoj adaptacii [The Concept of Long-Term Adaptation]. M.: Delo, 138 p. (in Russ)

13. Rozenblat, V.V., (1975), Problema utomleniya [The problem of fatigue]. M.: Medicina (in Russ)

14. Samsonkin, V. N., Druz V. A., Fedorovich E. S. (2010), Modelirovanie v samoorganizuyushihsya sistemah [Modeling in self-organizing systems]. D.: Zaslavskij, 104 p. (in Russ)
15. Serednyakov, V.E. (1993), Fiziologiya truda. Uchebnoe posobie [Physiology of Labor]. Yaroslavskij gos. universitet. Yaroslavl, 48 p. (in Russ)
16. Fiziologicheskoe normirovanie truda [Physiological regulation of labor] (1988) /Otv. red. V.I.Medvedev. L.: Nauka, 127 p. (in Russ)
17. Fiziologiya dvizheniya. Rukovodstvo po fiziologii [Physiology of movement. Physiology Manual] (1976), L.: Nauka, 376 p. (in Russ)
18. Fiziologiya myshechnoj deyatelnosti [Physiology of muscle activity] (1982), Uchebnik dlya VUZov /pod red. Ya.M.Koca. M.: Fizkultura i sport, 347 p. (in Russ)
19. Fiziologiya trudovoj deyatelnosti [Physiology of labor activity] (Osnovy sovremennoj fiziologii) (1993) / Otv. red. V. I. Medvedev. Sankt-Peterburg: Nauka, 528 p. (in Russ)
20. Fiziologiya cheloveka [Human physiology] (1986) / Per s angl./ Pod red. R. Shmidta, G. Tevsa. M.: Mir, T.1. 272 p. (in Russ)
21. Funkcionalnoe sostoyanie letchika v ekstremalnyh usloviyah [The functional state of the pilot in extreme conditions] (1994) /Pod red. V.A. Ponomarenko, P.V. Vasileva. - M.: Polet, 424 p. (in Russ)
22. Sherrer, Zh. (1973), Fiziologiya truda (Ergonomika) [Physiology of labor (Ergonomics)]. M.: Medicina, 495 p. (in Russ)
23. Galton, F. (1889), Natural London. (in Eng)
24. Hirata, K. (1968), The evaluating method of physique and physical fitness and its practical application, 240 p (in Eng)
25. Selye, H. (1976), Stress in health and disease. NY (in Eng)
26. Selye, H. (1989), Neuropeptides and stress. NY (in Eng)
27. Sheldon, W. H. (1954), Atlas of Man. New York: Harper and Brothers. 357 p. (in Eng)

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COMPONENT OF PSYCHOLOGICAL TRAINING OF BASKETBALL PLAYERS AT THE STAGE OF PRELIMINARY BASIC TRAINING IN THE PREPARATORY PERIOD

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Purpose: determination and analysis of indicators of individual typological characteristics of the personality of basketball players 13-14 years old, and, taking them into account, provide recommendations for the training process on the basis of a differentiated approach.

Material and methods: at the beginning of the preparatory period of 2019-2020 academic year the psychological diagnostics was carried out according to the method of G. Eysenck EPI (Eysenck Personality Inventory), with the help of which we obtained data on individual typological (predominance of the type of temperament) indicators of basketball players at the stage of preliminary basic training. The study involved 30 basketball players 13-14 years old.

Results: the issue of increasing the effectiveness of the organization of psychological training through the use of the opportunities for the development of the personality of athletes, its control and correction is one of the most important tasks facing both children and youth sports and sports of the highest achievements. Psychological preparation and control of the development of psychological readiness takes an

important place in the educational and training process of basketball players, and the stage of preliminary basic training was no exception.

Conclusions: the data obtained became the basis for recommendations for the correction of the educational and training process, namely: the distribution of basketball players by subgroups at the stage of preliminary basic training, taking into account the properties of the nervous system, individual typological characteristics, personality traits, sincerity according to the "scale of lies", which will increase the percentage of assimilation of educational material, to improve interpersonal relationships that develop between partners due to their compatibility, such as respect, mutual understanding, cohesion, interpersonal attraction, positive emotions, etc.

Keywords: basketball program, psychological training, basketball players, psychological diagnostics, G. Eysenck's method of EPI, correction.

Introduction

Youth basketball continues to grow rapidly in Ukraine and becomes more meaningful, and psychological factors play an important role in it. The result of the game mostly depends on those athletes who make original decisions, see the playground better, understand partners without words and are psychologically attuned to the game. So it is necessary for basketball players at the stage of preliminary basic training, in the competitive period to learn to solve complex psychological problems, because in this period the official competitions in the All-Ukrainian Youth Basketball League (VYUBL) begin.

In sports, great importance is attached to psychological training. Well-known experts in the field of sports theory pay attention to sports psychology (A. V. Alekseev, 2003; H. D. Babushkin, 2006; L. D. Hissen, 1990; H. D. Horbunov, 2006; H. B. Horska, 1995 ; Yu.Ya. Kiselyov, 2002; A. Ts. Puni, 1984; A. V. Rodionov, 2004; P. A. Rudyk, 1974; H. I. Savenkov, 2006).

Also in the system of psychological training there is a term "psychological support", which was developed by H. B. Horska, 1995; H. D. Babushkin, 2006, etc.,

"psychological control" (Yu.Ya. Kiselyov), and "psychological support" (N. B. Stambulova, 1999; V. H. Sivitsky, 2007, etc.).

Modern researches by such scientists as H.D. Babushkin, 2006; E.P. Ilyin, 2007; A.V. Rodionov, 2004 emphasize the problem of self-realization in sports due to a number of difficulties associated with insufficient theoretical aspects, the separation of physical, technical and tactical training from psychological training, which prevents the harmonious development of the athlete's personality potential [1, 7, 12].

The importance of the analysis of psychological features taking into account the types of temperament, personality traits of each basketball player 13-14 years, the properties of the nervous system necessary for successful training activities, and preparation for competitions and successful performance in them is the main direction in this work.

The issue of improving the effectiveness of psychological training through the use of opportunities for personal development of athletes, its control and correction is one of the most important tasks facing both children's and youth sports and sports of higher achievements [2, 5, 11, 21].

Taking into account above mentioned facts, the improvement of the components of psychological training of basketball players at the stage of preliminary basic training in the preparatory period is an urgent issue of children's and youth basketball.

Purpose of the research is to determine and analyze the indicators of individual typological characteristics of the personality of basketball players aged 13-14 and taking them into account to provide recommendations for the training process on the basis of a differentiated approach.

Material and Methods of research

The reseach was conducted in several stages. At the first stage of the reseach, experimental data were collected with further analysis of the results with recommendations for the correction of the training process of basketball players aged 13-14.

To determine the indicators of individual typological features, properties of the nervous system, the sincerity of basketball players at the stage of preliminary basic training, psychological diagnosis was performed according to the method of H. Eysenck EPI 1963.

The reseach involved 30 students of Children's and Youth Sports School of Olympic Reserve № 5 named after Deserved Coach of Ukraine M. I. Hovorunova, born in 2006-2007.

Results of the research

Psychologically, one of the common age characteristics of the adolescent is the need for self-affirmation. It is not based on victories in the game during official competitions, but on victories in the training process. The game is already the result of training sessions and conscious learning, where the ability to perform technical elements in the distribution of moral and volitional efforts is manifested. Volitional qualities characterize the desire of a basketball player to achieve results and begin to develop and consolidate in adolescence. A fairly complete assessment of the results of joint work of a coach and a basketball player can be obtained at the age of 15, for which the coach needs to understand and take into account the psychological characteristics of adolescence to subordinate further training work to the formation of each individual [2, 8, 10, 13 , 20].

Psychological features of competitions, circumstances and patterns that make high demands on the psyche of basketball players 13-14 years, all that the player has learned and accumulated as a result of the training process, can be lost in minutes and sometimes seconds before the start of decisive games. Therefore, we believe that the psychological training of basketball players at the stage of preliminary basic training is an important and mandatory element in the system of long-term training of basketball players [14, 15, 16, 17].

The content of psychological training during the annual microcycle in young basketball players aged 13-14 is presented in Figure 1.

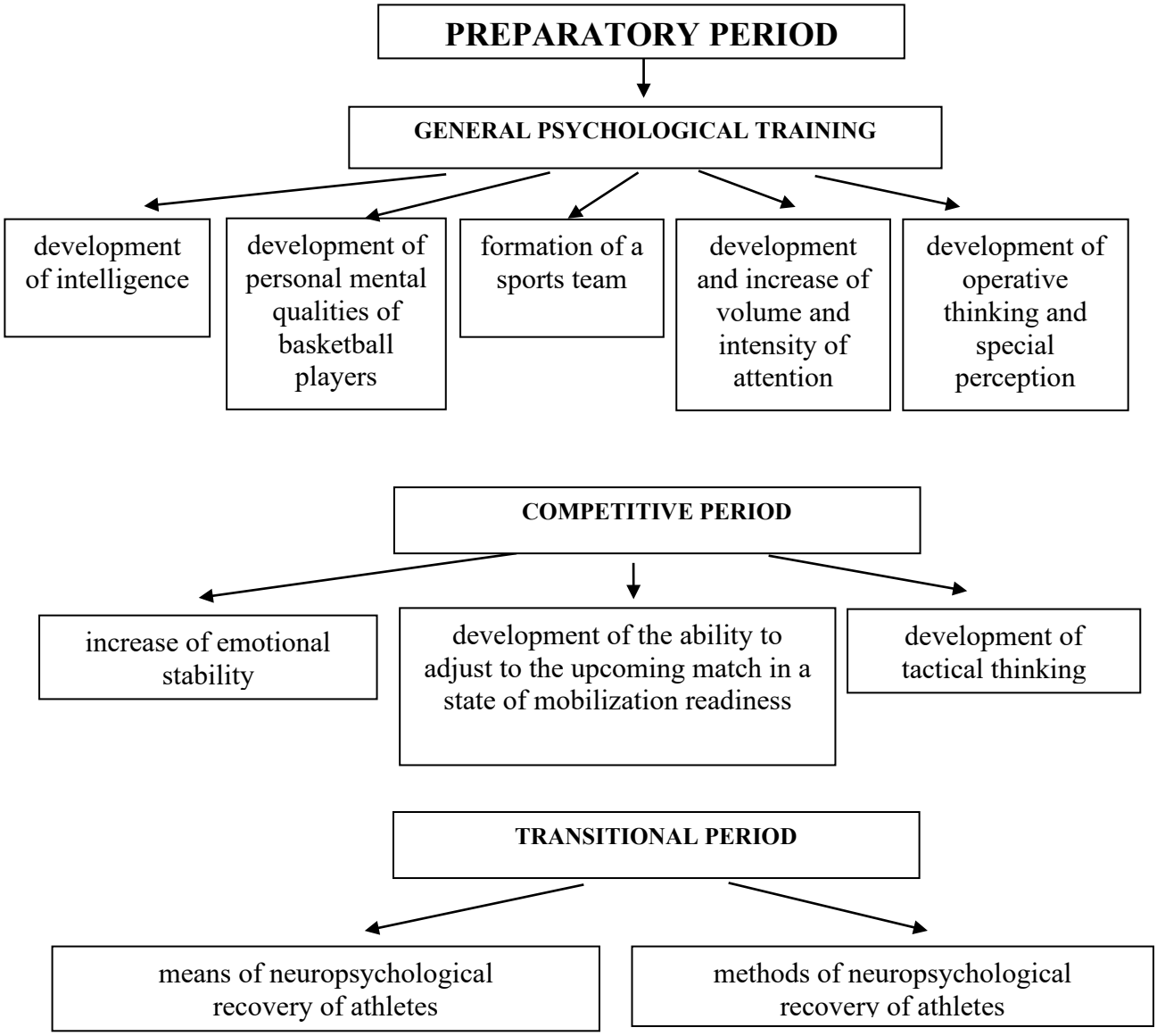

Figure 1. Periods of psychological training according to the curriculum for Children's and Youth Sports School 2019

After analyzing the current basketball curriculum for Children's and Youth Sports School of Ukraine (2019), we can note that psychological training is organically combined with other types of training such as physical, technical, tactical, game, and is conducted during the year during the training process. In particular, it was found that the amount of psychological training is not determined by quantitative indicators, but it does not cease to be a necessary condition for the successful solution of the system of long-term training of basketball players [11].

It should be noted that to the greatest extent psychological preparedness should be developed during the preparatory period. Taking into account the

recommendations on the sequence of construction of the annual cycle of basketball training, a psychological diagnosis was carried out according to the method of H. Eysenck EPI (Eysenck Personality Inventory) with the help of which data on individual indicators were obtaines, namely: the predominance of temperament, taking into account the properties of the nervous system, indicators of personality traits and sincerity of the researched members [6, 7, 10, 18].

The reseach involved 30 basketball players aged 13-14, but the results of 11 (36.66%) basketball players are not used as reliable, due to the critical threshold of scores on the "sincerity scale". In the Table 1, which characterizes these players as those who tend to give positive answers to questions.

Table 1

Determining the sincerity of basketball players aged 13-14 by numerical indicator according to the method of H. Eysenck EPI (n = 30)

The name of the scale	The number of sportsmen	%
A reliable result on the scale of sincerity	19	63,33%
A critical indicator on the scale of sincerity	11	36,66 %

They are also seen as promising, as those who can perform more loads than others and improve their physical and psychological performance faster than others.

The results obtained on the indicators of individual typological personality traits of basketball players at the stage of preliminary basic training (n = 19) are indicated in Figure 2 as follows: 5% of basketball players have an even combination of all types of personality temperament that easily adapt to emerging circumstances and can fit in them , it is usually desirable to set them important tasks that they will be happy to perform with (social) support from parents and mentors.

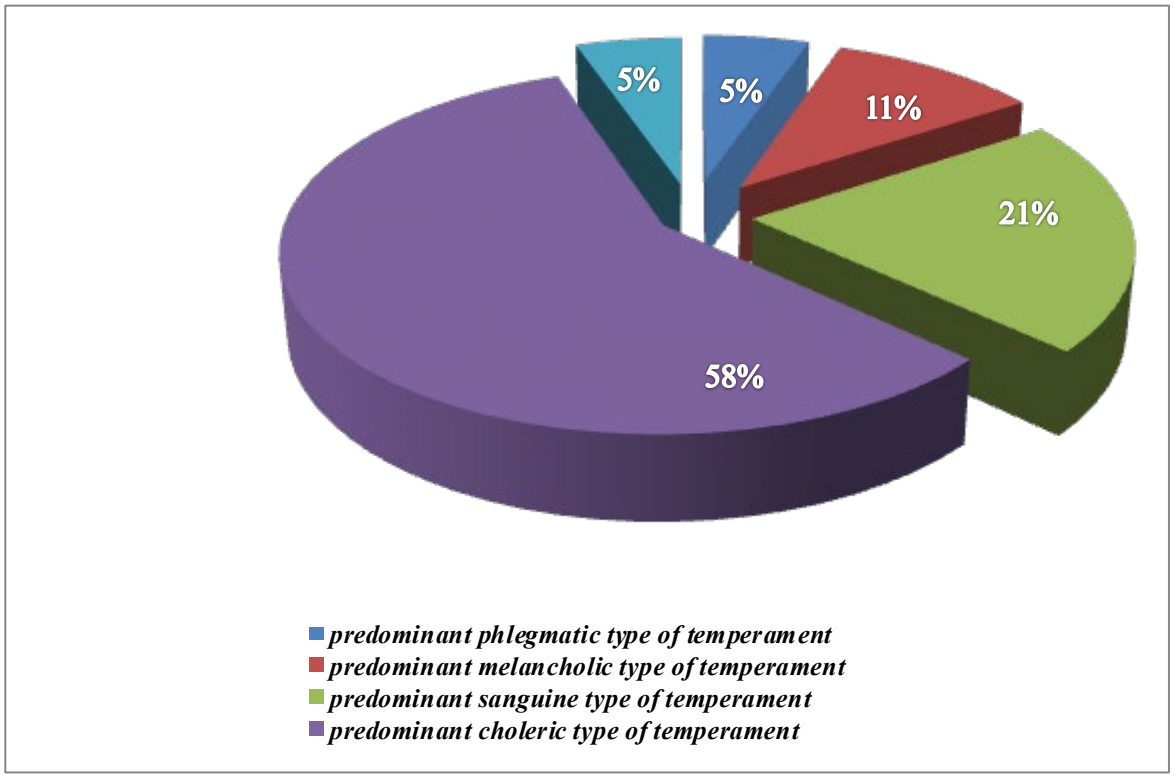

Fig. 2. Typological indicators (predominance of temperament type) of basketball players aged 13-14 (n = 19)

The predominance of the phlegmatic type of temperament of basketball players - 5%, require more time to study the task, but after mastering give a stable result, both during training and in competitive periods. The predominance of the melancholic type of temperament of basketball players - 11% need emotional encouragement and support and react negatively to criticism. The predominance of sanguine type of temperament of basketball players - 21%, in which the mind takes precedence over emotions, they strive to take leadership positions, then the predominance of choleric type of temperament of basketball players - 58% have great stability of aspirations and interests, persistence, but possible difficulties in switching and retention of attention and require additional control over discipline.

Thus, the obtained indicators of the properties of the nervous system from emotional stability to neuroticism according to the method of H. Eysenck EPI show

that emotional stability, which is more characteristic of athletes with a predominance of sanguine and phlegmatic temperament - 31.6%, neuroticism – characteristic of athletes with a predominance of choleric and melancholic temperament types 68.4%.

Table 2

Determination of properties of the nervous system from stability to neuroticism according to the method of H. Eysenck EPI (n = 19)

Properties of the nervous system	The number of people	%
Emotional stability	6 people	31,6%
Emotional instability (neuroticism)	13 people	68,4%

Indicators of measuring personality traits of the nervous system of basketball players aged 13-14 (n = 19) are 68.4% among extroverts, 21.1% among introverts and 10.5% among ambiverts (Figure 3).

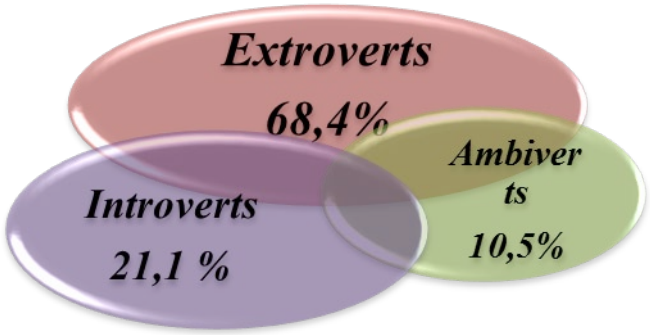

Fig 3. Indicators of measuring personality traits of the nervous system of basketball players 13-14 years (n = 19)

The vast majority of extrovert players (sanguine and choleric) are sociable, flexible, have great initiative, high social adaptability, and lack perseverance. The second place is occupied by introverts, who are characterized by isolation and observation, tendency to introspection and complication of social adaptation, fixation of interests around the phenomena of their own inner world, as well as social passivity with sufficient persistence.

Among basketball players at the stage of preliminary basic training there are ambiverts who have a flexible psychotype, are able to adapt well to the situation and can take advantage of both introverts and extroverts.

Conclusions / Discussion

The data obtained at the end of the reseach give rise to the correction of the training process during the preparatory period, namely, the division of basketball players 13-14 years into subgroups, which will increase the percentage of assimilation, improve interpersonal relationships between partners due to their compatibility such as respect, mutual understanding, cohesion, interpersonal attraction, positive emotions, etc.

The obtained results made it possible to provide recommendations for the correction of the training process by applying a differentiated approach taking into account individual typological features, such as: temperament types, personality traits of each basketball player, nervous system properties, namely, distribution of basketball players by subgroups to perform special basketball exercises at the stage of preliminary basic training.

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Prospects for further research are to find the necessary techniques and control of psychological preparedness in the competitive and transitional periods, which will allow coaches to adjust the training process of basketball players at the stage of preliminary basic training.

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References

1. Babushkin, G. D. (2012), Psihodiagnostika lichnosti pri zanyatiyah fizicheskoy kulturoy i sportom [Psychodiagnostics of personality in physical culture and sports]: ucheb. posobie. Omsk: Izd-vo SibGUFK, 328 p. (in Russ).

2. Voronova, V. I. (2007), Psykholohiia sportu [Psychology of sport]: navch. posib. K.: Olimpiiska literatura, 298 p. (in Russ).

3. Gavrilovich, A. A. (2017), "Compatibility as an indicator of interpersonal relationships in a sports team and the effectiveness of its activities", Brestskiy gosudarstvennyiy universitet imeni A. S. Pushkina, pp.64-70. (in Ukr).

4. Zaporozhets, T. M. & Pavlenko, G. P. (2016), Zahalna fiziolohiia zbudlyvykh tkanyn ta tsentralnoi nervovoi systemy [General physiology of excitable tissues and the central nervous system], Kyiv, 169 p. (in Ukr).

5. Ivchenko, O. M., Mitova, O. O. (2016), "The state of control of psychological preparedness of basketball players at the stage of preliminary basic training". Fizychna kultura, sport ta zdorovia: materialy XV Mizhnarodnoi naukovo-praktychnoi konferentsii, pp. 30–32. (in Ukr).

6. Ivchenko, O. M. (2016), "Prerequisites for modifying the test" Assessment of the sense of time "(Sermeev, 1973) to improve control in basketball", materialy I Vseukrainskoi (z mizhnarodnoiu uchastiu) naukovo-praktychnoi internet-konferentsii «Basketbol: istoriia, suchasnist, perspektyvy, pp.151–154. (in Ukr).

7. Ilyin, E. P. (2008), Psihologiya sporta [Psychology of sport], Piter, Mastera psihologi, 291 p. (in Russ).

8. Mirzoev, O. M. (2005), Primenenie vosstanovitelnyih sredstv v sporte [The use of restorative agents in sports], Moskva: Fizkultura i sport, 220 p. (in Russ).

9. Mitova, O. O., Sushko, R. O. (2016), Testuvannia basketbolistiv [Testing of basketball players]: navchalnyi posibnyk dlia studentiv, vykladachiv, treneriv. Dnipropetrovsk: Innovatsiia, 140 p. (In Ukr).

10. Pashukova, T. I.& Dyakonov, G. V. (1996), Praktikum po obschey psihologii dlya studentov pedagogicheskih vuzov. Kratkiy Otborochnyiy Test, Test KOT V.N. Buzina, E.F.Vanderlika [Workshop on General Psychology for Students of

Pedagogical Universities. Short Selection Test, Test KOT V.N. Buzina, E.F. Vanderlika]: ucheb. posobie. Moskva, 236 p. (in Russ).

11. Poplavsky, L. Y. & Bezmilov, M. M. (2019), Basketbol: navchalna prohrama dlia dytiacho-yunatskykh sportyvnykh shkil, spetsializovanykh dytiacho-yunatskykh sportyvnykh shkil olimpiiskoho rezervu, shkil vyshchoi sportyvnoi maisternosti ta spetsializovanykh navchalnykh zakladiv sportyvnoho profiliu [Basketball. Curriculum for children and youth sports schools, specialized children and youth sports schools of the Olympic reserve, schools of higher sportsmanship and specialized educational institutions of sports profile]. Kyiv, 166 p. (in Ukr).

12. Rodionov, A. V. (2004), Psihologiya fizicheskogo vospitaniya i sporta [Psychology of physical education and sport]. M.: Akademicheskiy proekt, Fond «Mir», 182 p. (in Russ).

13. Sergienko, L. P. (2009), Osnovy naukovykh doslidzhen u psykholohii: kvalifikatsiini ta dyplomni roboty [Fundamentals of scientific research in psychology: qualification and diploma works]: navchalnyi posibnyk, Kyiv, 240 p. (in Ukr).

14. Ulyaeva, L. G., Melnik, E. V. (2014), Psihologo-pedagogicheskoe soprovozhdenie sportivnoy deyatelnosti v kontekste samorealizatsii lichnosti [Psychological and pedagogical support of sports activities in the context of self-realization of the person], Moscow, 236 p. (in Russ).

15. Shevyakov, O. V. (2012), Psychological support for the development of socio-technical system of athletes. Pedagogy, psychology and medical and biological problems of physical education and sports: [scientific monograph edited by prof. Yermakova SS]. Kharkiv: KhDADM ,. №7. Pp. 120-125. (in Ukr).

16. Shuba, V. V. (2012), "Psychological and pedagogical organization of the training process of Paralympians with musculoskeletal disorders", Pedahohika, psykholohiia ta medyko-biolohichni problemy fizychnoho vykhovannia i sportu, pp.126-129. (in Ukr).

17. Costas, I. K., Terry, P.C. (2011), Inside sport psychology. Champaign: Human Kinetics, 235 p. (in Eng).

18. Kunath, P. T., Schellenberger, H. (1991), Eatigkeitorientierte Sportpsychologie. Frankfurt am Main: Verlag Harri Deutsch, 329 p. (in Eng).
19. Lafrenière, M.-A.K., Jowett, S., Vallerand, R.J., Carbonneau, N. (2011), "Passion for coaching and the quality of the coacheathlete relationship: The mediating role of coaching behaviors", Psychology of Sport and Exercise, No. 12, pp.144-152. (in Eng).
20. Loehr, J. (1988), "Exorcisimnegative feedback", Word tennis, August, p. 18–19. (in Eng).
21. Podloga, L., Eklundb, R.C. (2007), "The psychosocial aspects of a return to sport following serious injury: A review of the literature from a self-determination perspective", Psychology of Sport and Exercise, No. 8, pp. 535-566. (in Eng).

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FEATURES OF CONSTRUCTION OF THE TRAINING PROCESS OF YOUNG FEMALE WEIGHTLIFTERS OF 14-15 YEARS OLD IN BASIC MESOCYCLE OF THE PREPARATORY PERIOD OF THE ANNUAL MACROCYCLE TAKING INTO ACCOUNT SPECIFIC BIOLOGICAL CYCLES

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Purpose: to consider the issue of the peculiarities of construction the training process of young weightlifters 14-15 years old in the basic mesocycle of the preparatory period in the annual macrocycle, taking into account the peculiarities of a specific biological cycle.

Material and methods: the work uses the methods of theoretical analysis and generalization of scientific information, system analysis. The reseach involved young pupils of the Children and Youth Sports School № 16 and Children and Youth Sports School № 8, Kharkov. The experiment involved 24 young female weightlifters 14-15 years old, who were divided into two groups: control and experimental, 12 athletes in each group. The participants in the experiment trained 3-4 times a week in accordance with the developed methodology.

Results: presents modern approaches to the peculiarities of building the training process of young weight-lifters 14-15 years old; provides a detailed structure for constructing the basic mesocycle in the annual macrocycle, taking into account the phases of the ovarian-menstrual cycle. Comparative analysis of indicators of special exercises and general physical fitness of female athletes in the control and

experimental groups at the beginning and at the end of the experiment showed that the level of general physical fitness of athletes in the experimental group significantly increased under the influence of the proposed methodology.

Conclusions: it was determined that among young athletes involved in kettlebell lifting it is necessary in the basic mesocycle of the annual macrocycle to carry out the distribution of loads in accordance with the phases of the ovarian-menstrual cycle. The introduction of the methodology of the training process of young kettlebells 14-15 years old in the basic mesocycle of the annual macrocycle, taking into account the phases of the ovarian-menstrual cycle, contributed to a significant increase in the indicators of general and special-auxiliary exercises in the experimental group.

Keywords: young female athletes, specific biological cycle, phases of the ovarian-menstrual cycle, microcycles, mesocycles.

Introduction

Modern sport is characterized by a steady increase in sports achievements, accompanied by an increase in the volume and intensity of the training load. Such an approach to the training process often leads to overstrain of regulatory systems, depletion of the adaptive reserve and shortening of the performance time of athletes, does not allow achieving high sports results.

The functioning of physiological systems and adaptation processes in the body of women differ from those in men. This is due to one of the main biological characteristics of the female body associated with reproductive function - the cyclic functions of the hypothalamic-pituitary-ovarian-adrenal system. A number of studies (A. G. Radzievsky, 1990; F. A. Iordansky 2012; V. V. Mulik 2001; 2016; L. Ya. - G. Shakhlina, 1995-2014) [3-5; 12-14], including foreign (A. M. Burrows, S. R. Bird, 2005; S. B. da Silva, 2006; A. J. Anderson, M. A. Babcock, 2008), [16-21] devoted to the influence of sex hormones in the system of women's sports training. Experts have established the dependence of the manifestation of the working capacity of athletes of various sports specializations and the reaction of their bodies on changes in the

concentration of sex hormones during the menstrual cycle (V. Mulik, 2001; V.M. Platonov 2004; M.S. Prudnikova, 2009) [4; 9; 10].

The purpose of the reseach is to consider the issue of the peculiarities of the construction of the training process of young female kettlebells 14-15 years old in the basic mesocycle of the preparatory period in the annual macrocycles, taking into account the peculiarities of a specific biological cycle.

Material and methods of research

According to the methodological approach in solving the problem and the set tasks, the research program included a set of research methods: analysis of scientific and methodological literature, determination of special physical readiness using pedagogical testing of young weight lifters, pedagogical testing according to the training process and methods of mathematical statistics.

This reseach involved young pupils of the Children's and Youth Sports School №16 and Children's and Youth Sports School №8, Kharkov. The experiment involved 24 young female weightlifters 14-15 years old, who were divided into two groups: control and experimental, 12 athletes in each group. The participants in the experiment trained 3-4 times a week in accordance with the developed methodology.

Results of the research

Sports training of young athletes involved in kettlebell lifting provides for the use of means and methods that affect the development of such physical qualities as strength, strength endurance and speed-strength training. Under the influence of training in the body of the athlete, certain changes occur. In the process of adaptation to physical activity, the level of physical performance and fitness of athletes increases. One of the manifestations of the body's adaptation to power manifestations is muscle hypertrophy.

However, in order for the changes in the body of the athletes to have a positive character, the trainer must choose the optimal training regimen, taking into account the ovarian-menstrual cycle and properly selected rest, recovery procedures, contribute to a faster growth of sports skills. At the same time, today there are no

studies on the construction of a one-year macrocycle of training young athletes involved in kettlebell lifting, taking into account the ovarian-menstrual cycle.

At the beginning of the research, young athletes involved in kettlebell lifting were divided into two groups of 12 people each. Female athletes of the experimental group trained according to the developed experimental methodology, which provided for the training process of taking into account loads in the basic mesocycle of the annual macrocycle, taking into account the phases of the ovarian-menstrual cycle.

Taking into account the recommendations of leading experts in the field of building the training process of training athletes (V. Platonov, 2004; V.V. Mulik 2017) [4-5; 8-9], it is reasonable to construct a two-cycle summer training of young athletes involved in kettlebell lifting, taking into account the phases of the OMC during a one-year macrocycle.

In our reseach, the construction of a one-year macrocycle of training young athletes is based on the generally accepted theory of periodization (V.M. Platonov), which provides for the division of the macrostructure into preparatory, competitive and transitional periods, and when menarche appears, we have introduced a developed experimental technique for constructing a basic mesocycle (basic on GPP in June) in the preparatory period, developed taking into account the phases of the ovarian-menstrual cycle (Table 1).

The control group carried out the training process according to the sports school program, which did not take into account the distribution of the load during the biological cycle system. The total volume of loads in the basic mesocycles did not have significant differences between the groups. ($p>0,05$).

Table 1

The structure of the basic mesocycle according to GPP, taking into account the phases of the OMC of weightlifters 14-15 years old

Basic mesocycle																										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Distribution of phases of the menstrual cycle																										
Menstrual					Postmenstrual							Ovulatory			Postovulatory									Premenstrual			
Number of training sessions																										
-	1	1	2	1	1	2	2	1	2	2	1	-	1	1	1	2	1	1	2	2	2	1	-	1	1	2	1
Methods and magnitude of load																										
1 training session																										
-	U	U	U	AL	U	AL	ПО	U	U	AL	U	-	U	AL	U	R	P	ПО	U	U	AL	AL	-	U	U	AL	U
-	S	A	A	S	A	A	SI	S	A	SI	A	-	A	S	A	З	-	A	SI	A	SI	A	-	SI	S	A	A
2 training session																										
-	-	-	AL	-	-	U	U	-	AL	U	U	-	-	-	-	P	-	-	AL	AL	U	-	-	-	-	U	-
-	-	-	S	-	-	S	S	-	A	A	S	-	-	-	S	S	S	-	S	-	-	-	-	-	-	-	-
Distribution of training hours																										
-	2	2	3	1	2	3	4	2	4	2	2	-	2	2	3	3	2	3	3	4	2	1	-	2	4	1	3
-	-	-	1	-	-	1	1	-	1	2	-	-	-	-	-	2	-	-	1	1	1	-	-	-	-	2	-

Remark: U - uniform; AL - alternating; R - repeated; S- small; A - average; SI- significant

The proposed approach to planning in the annual macrocycles of the basic mesocycle for young female kettlebell lifting athletes, taking into account the phases of the ovarian-menstrual cycle, modified from the works of V.V. Mulik (2017). So, table 2 shows the detailed content of the training process in the preparatory period of the basic mesocycle. The proposed experimental training program for the basic mesocycle took into account kettlebell lifting during the ovarian-menstrual cycle and included four anaerobic exercises.

Table 2

The content of the training program of young weightlifters 14-15 years old from the experimental group in the basic mesocycle for general physical training, taking into account the ovarian-mental cycle

Day	Start time of lesson	Duration of the lesson, min	Training aids	Load direction	Load value	The main method of performing exercises
1	11-00	60	Exercises for snatching weights and barbell rows, squats with kettlebells	Anaerobic	L	Interval
	19-00	20	Exercises using different modes of work. Use of exercise equipment	Mixed	S	Interval
2	11-00	60	Exercises for pushing weights and deadlifts for the number of times, squats with a barbell Use of exercise equipment	Anaerobic	A	Interval
3	11-00	60	Exercises for weightlifting and barbell pulling, squats with dumbbells	Anaerobic	L	Interval
	19-00	30	Exercises using different modes of operation and exercise equipment to improve physical qualities	Mixed	A	Interval
4	Day off		Restorative means	Recovery of female athletes body		
5	11-00	60	Exercises for snatching weights and barbell rows, squats with kettlebells	Anaerobic	A	Interval
	19-00	30	Exercises using different modes of work. Use of exercise equipment	Mixed	Si	Interval
6	11-00	60	Exercises for snatching weights and barbell rows, squats with kettlebells	Anaerobic	L	Interval
	19-00	20	Cross training	Aerobic	S	Continuous
7	Day off		Restorative means	Recovery of female athletes body		

Load: S- small; A - average; *Si - significant L. - large.*

As a result of the use of the author's methodology for constructing the training process among 14-15 years old girls-kettlebells in the basic GPP mesocycle of the preparatory period of the annual macrocycle, taking into account the specific biological cycle, significantly better results of the test indicators of young weights in the experimental group (Table 3).

Table 3

Indicators of general physical training of weightlifters of control (CG, n_1 = 12) and experimental (EG, n_2 = 12) groups at the beginning and at the end of the experiment, $\overline{X} \pm m$

Indicators		Groups of athletes		t	p
		CG	EG		
Running for 30 m, s	before	5,6±0,4	5,7±0,7	0,12	>0,05
	after	4,6±0,2	3,9±0,2	**2,47**	**<0,05**
Running for 60 m, s	before	10,6±0,4	10,3±0,7	0,37	>0,05
	after	9,1±0,5	7,8±0,3	**2,22**	**<0,05**
Standing long jump, cm	before	168,8±6,5	167,5±5,8	0,14	>0,05
	after	196,6±7,3	214,7±4,2	**2,14**	**<0,05**
Pull-ups, number of times	before	6,4±1,3	6,2±2,2	0,07	>0,05
	after	13,1±1,5	17,3±0,7	**2,53**	**<0,05**
Push-ups, number of times	before	10,5±3,0	11,2±2,5	0,17	>0,05
	after	20,4±2,5	26,6±1,4	**2,16**	**<0,05**
Hanging on the bar 1.5 cm wide, s	before	11,7±2,7	11,5±2,0	0,06	>0,05
	after	26,0±3,2	34,5±2,1	**2,22**	**<0,05**
Hanging on the bar on one hand, s	before	16,7±1,8	16,9±1,7	0,08	>0,05
	after	24,1±1,9	29,4±1,5	**2,18**	**<0,05**
Hanging on the bar on bent arms, s	before	20,8±2,1	20,3±2,5	0,15	>0,05
	after	34,5±2,8	41,9±1,3	**2,39**	**<0,05**
Raising legs to the crossbar, number of times	before	8,4±2,1	8,0±2,5	0,12	>0,05
	after	17,4±2,4	23,8±1,7	**2,17**	**<0,05**
Pull-ups on the bar 1.5 cm wide, number of times	before	3,5±1,0	3,1±1,3	0,24	>0,05
	after	8,3±1,2	12,3±1,3	**2,26**	**<0,05**

The results of 30 m running in the experimental group were 3.9 s, which is 0.7 s better than in the control ($t = 2,47$; $p < 0,05$) 60 m run – 1,3 s ($t = 2,22$; $p < 0,05$) standing long jump - by 18,1 cm ($t = 2,14$; $p < 0.05$) pull-up on the crossbar - by 4,2 times ($t = 2,53$; $p < 0.05$) flexion and extension of the arms in an emphasis lying on the floor – by 6.2 times ($t = 2,18$; $p < 0.05$) hanging on a bar 1,5 cm wide - by 8,5 s ($t = 2,22$; $p < 0,05$) hanging on the bar on one hand - by 5.3 s ($t=2,18$; $p<0,05$); hanging on the bar on bent arms - by 7,4 s ($t = 2,39$; $p < 0,05$) lifting the legs up in the hang on

the bar - by 6.4 times ($t = 2,17$; $p < 0,05$) and pulling up on a plank with a width of 1,5 cm – by 5,0 times ($t = 2,26$; $p < 0,05$). While no significant difference was found at the start of the study.

Thus, a comparative analysis of the indicators of special exercises and general physical fitness of female athletes in the control and experimental groups at the beginning and at the end of the experiment showed that the level of general physical fitness of athletes in the experimental group significantly increased under the influence of the proposed methodology, in which the developed exercise complexes were used in the basic mesocycle of the preparatory period taking into account the ovarian-menstrual cycle.

Conclusions / Discussion

An analysis of the scientific literature shows isolated studies in weightlifting. In recent years, scientists have conducted research on the content and methods of the training process of young female weight-lifters of 14-15 years old with various methods of motor skills and strength qualities (Yu.V. Verkhoshanskiy 2013), planning the training process during a one-year macrocycle of athletes aged 14-15 (V. Platonov, 2014, 2015) and the influence of the training process of young female weight-lifters 14-15 years old on the manifestations of physical qualities M.S. Ipolitov. However, the influence on the working capacity of the physical loads of young female kettlebells athletes 12-13 years old at the first stage of training in long-term training was studied, which prompted the construction of the training process of young female kettlebell lifters 12-13 years old during a one-year macrocycle, taking into account the ovarian-menstrual phases.

The conducted research confirmed the results of other authors [1, 2] about the need to take into account the influence of training on the physical indicators of female athletes aged 14-15 at the stage of initial training. Also, the data of domestic [4-5; 8; nine; 11] and foreign [16-21] authors on the issues of increasing the level of the most significant indicators of physical qualities on the body of young athletes involved in kettlebell lifting.

Today, there are a number of scientific studies that consider the issues of the peculiarities of building the training process of female athletes based on taking into account the working capacity in different periods (phases) of a specific biological cycle. The works of A.R. Radzievsky, Yu.T. Poholenchuk, N.V. Svechnikov, B.P. Pangelova, T.A. Lozy, S.K. Fomina, A. Ya. Kvale, Yu.A. Karp, L.Ya.-G. Shakhlin, who determined the functional state of female athletes during a specific biological cycle. The issues of building the training process of young athletes have been studied to a lesser extent, especially during the formation of a specific biological cycle.

The experimental training program, which was developed for female athletes of kettlebells 14-15 years old, taking into account the phases of the ovarian-menstrual cycle, provided for the features of the training process in the basic mesocycle of the annual macrocycle.

Competitive and competitive-auxiliary exercises were used as training means, which were applied differentially depending on the phases of the ovarian-menstrual cycle in accordance with the developed training program in the basic mesocycle in annual macrocycles.

The introduction of the methodology of the training process of 14-15-year-old female kettlebells in the basic mesocycle of the annual macrocycle, taking into account the phases of the ovarian-menstrual cycle, contributed to a significant increase in the indicators of general and special-auxiliary exercises in the experimental group.

Prospects for further research provides for the definition of the construction of the training process of young kettlebells 14-15 years old in separate mesocycles, taking into account the phases of the CMC during a one-year macrocycle.

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References

1. Verhoshanskiy, Yu. V. (2013), Osnovyi spetsialnoy silovoy podgotovki v sporte [Fundamentals of special strength training in sports]. M. : Sovetskiy sport, 215 p. (in Russ).

2. Dzhim, V. Yu. (2013), "Comparative analysis of the technique of snatch exercises in weightlifting and kettlebell lifting", Pedahohika, psykholohiia ta medyko-biolohichni problemy fizychnoho vykhovannia i sportu, No. 11, pp. 10–16. (in Russ).

3. Iordanskaya, F. A. (2012), Muzhchina i zhenschina v sporte vyisshih dostizheniy: Problemyi polovogo dimorfizma [Man and Woman in Elite Sports: Problems of Sexual Dimorphism]: monografiya. Moskva: Sovetskiy sport, 256 p. (in Russ).

4. Mulik, V. V. (2001), Sistema mnogoletnego sportivnogo sovershenstvovaniya v uslozhnennyih usloviyah sopryazheniya osnovnyih storon podgotovlennosti sportsmenov (na materiale lyizhnogo sporta) [The system of long-term sports improvement in complicated conditions of conjugation of the main sides of the athletes' fitness (based on skiing)]: avtoref. dis. na soiskanie uch. stepeni d-ra nauk po fiz. vosp. i sportu : spets. 24.00.01. KiYiv, 33 p. (in Russ).

5. Mulik, V. V. (2016), "Modern aspects of building the training process of athletes", Slobozhanskyi naukovo-sportyvnyi visnyk, No. 5(55), pp. 57–62. (in Ukr).

6. Novikov, V. P. (1990), "Characteristics of the development of strength in schoolchildren 7 - 10 years old", Vozrastnyie osobennosti fiziologicheskih sistem detey i podrostkov. M., pp. 203-204. (in Russ).

7. Oleshko, V. H. (2011), Pidhotovka sportsmeniv u sylovykh vydakh sportu [Training of athletes in power sports]: navch. posib. dlia vuziv. K. : DIA, 444 p. (in Ukr).

8. Platonov, V. N. (2004), Sistema podgotovki sportsmenov v olimpiyskom sporte. Obschaya teoriya i ee prakticheskie prilozheniya [The system of training athletes in Olympic sports. General theory and its practical applications]. Kiev : Olimpiyskaya literatura, 808 p. (in Russ).

9. Platonov, V. N. (2015), Sistema podgotovki sportsmenov v olimpiyskom sporte. Obschaya teoriya i ee prakticheskie prilozheniya [The system of training athletes in Olympic sports. General theory and its practical applications]: uchebnik dlya trenerov : v 2 kn. Kiev. : Olimpiyskaya literatura, Kn. 2. 752 p. (in Russ).
10. Prudnikova, M. S., Mulik, V. V. (2009), "The influence of physical activity on the functional state and personal qualities of young cyclists 12-15 years old during the formation of the CMC", Slobozhanskyi naukovo-sportyvnyi visnyk, No. 3, pp. 164–167. (in Russ).
11. Rovnyi, A. S. (2001), Formuvannia systemy sensornoho kontroliu tochnykh rukhiv sportsmeniv [Formation of a system of sensory control of precise movements of athletes]: avtoref. dys. na zdobuttia nauk. stupenia d-ra nauk z fiz. vykhovannia i sportu: spets. 24.00.02. Kyiv, 40 p. (in Ukr).
12. Shahlina, L. G. (2000), "Women and sports at the turn of the third millennium", Nauka v olimpiyskom spopte, No. 4, pp. 10–22. (in Russ).
13. Shahlina, L. G. (1995), Mediko-biologicheskie osnovyi upravleniya protsessom sportivnoy trenirovki zhenschin [Medical and biological foundations of managing the process of sports training for women]: avtoref. dis ... d-ra med. nauk. Kiev, 32 p. (in Russ).
14. Shahlina, L. G. (1999), "Sexual dimorphism problems in elite sports", Teoriya i praktika fizicheskoy kulturyi, No. 6, pp. 51–55. (in Russ).
15. Sheyko, B. I. (2008), "Planning Technique for Beginner Powerlifters", Mir silyi, No.4, pp.28-29. (in Russ).
16. Casazza, G. A., Jacobs, K. A., Suh, S. et al. (2004), "Menstrual cycle phase and oral contraceptive effects on triglyceride mobilization during exercise", J. Appl. Physiol., Vol. 97, pp. 302–309. (in Eng).
17. Horton, T. J., Miller, E. K., Bourret, K. (2006), "No effect of menstrual cycle phase on glycerol or palmitate kinetics during 90 min of moderate exercise", J. Appl. Physiol.,Vol. 100, pp. 917–925. (in Eng).

18. Jacobs, K. A., Cassaza, G. A., Suh, S. et al. (2005), "Fatty acid re-esterification but not oxidation is increased by oral contraceptive use in women", J. Appl. Physiol., Vol. 98, pp. 1720–1731. (in Eng).
19. Janse de Jonge X. A. (2003), "Effects of the menstrual cycle on exercise performance", Sports Med, Vol. 33, pp. 833–851. (in Eng).
20. Kenney, L. W., Wilmore, J. H., CostiiL, d. L. (2012), Physiology of sport and exercise. Champaign: Human Kinetics, 621 p. (in Eng).
21. Nimmo, M. A. (2009), "The female athletes", Olympic text-book of science in sport / ed. by R. J. Maughan. Blackwell Sci. Publ., pp. 382–400. (in Eng).

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SELECTION CRITERIA FOR MILITARY AVIATION PENTATHLON ACCORDING TO THE SENSORIMOTOR COORDINATION OF ATHLETES

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Purpose: to analyze the initial indicators that characterize the level of development of sensorimotor coordination and physical (motor) readiness of cadets of higher educational estasblishment for further sports activities in military aviation pentathlon.

Material and methods: analysis of literature sources, questionnaires, testing, statistical analysis. The reseach involved 48 first-year cadets of the Kharkiv National University of the Air Force named after Ivan Kozhedub (men), aged 17-18 years old, of which 38 Candidates Master of Sports and 10 Masters of Sports.

Results: the initial indicators of candidates for further sports activities in military aviation pentathlon were analyzed. The distribution of candidates by sports such as game, cyclic, complex coordination and martial arts. Using the definition that sensorimotor coordination is an integrated indicator of the functioning of the body's sensory systems, tests were selected and systematized, the indicators of which characterize the coordination abilities. The analysis of results in the form of the

verbal description, tables, the analytical description of the received regularities is carried out.

Conclusions: determined the heterogeneity of the initial indicators of sensorimotor coordination of candidates for the national team in military aviation pentathlon. It is necessary to develop a single universal training algorithm with the definition of mandatory control points - periods of determining the leading opportunities and the development of a set of additional exercises to improve certain indicators of sensorimotor coordination in accordance with the sport in which the cadets was engaged before entering.

Keywords: military-aviation pentathlon, obstacle course, sports orientation, sensorimotor coordination.

Introduction

It is known that the components of international military aeronautical pentathlon are piloting (not included in the competition), shooting from a large-caliber pistol (revolver) at 25 meters, swimming at 100 m with obstacles, fencing, basketball test (4 exercises with ball) and overcoming the obstacle course and orienteering [1, 2]. The results of the competition are determined in individual and team competitions. Personal place is determined by the highest sum of points scored by the participant in each discipline. The final, decisive stage, which takes place on the last day of the competition, is overcoming the obstacle course and orienteering [3, 4]. Despite the fact that these two varieties exist separately as independent sports, in international military aeronautical pentathlon they are combined into a single stage, which is held on the last day of competition and is crucial in determining the level of training of athletes [5, 6] . It is when performing tasks that are mandatory when overcoming the obstacle course and combine the largest number of exercises that depend on the coordination capabilities of the athlete, as well as performed on the maximum possible speed and strength, the body functions at the limit of its own physical opportunities. Further "legend" that the athlete must go through during

further orienteering, also requires maximum speed and endurance, but also requires the athlete to involve his sensori-motor, cognitive and analytical abilities [7, 8].

Both theoretical and practical methods are important in preparation for competitions. Since "coordination" is overcoming the excessive degrees of freedom of our organs of movement, i.e. turning them into controlled systems [9], it is important not only to be able to perform tasks during training, but also to know all the sensory and motor components of basic exercises, at the appropriate level is crucial in the results of competitions, etc. [10]. When planning the stages and components of the training period, it is important to determine the initial, intermediate and maximum indicators of sensori-motor coordination, which in international military aeronautical pentathlon are the leading indicators that predict the outcome of the competition. Since the maximum realization of the abilities of this indicator occurs during the last decisive day of the competition - overcoming the obstacle course and orienteering - this segment was chosen to determine the purpose of the reseach.

Purpose of the reseach is to analyze the initial indicators that characterize the level of development of sensorimotor coordination and physical (motor) training of first-year cadets of higher education, who are candidates for the national team in international military aeronautical pentathlon.

Material and Methods of research

The research involved 48 first-year cadets of the Kharkiv National University of the Air Force named after Ivan Kozhedub (men), aged 17-18, including 38 candidates for Masters of sports and 10 Masters of sports. All candidates for further training in military aeronautical pentathlon were divided into four groups by sport, namely: game (group I - 12 cadets), cyclic (group II - 14 cadets), complex coordination (group III - 10 cadets), martial arts (group IV - 12 cadets). The cadets who participated in the research were randomized by age, anthropometric, and general health.

Testing was conducted during the first week of training (ie 01.09.2018 - 08.09.2018).

To solve the purpose and objectives of the research, we selected and systematized nine tests, the indicators of which characterize the coordination abilities of the subjects [6]. A feature or criterion of evaluation, which was chosen as the basis for the selection and systematization of tests for measuring and evaluating coordination abilities, was the definition of sensorimotor coordination as an integrated indicator of the functioning of sensory systems of the body [10].

The following tests were selected:

1. Test 1 - study of static balance of the body (Biryuk test). Performing the exercise: vertical stand on high toes, feet closed, arms up, eyes closed. Fix the position of the body for a long time (without getting up);

2. Test 2 - a study to assess vestibular sustainability in terms of dynamic equilibrium (Barany test). Exercise: sitting in Barany chair, head tilted to his chest (30 °), eyes closed. Perform ten turns of the chair clockwise for 10 seconds. After stopping the chair, get up and walk in a straight line of five meters, look in front of you, hands down. The arithmetic mean of the sum of six deviations of the body to the left and right of a straight line (cm) is calculated;

3. Test 3 - study of statodynamic sustainability of the body (test with forward tilts). Performing the exercise: squatting from the stop, perform five forward throws in the group for 5 s, followed by ten jumps on the spot, as high as possible, in the center of the circular calibration. Jumps are performed with closed feet, hands on the waist, looking forward. The arithmetic mean of the three largest deviations from the center of circular calibration was estimated;

4. Test 4 - a study of the level of development of coordination skills (coordination test in difficult conditions). Performing coordination exercises - from the starting position of the main rack: 1. Left hand on the belt. 2. Right hand on the belt. 3. Left hand-in-hand. 4. Right hand-in-hand. 5. Left hand up. 6. Right hand up. 7 - 8. Two applause. 1 - 6. Move your hands down in reverse order. 7 - 8. Two claps of the hands on the thighs. The exercise was evaluated by experts on a ten-point scale. For each incorrectly performed movement subtraction of 0.5 points was carried out;

5. Test 5 - study of spatial orientation in conditions of short-term weightlessness and proprioceptive sensitivity in changed conditions (test of spatial orientation). Exercise: Squeeze the dynamometer with a comfortable hand with a force of 200 N. Three attempts to perform with visual control and three attempts - without visual control when performing a deep jump with the adoption of a straight body position from a height of 3 m and hanging on bent legs at the top poles of bars of various height. Predominant irritation of the otolith analyzer. Assessment: the average of the three attempts should not exceed 10 N;

6. Test 6 - study of stable landing when performing a deep jump (landing test). Exercise: jump from a height of 3 m take a straight position of the body in the center of the circle on soft mats. The quality of landing and the nature of errors when landing on a 10-point scale were determined: a small error of 0.2 points, medium - 0.5 points, fall - 1 point. Score: average of three attempts;

7. Test 7 - study of dynamic equilibrium when passing the perimeter of a polygon (dynamic equilibrium test). Exercise: stand on one of the faces of the polygon, put your hands on your waist and start moving along the faces. Perform each step on only one side, look ahead. Movement is carried out until the first loss of balance (movement of hands, torso, touching the foot with support). ± The number of passed faces is taken into account.

Methods of parametric statistics were used to process the obtained data (Glanz S., 1999). Statistical processing of data entered in Excel spreadsheets was performed. Quantitative characteristics of the main functional indicators were processed statistically, namely, determined the arithmetic mean, the error of the mean. The significance of the obtained data was checked using Student's t-test (for $n < 100$) at a given level of reliability $p = 0.95$. To be able to use the Student's t test, the Fischer-Snedekor test was calculated - the ratio of the larger variance to the smaller. All mathematical operations and graphical constructions were performed using the software packages "Microsoft Office XP": "Microsoft XP Home" and "Microsoft Excel XP" on a personal computer (license numbers: 00049 153 409 442 and 74017 640 0000106 57664, respectively).

Results of the research

During the statistical analysis, the obtained data were entered into a table, on the basis of which a diagram of the dependence of the initial sensorimotor abilities of the subjects on sports activities, which was in them on the eve of admission to the university: game (group I - 12 cadets), cyclic 14 cadets), complex coordination (group III - 10 cadets) and martial arts (group IV - 12 cadets) (Tables 1, 2).

Table 1

The results of the initial testing of first-year cadets with the definition of sensorimotor parameters, + m

№	Test	Group I (n_1=12)	Group II (n_2=14)	Group III (n_3=10)	Group IV (n_4=12)
1	Test 1, c.	7,11±0,42	7,61±1,72	8,48±0,37	7,42±1,61
	Test 1: t, p	$t_{1,2}$=1,53 ($p_{1,2}$>0,05); **$t_{1,3}$=2,45 ($p_{1,3}$<0,05);** $t_{1,4}$=1,62 ($p_{1,4}$>0,05); $t_{2,3}$=1,32($p_{2,3}$>0,05); $t_{2,4}$=1,48 ($p_{2,4}$>0,05); $t_{3,4}$=0,52 ($p_{3,4}$>0,05)			
2	Test 2, см	20,41±1,42	18,24±1,81	12,17±1,67	14,21±1,26
	Test 2: t, p	$t_{1,2}$=1,63 ($p_{1,2}$>0,05); **$t_{1,3}$=3,76 ($p_{1,3}$<0,01); $t_{1,4}$=3,26 ($p_{1,4}$<0,01); $t_{2,3}$=2,47 ($p_{2,3}$<0,05); $t_{2,4}$=2,75 ($p_{2,4}$<0,05);** $t_{3,4}$=1,51 ($p_{3,4}$>0,05)			
3	Test 3, см	24,62±2,72	22,8±2,10	14,31±1,64	13,94±1,92
	Test 3: t, p	$t_{1,2}$=0,53 $p_{1,2}$>0,05; **$t_{1,3}$=3,24 $p_{1,3}$<0,05; $t_{1,4}$=3,22 $p_{1,4}$<0,01; $t_{2,3}$=3,19 $p_{2,3}$<0,01; $t_{2,4}$=2,41 $p_{2,4}$<0,05;** $t_{3,4}$=0,34 $p_{3,4}$>0,05			
4	Test 4, бали	9,72±0,47	9,81±0,74	9,86±0,27	9,81±0,24
	Test 4: t, p	$t_{1,2}$=0,10 ($p_{1,2}$>0,05); $t_{1,3}$=1,41 ($p_{1,3}$>0,05); $t_{1,4}$=0.28 ($p_{1,4}$>0,05); $t_{2,3}$=0,22 ($p_{2,3}$>0,05); $t_{2,4}$=0,12 ($p_{2,4}$>0,05); $t_{3,4}$=0,66 ($p_{3,4}$>0,05)			
5	Test 5, N	218,17±6,81	221,49±6,40	204,31±4,60	206,82±6,44
	Test 5: t, p	$t_{1,2}$=0,31 ($p_{1,2}$>0,05); **$t_{1,3}$=2,57 ($p_{1,3}$<0,05);** $t_{1,4}$=1,62 ($p_{1,4}$>0,05); **$t_{2,3}$=2,18 ($p_{2,3}$<0,05);** $t_{2,4}$=1,42 ($p_{2,4}$>0,05); $t_{3,4}$=0,38 ($p_{3,4}$>0,05)			

When analyzing the data in Table 1, during the assessment of static balance by Biryuk breakdown, it was determined that the most effective was the possession of body stability in the subjects of group III, i.e. cadets who trained in complex coordination sports, which was 8.48 ± 0.37 s., The worst were the figures of this indicator in group I - game sports - 7.11 ± 0.42 s., Which indicates the mandatory additional inclusion in the training process for cadets of this group of exercises to improve stability body.

Table 2

The results of the initial testing of first-year cadets with the definition of sensorimotor parameters, abs. (%)

№	Test	Group I (n_1=12)	Group II (n_2=14)	Group III (n_3=10)	Group IV (n_4=12)
1	**Landing test (Test 6)**				
	- a small mistake	7(58%)	8(57%)	9(90%)	9(75%)
	- average error	4(34%)	4(29%)	1(10%)	3(25%)
	- fall	1(8%)	2(14%)	0	0
2	**Dynamic equilibrium test (Test 7)**				
	- 0-14 circles	0	0	0	0
	- 15-29 circles	2(16%)	4(28%)	1(10%)	5(41%)
	- 30-45 circles	10(84%)	10(72%)	9(90%)	7(59%)

In determining the vestibular sustainability on the breakdown of Barany, it was determined that, despite the high achievements in sports on the eve of admission to the university, in the vast majority of all studied after turns there is a discoordination of vertical body position: the worst indicators were in group I - playing sports (20 , 41 ± 1.42 cm), and group II cyclic sports (18.24 ± 1.81 cm), the best in group III - complex coordination sports (12.17 ± 1.67 cm) and group IV - martial arts (14.21 ± 1.26 cm). Thus, vestibular sustainability, as an important element of overcoming the obstacle course and orienteering, at the initial level of cadets aspiring to the national team in international military aeronautical pentathlon is compromised and requires additional introduction into the training process of exercises that would affect its further development and improvement.

In turn, the vestibular load, which we determined during the experiment on the breakdown with forward rolls, also determined a large difference in performance between groups, which depended on the type of sports activity the day before. Thus, the worst dynamic sustainability was determined in groups I and II, where after five twists the subjects were unable to perform ten jumps in the center of the graduated circle and jumped out of it and made a fall at a distance of 24.62 ± 2.72 cm and 22 , 8 ± 2.10 cm, respectively. In groups III and IV, this figure was 14.31 ± 1.64 cm and 13.94 ± 1.92 cm, respectively, which is better than in cadets of groups I and II. Thus,

it can be noted that game and cyclic sports to a lesser extent develop adaptation to the vestibular load than complex coordination and martial arts. Given the difference between the indicators of groups I and II from the indicators for this breakdown in groups III and IV, it is important to introduce additional exercises into the training process, which would increase the resistance of athletes to vestibular load.

When determining the level of development of coordination skills when performing a test for coordination in difficult conditions, take into account the level of average and above average, as low level of development of these abilities cannot be at all when achieving high results in sports regardless of its type [10]. Therefore, during the analysis of this indicator in the studied all four groups a high level of coordination abilities was determined, the figures in groups I, II, III and IV were 9.72 ± 0.47 points, 9.81 ± 0.74 points, 9.86 ± 0.27 points and 9.81 ± 0.24 points, respectively, without any differences between them. Thus, it can be noted that during the training process, given the initial level of this indicator as high, there is no need for additional introduction of special exercises that would affect the development of coordination skills, i.e. when planning an algorithm for training an athlete in international military aeronautical pentathlon these abilities only need to be improved.

During the tests to determine the ability of spatial orientation, the subjects of groups I and II made excessive muscle effort, which is confirmed by exceeding them by more than 10% of 200 N - 218.17 ± 6.81 N and 221.49 ± 8 , 40 N, respectively. In the studied groups III and IV, these indicators were 204.31 ± 8.60 N and 206.82 ± 8.44 N, which coincides with the possible deviation and meets the standard. Therefore, athletes who have achieved achievements in game and cyclic sports the day before, when intending to be a member of the national team in international military aeronautical pentathlon, should pay attention to increasing the level of adaptation to spatial orientation.

Data from the results of a complicated coordination test show that the best indicators of stable landing when performing a deep jump in groups III and IV, where a small error was found in 90% and 75% of cadets, respectively, in groups I and II a

small error was in 58% and 57% of subjects, respectively. Only cadets of groups I and II had falls, 8% and 14% of them. But the exaggeration of the number of cadets in each of the groups, who almost did not make a mistake when performing a complex test for coordination confirms the preliminary data that indicate the need for additional introduction of special exercises that would affect the development of coordination skills in the main training program military aeronautical pentathlon.

In the analysis of dynamic equilibrium during the passage of the faces of the polygon, in contrast to the data of the previous test, the worst indicators were in the subjects of group IV, where the maximum number of circles (30-45) passed only 59% of them. At the same time, in group III this indicator was the highest - 90% of cadets overcame the maximum number of laps. In groups I and II the data were identical, the greatest distance was covered by 84% and 72% of cadets, respectively.

Conclusions / Discussion

Given the heterogeneity of the starting capabilities of the body of athletes in determining the composition of the national team in military aeronautical pentathlon, it was determined that the selection for the team requires a more thorough assessment the day before. Although the results of the initial analysis confirm the importance of each of the categories of sports (game, cyclic, complex coordination, martial arts), it is important to determine the modal characteristics of the components of training, comparison with the results for each category of sports and development of training programs for each group. categories) of athletes to increase their performance in accordance with the modal.

Introduction of sensorimotor-coordination abilities testing to the national team of international military aeronautical pentathlon during the process of selection of athletes is an important point in determining the appropriate algorithm for further training. The data that provide the most objective assessment of the athlete's abilities depending on the sporting achievements the day before (sport) provide an opportunity to timely and maximally promote the inclusion of the athlete in the training process to prepare for international military aeronautical pentathlon. Overcoming the obstacle course and sports orientation requires the presence of the maximum number of

sensorimotor qualities in one athlete per unit time, thus being the most demanding stage of training.

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References

1. Shchegolev, V. A., Sivak, A. N., Kochin, A. A. and Egorov, V. Yu. (2016), "Training specialist's military physical profile in the armed forces of the leading NATO", Teoriya i praktika fizicheskoj kul`tury`, No. 2, pp. 61-66. (in Russ.)
2. Sushchenko, V. P., Shchegolev, V. A. and Korshunov, A. V. (2016)? "Pedagogical features of the personal and professional development of different categories of specialists in physical culture and sport", Teoriya i praktika fizicheskoj kul`tury, No. 6, pp. 3-6. (in Russ.)
3. Shchegolev, V. A., Zykov A. V. and Trapeznikov, S. A. (2015), "Theoretical and methodical aspects of education of cadets with use of means of physical training and sport", Aktual`ny`e problemy` fizicheskoj i speczial`noj podgotovki silovy`kh struktur, No. 4, pp. 44-51. (in Russ.)
4. Osadchenco, I. V. and Cherepanova, I. O. (2017), "Development of balance and coordination abilities among the young skaters", Olympic games and modern society: IV Vserossijskoj nauchno-prakticheskoj konferenczii s mezhdunarodny`m uchastiem - IV All-Russian scientific and practical conference with international participation (pp. 172-178). Malakhovka. (in Russ.)
5. Korostelev, S. Yu., Komrakov, N. Yu. and Dmitriev, A. A. (2017), "At the sources of the development of characteristics of vulnerability of air targets", Voennaya My`sl`: Moscow, No. 12, pp. 12. (in Russ.)
6. Laktionova ,T. I. and Krotikov, N. V. (2017), "Typological features of the functional state of central nervous system and higher nervous activity of skilled hockey players", Nauka i sport: sovremenny`e tendenczii, Vol. 16, No. 3, pp. 33-38. (in Russ.)
7. Rumiantseva, E. R., Tokmakova, N. Iu. and Ovchinnikov, A. V. (2017), "Training coordination abilities of hockey players with hearing impairments in initial

specialization groups", Izvestiia TulGU Fizicheskaia kultura. Sport, No. 4, pp. 187-192. (in Russ.)
8. Sliva, A. S., Podoprigora, R. V. and Pereiaslov, G. A.(2014), "Using Stabilan–01 stabiloanalyzer for refi nement of sport skills", Inzhenernyi vestnik Dona, No. 4, pp. 2. (in Russ.)
9. Zankovets, V. E. and Popov, V. P. (2015) "Control of coordination abilities of the players", Vestnik Kemerovskogo Gosudarstvennogo Universiteta, No. 4 (64), pp. 32–37. (in Russ.)
10. Mishyn, M., Kamaiev, O., Mulyk, V., Taran, L., Grashchenkova, Z., Tarasevich, O. et al. (2018), "Problems and features of technique in the development of coordination abilities of players specializing in wheelchair basketball", Journal of Physical Education and Sport, 18 Suppl. №2, pp. 1016–1020. (in Eng.).

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