

**ISSN 2311-6374**

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
KHARKIV STATE ACADEMY OF PHYSICAL CULTURE**

**SLOBOZHANSKYI  
HERALD  
OF SCIENCE AND SPORT**

**Scientific and theoretical journal**

Published 6 times in a year  
English ed. Online published in October 2013

**Volum 7 No. 4(72)**

Kharkiv  
Kharkiv State Academy of Physical Culture  
2019

P 48

UDC 796.011(055)"540.3"

Slobozhanskyi herald of science and sport : [scientific and theoretical journal]. – Kharkiv :  
KhSAPC. 2019, Vol. 7 No. 4(72), 54 p.

English version of the journal “**SLOBOZANS`KIJ NAUKOVO-SPORTIVNIJ VISNIK**”

The journal includes articles which are reflecting the materials of modern scientific researches in the  
field of physical culture and sports.

The journal is intended for teachers, coaches, athletes, postgraduates, doctoral students research  
workers and other industry experts.

**Contents Themes:**

1. Physical education of different population groups.
2. Improving the training of athletes of different qualification.
3. Biomedical Aspects of Physical Education and Sports.
4. Human health, physical rehabilitation and physical recreation.
5. Biomechanical and informational tools and technologies in physical education and sport.
6. Management, psychological-educational, sociological and philosophical aspects of physical education and sport.

Publication of Kharkiv State Academy of Physical Culture  
Publication language – English.

**ISSN (English ed. Online) 2311-6374**

**ISSN (Ukrainian ed. Print) 1991-0177**

**ISSN (Ukrainian ed. Online) 1999-818X**

Key title: Slobozhanskyi herald of science and sport

Abbreviated key title: Slobozhanskyi her. sci. sport

© Kharkiv State Academy of  
Physical Culture, 2019



# SLOBOZHANSKYI HERALD OF SCIENCE AND SPORT

Scientific and Theoretical Journal

Volum 7 No. 4(72), 2019

## Editor in Chief

**Anatoliy Rovnyi**, Doctor of Science (Physical Education and Sport), Professor, Academician of International Academy of Human Problems in Aviation and Aerospace (Kharkiv State Academy of Physical Culture, Ukraine)

## Editorial board:

**Oleksandr Azhippo**, Doctor of Science (Pedagogical), Professor (Kharkiv State Academy of Physical Culture, Ukraine)

**Volodymyr Ashanin**, PhD (Mathematics and Physics), Professor, Academician ANPRE (Kharkiv State Academy of Physical Culture, Ukraine)

**Eugeny Vrublevskiy**, Doctor of Science (Pedagogical), Professor, Francisk Scorina Gomel State University (Belarus)

**Valeriy Druz**, Doctor of Science (Biology), Professor (Kharkiv State Academy of Physical Culture, Ukraine)

**Oleg Kamaev**, Doctor of Science (Physical Education and Sport), Professor (Kharkiv State Academy of Physical Culture, Ukraine)

**Lesia Korobeynikova**, Doctor of Science (Biology), Professor (National University of Physical Education and Sport of Ukraine, Ukraine)

**Viacheslav Mulyk**, Doctor of Science (Physical Education and Sport), Professor (Kharkiv State Academy of Physical Culture, Ukraine)

**Ieonid Podrigalo**, Doctor of Science (Medicine), Professor (Kharkiv State Academy of Physical Culture, Ukraine)

**Yevhen Prystupa**, Doctor of Science (Pedagogical), Professor (Lviv State University of Physical Culture, Ukraine)

**Wojciech Czarny**, Doctor of Science (Physical Culture), Professor (Uniwersytet Rzeszowski, Polska/ Poland)

**Liudmyla Shesterova**, PhD (Physical Education and Sport), Professor (Kharkiv State Academy of Physical Culture, Ukraine)

**Yuliya Kalmykova**, PhD (Physical Therapy), Associate Professor, Kharkiv State Academy of Physical Culture, Ukraine

**Mosab Saleem Hamed Amoudi**, PhD (Physical Therapy), Arab American university, Jenin, Palestine

**Mohammed Zerf**, PhD, Physical Education Institut University Abdelhamid Ibn Badis de Mostaganem, Mostaganem, Algeria

## CONTENT

### **Mariia Aravitska**

Determining the effectiveness of the physical therapy program for obese patients according to the dynamics of metabolic syndrome parameters .....4-8

### **Galyna Artemyeva & Maryna Khorkova**

Features of the formation of biochemical mechanisms of energy supply in the process of endurance development female athletes in sports aerobics .....9-12

### **Tetiana Bala & Anhelina Petrova**

Analysis of the attitude of high school students to innovative types of motor activity in the system of school physical education .....13-16

### **Olena Bismak**

Assessment of functional disorders of the upper limb in individuals with carpal tunnel syndrome .....17-21

### **Taras Bondar & Iryna Holoviichuk**

Students' understanding of physical culture and sports as a factor of health protection .....22-25

### **Taras Bondar & Iryna Holoviichuk**

Physical activity of adolescents in health and recreation facilities: motives and interests .....26-29

### **Alfiya Deyneko & Olha Riabchenko**

Optimization of the training method for the turns of young gymnasts, taking into account the level of development of the ability to maintain balance .....30-34

### **Vladimir Favoritov & Vadim Gostishchev**

Assessment of the effectiveness of biological and pharmacological support for training at the preparatory stage for handball players .....35-38

### **Larysa Ruban, Oleksandr Khatsaiuk, Oleh Yareshchenko, Artem Korolov & Viacheslav Olenchenko**

Vegetative reactivity in athletes in a state of overtraining .....39-42

### **Marina Sannikova**

Legal regulation of labor of specialists in the field of physical education and sports in Ukraine .....43-47

### **Liliia Sheiko**

Innovative programs for recreational swimming and their impact on the physical development of women 30-40 years old .....48-52

# Determining the effectiveness of the physical therapy program for obese patients according to the dynamics of metabolic syndrome parameters

**Mariia Aravitska**

Vasyl Stefanyk Precarpathian National University,  
Ivano-Frankivsk, Ukraine

**Purpose:** to determine the effectiveness of the physical therapy program for obese patients by the dynamics of the components of the metabolic syndrome.

**Material & Methods:** 214 people of the second adulthood with obesity I and II degree were examined. In terms of compliance, they were divided into a comparison group (low level) and a main group (high level). The control group consisted of 63 people without signs of obesity. The components of the metabolic syndrome were evaluated by anthropometric indicators (body mass index, waist and hip circumference, their ratio) and biochemical parameters (blood glucose, cholesterol, triglycerides, high density lipoproteins, leptin), and the visceral obesity index was calculated. The examination was carried out before and after the introduction of the annual program of physical therapy, which included maintaining a high level of compliance, increasing physical activity, changing the diet, reflexology, massage, and psychocorrection.

**Results:** in all obese individuals were determined by abdominal obesity, fasting hyperglycemia and impaired glucose tolerance, high levels of total cholesterol, triglycerides, leptin, low levels of low-density lipoproteins. The visceral obesity index exceeded those of people with normal body weight ( $p < 0,05$ ). Compliance with the principles of the developed program made it possible to achieve a statistically significant ( $p < 0,05$ ) improvement relative to the initial indicators of all the studied parameters of the persons of the main group. Patients in the comparison group showed an increase in body mass index, a tendency to deteriorate atherogenic dyslipidemia and glucose uptake, a high content of leptin.

**Conclusions:** as a result of the implementation of the developed program of physical therapy, a statistically significant improvement in the studied parameters of the metabolic syndrome in obese patients was compared with the initial result and the comparison group.

**Keywords:** metabolic syndrome; obesity; physical therapy; rehabilitation.

## Introduction

According to the World Health Organization (WHO), a global public health problem among diseases of eating disorders is obesity and overweight, which are considered an epidemic of the XXI century, because now they have more than 1,6 billion people on Earth; every 10 years their number increases by 10% [13]. 80% of all diseases to one degree or another are associated with malnutrition, and 41% is their direct consequence. The urgency of the problem of these conditions is justified by the high prevalence, increased disability and mortality from related disorders [10; 12].

The concept of "metabolic syndrome" (MS) was proposed to highlight a cluster of individuals at increased risk of developing cardiovascular disease and type 2 diabetes. In all definitions of MS, the main criterion is considered to be central (abdominal) obesity, that is, we are talking about options for its combination with an increased level of low density lipoproteins (LDL), triglycerides (TG), a decrease in the concentration of high density lipoproteins (HDL), high blood pressure, disorders carbohydrate metabolism (all of them belong to additional criteria of MS) [6; 7].

Like obesity, MS is characterized by an increase in the mass of visceral fat, a decrease in the sensitivity of peripheral tissues to insulin and hyperinsulinemia, the development of disorders of carbohydrate, lipid, purine metabolism, arterial hypertension, microalbuminuria, an increase in the level of fibrinogen,

a highly sensitive C-reactive protein, interleukins 1, 6, 18, tumor necrosis factor, leptin and a decrease in adiponectin levels. It was determined that people with overweight have a 50% higher risk of developing hypertension than people with normal body weight, and the risk of developing diabetes is 4,0–6,0 times higher; Also, the risk of developing fatty liver, digestive, respiratory, musculoskeletal, neoplasms, etc. [6; 9].

Both conditions – obesity and MS – have similar pathogenetic mechanisms and clinical manifestations. In practice, this means that without obesity it is not MS, but the etiopathogenetic correction of its individual signs that must necessarily include a decrease in the amount of abdominal fat. Directions of the correction of MS aimed at stabilizing the main links of the metabolic chain, combined by common components of pathogenesis, drug and non-drug measures. Among the latter, lifestyle modification, hypocaloric nutrition, and the expansion of physical activity occupy a prominent place [2–5], which also echoes the correction of excess body weight [9; 11; 12].

The problem of reducing body weight is that, despite the well-known methods of its correction (creating a deficit between the intake and consumption of energy compounds through hypocaloric nutrition and an increase in physical activity) [9; 10; 12], the results of conducting rehabilitation programs are not always satisfactory due to non-compliance with the recommendations provided by patients – a low level of adher-

ence to treatment or low compliance) [13]. Thus, the creation of a program for reducing body weight in obese patients with elements of overcoming non-compliance and assessing its effectiveness in terms of the dynamics of MS components is an urgent issue in modern physical therapy.

**Purpose of the study:** to determine the effectiveness of the PT program for obese patients by the dynamics of the components of MS.

## Material and Methods of the research

The study was based on a survey of 214 people of the second adulthood with nutritional and constitutional obesity: I degree – 65 women and 51 people; II degree – 64 women and 34 men. The control group (CG) consisted of 63 people with normal body weight (32 women, 31 people). The average age of the examined with obesity was  $39,6 \pm 1,6$  years, and the CG –  $41,3 \pm 2,6$  years. According to the results of determining rehabilitation compliance (consent to the implementation of rehabilitation recommendations), patients were divided into two parts. The comparison group (CG – depending on the degree of obesity according to CG1 and CG2) consisted of individuals with a low level of compliance; they refused to undergo the PT program to reduce body weight, but were informed about the consequences and complications of obesity; acquainted with the basic principles of hypocaloric nutrition and physical activity with it. The main group (MG, in accordance with the degree of obesity of MG1 and MG2) consisted of individuals with a high level of compliance, they underwent the PT program for one year and included the following components:

- constant support and improvement of the compliance level, which is the key to patient compliance with the developed PT program (adapting the program to individual social conditions; educational conversations; psychological support; regular

personal and electronic consultations; setting and achieving short and long-term goals of PT) [1];

- the gradual development of a long stereotype of a healthy diet (by optimizing calories and diet)

- Increase in physical and physical activity (morning hygienic gymnastics, stretching, cardio, strength training);

- Corporate and auricular acupuncture (in order to suppress feelings of hunger and thirst, reduce the degree of discomfort during the period of limiting nutrition, improve the functioning of internal organs);

- massage (lymphatic drainage, general, abdominal cavity) in order to accelerate the removal of excess fluid, recovery after training, improve the functioning of the abdominal organs;

- psychological support (improvement of the psychoemotional state, behavioral psychocorrection, development of a conscious active attitude to the process of losing weight).

The main principle of creating the program was an individual approach, taking into account the possibilities, concomitant diseases, the psycho-emotional state of the patient with constant monitoring of the state of body functions against the background of maintaining a high level of compliance.

As the main criteria for MS in this study, according to the recommendations of the International Diabetes Association [6; 7], considered a combination of abdominal obesity (a mandatory criterion) (according to the ratio of waist circumference (WC) and hips (HC)) and a high content of TG, fasting hyperglycemia, and a decrease in HDL content. Additional criteria were considered impaired glucose tolerance (according to the results of a 2-hour exercise test), high levels of leptin,

**Table 1**  
**Dynamics of anthropometric parameters under the influence of the PT program ( $\bar{X} \pm S$ )**

Indicators	CG n=63	Obesity I degree				Obesity II degree			
		CG1 before n=60	CG1 after n=60	MG1 after PT n=56	MG1 after PT n=56	CG2 before n=57	CG2 after n=57	MG2 after PT n=41	MG2 after PT n=41
<b>BMI</b>									
men	23,9±0,8	31,4±0,6*	32,6±0,5*	31,4±0,4*	25,0±0,2●	36,2±0,7*	36,8±0,5*	38,0±0,3*	30,2±0,2**●
women	22,4±1,1	31,8±0,4*	32,2±0,5*	31,9±0,4*	24,1±0,2●	35,6±0,3*	37,4±0,4*	36,4±0,9*	26,2±0,5**●
<b>WC, cm</b>									
men	80,3±1,2	109,7±1,5*	110,5±1,2*	109,1±2,0*	85,9±1,1●	117,3±1,5*	122,8±1,6*	121,6±1,4*	100,6±0,8**●
women	73,5±1,5	93,4±1,1*	95,1±0,9*	93,7±1,2*	76,2±0,8●	106,6±1,3*	112,3±1,8*	112,9±1,3*	93,2±1,0**●
<b>HC, cm</b>									
men	90,6±1,2	112,2±1,6*	114,1±1,5*	110,5±1,4*	98,1±0,5●	120,4±1,2*	125,9±0,8*	122,7±0,6*	104,8±0,9**●
women	97,2±1,2	108,8±1,1*	111,1±0,6*	107,1±1,0*	96,9±1,5●	115,1±1,7*	118,5±1,5*	119,4±1,2*	106,1±0,9**●
<b>WC/HC</b>									
men	0,89±0,07	0,98±0,02	0,97±0,04	0,99±0,03	0,88±0,04●	0,97±0,02	0,98±0,04	0,99±0,03	0,96±0,03
women	0,76±0,05	0,86±0,05	0,86±0,06	0,87±0,04	0,79±0,03●	0,93±0,06	0,95±0,04	0,95±0,03	0,88±0,02●

**Remark.** \* – statistically significant difference compared with the value of the corresponding indicator of CG ( $p < 0,05$ ); \* – statistically significant difference compared with the initial examination indicator (for CG) or the corresponding indicator in PT (for MG) ( $p < 0,05$ ); ● – statistically significant difference compared with the corresponding indicator of CG ( $p < 0,05$ ).

total cholesterol (cholesterol). Biochemical studies were carried out using a CardioChekRA express analyzer. The Visceral Adiposity Index was calculated [8].

Testing was carried out before and after the summer observation period (persons CG) or the period of implementation of the rehabilitation program (persons MG).

The study participants were acquainted with the main provisions of the study and signed an informed consent to participate in it. The data obtained were processed using Microsoft Excel programs. The arithmetic mean value ( $\bar{X}$ ) and the standard deviation (S) of the studied parameters were calculated. To assess the reliability of the obtained indicators, student criteria were used. The critical level of significance in testing statistical hypotheses in this study was taken equal 0,05.

## Results of the research

In patients with obesity of I and II degrees, abdominal obesity was determined according to the calculation of the ratio of WC to HC (greater than 0,95 in men and 0,80 in women) (Table 1). An increased content of visceral (brown abdominal) fat is considered a predictor of high cardiovascular risk and metabolic disorders [7].

Certain fasting hyperglycemia and impaired glucose tolerance according to the analysis of the glucose profile after a stress test in obese patients indicate insulin resistance and is interpreted as the presence of type 2 diabetes mellitus (Table 2).

In patients with obesity, TG revealed atherogenic dyslipidemia. Dangerously high levels of the threat of developing athero-

sclerosis were characterized by the level of total cholesterol and TG; low levels of LDL cholesterol having an antiatherogenic effect were also identified (Table 2).

In patients with obesity, the levels of leptin, a key mediator between the hypothalamic-pituitary system and adipose tissue, were also characterized by high levels (Table 2). It is a protein that is encoded by the genome in fat cells, causes excessive development of adipose tissue; participates in the processes of regulation of body weight, increases with its increase. Normally, in response to an increase in insulin concentration, the production of leptin also increases, which, by the principle of negative feedback, inhibits further production and release of insulin [7; 12].

Indicative were the results of the calculation of VAI, an integral marker that combines the parameters of WC, BMI, TG, HDL and is a parameter of visceral adipose tissue function and insulin sensitivity [8]. In the presence of obesity, this parameter was several times higher than the value of individuals with normal body weight.

Obesity patients adhering to the principles of the developed PT program against the background of a high level of compliance showed an improvement in all the studied parameters.

With obesity of the first degree, BMI in women was normal, in men it reached the indicator of overweight. In obesity of the II degree, women also achieved a better result: BMI reached the level of overweight, in men – obesity of the I degree (Table 1).

Due to interventions, the amount of abdominal fat in all groups

**Table 2**  
Dynamics of biochemical blood parameters under the influence of the PT program ( $\bar{X} \pm S$ )

Indicators	CG	Obesity I degree				Obesity II degree				
		CG1 before	CG1 after	MG1 after PT	MG1 after PT	CG2 before	CG2 after	MG2 after PT	MG2 after PT	
<b>Glucose, mmol/l</b>										
on an empty stomach	3,92±0,08	5,68±0,03*	5,85±0,02*	5,74±0,06*	4,32±0,02**●	6,16±0,05*	6,47±0,05*	6,08±0,06*	5,18±0,03**●	
after glucose loading	5,17±0,02	7,15±0,06*	7,62±0,05*	7,59±0,08*	6,08±0,03**●	8,09±0,11*	8,22±0,04*	8,15±0,07*	7,32±0,05**●	
Total cholesterol, mmol/l	5,03±0,06	5,95±0,07*	6,15±0,08*	6,08±0,04*	5,12±0,02**●	7,45±0,07*	7,92±0,0*	7,33±0,08*	5,61±0,03**●	
<b>HDL, mmol/l</b>										
men	1,21±0,06	1,02±0,02*	1,05±0,04*	1,05±0,03*	1,17±0,03**●	0,86±0,05*	0,83±0,01*	0,87±0,03*	1,04±0,04**●	
women	1,39±0,08	1,08±0,03*	1,11±0,04*	1,12±0,05*	1,26±0,05*	0,99±0,02*	0,98±0,01*	0,97±0,04*	1,13±0,05**	
TG, mmol/l	1,38±0,07	1,76±0,03*	1,72±0,04*	1,72±0,06*	1,42±0,05**●	2,93±0,07*	3,04±0,09*	2,92±0,06*	2,02±0,05**●	
<b>Leptin, ng/ml</b>										
men	4,13±0,08	16,98±0,09*	16,67±0,06*	17,05±0,05*	10,92±0,04**●	26,39±0,11*	27,15±0,09*	27,91±0,7*	19,37±0,04**●	
women	5,81±0,05	22,58±0,11*	21,31±0,14*	23,08±0,18*	15,63±0,07**●	32,45±1,06*	33,18±0,16*	31,52±0,20*	20,48±0,12**●	
<b>VAI</b>										
men	1,38±0,03	2,44±0,06*	2,24±0,08*	2,30±0,07*	1,53±0,06**●	4,72±0,25*	5,25±0,11*	4,68±0,06*	3,66±0,03**●	
women	1,74±0,05	2,95±0,05*	2,79±0,04*	2,79±0,07*	1,86±0,09**●	5,70±0,06*	6,09±0,06*	6,06±0,08*	3,63±0,04**●	

**Remark.** \* – statistically significant difference compared with the value of the corresponding indicator of CG ( $p < 0,05$ ); \*\* – statistically significant difference compared with the initial examination indicator (for CG) or the corresponding indicator in PT (for MG) ( $p < 0,05$ ); ● – statistically significant difference compared with the corresponding indicator of CG ( $p < 0,05$ )

decreased relative to the initial parameter. In representatives of MG1 they reached normal ratios; in MG2 – statistically significant improved relative to the initial parameters ( $p < 0,05$ ).

Under the influence of the developed measures, the severity of biochemical manifestations of metabolic and dyslipidemic manifestations relative to the parameters of the initial examination decreased in the main groups. Fasting glucose parameters normalized, tissue sensitivity to glucose was restored. Positive changes occurred in the concentrations of atherogenic lipid fractions – total cholesterol, LDL, TG; respectively, improved VAI (Table 2).

In MG1 and MG2, an improvement in the concentration of leptin was determined relative to the initial parameters and the level of CG ( $p < 0,05$ ). However, the lack of full normalization indicates an incomplete metabolic rearrangement of metabolism in adipose tissue. That is, the duration of correction of body weight and its content requires a long intervention than 1 year.

At the same time, in patients of the comparison groups with low compliance there was a visible increase in body weight, a tendency to worsen atherogenic dyslipidemia, that is, signs of MS, and, accordingly, the risk of cardiovascular catastrophes increased.

## Conclusions / Discussion

Obesity is an independent chronic disease with many complications, which in the practice of a physical therapist is advisable to adjust as a separate class. Its correction goes beyond the endocrinological direction and acquires the character of a multidisciplinary pathology. In the framework of obesity, it is advisable to distinguish MS – a complex of individual symptoms that indicate a potentially high risk of cardiac pathology [7].

If the problem of medical compliance with an emphasis on medication is given some attention, the problem of rehabilitation compliance remains poorly understood [3], and data on compliance of patients with obesity are generally absent. obese patients.

Therefore, studies of the effectiveness of the developed rehabilitation programs taking into account the level of compliance is a new look at reducing body weight in the framework of rehabilitation programs.

When correcting the constituent components of MS in the framework of rehabilitation of obese patients, it is necessary to eliminate or reduce the influence of factors acting on its formation (lack of exercise, poor nutrition, smoking, alcohol abuse, psychosocial stress) [2; 4, 6; 7], because an improper lifestyle promotes the manifestation of genetically engineered biological risk factors for MS. It is advisable to correct these aspects in the framework of rehabilitation interventions, which are carried out by a physical therapist. In addition, it is advisable to consider ways of correcting body weight from a position of improving the issues of rehabilitation compliance, because the level of agreement on the implementation of measures is the basis for making progress in rehabilitation and explains the lack of results in some patients.

The results complement and expand information on the need for an integrated approach to body weight correction, in particular, the use of nutrition and physical activity modifications to correct dysmetabolic and dyslipidemic disorders, increase the risk of cardiovascular complications [7; 9; 13].

A high level of compliance and its maintenance at a sufficient level is a key point for obese patients adhering to recommendations on lifestyle modification and physical activity both independently and as part of a physical therapy program. A decrease in dysmetabolic and dyslipidemic manifestations indicates the sufficient effectiveness of non-drug remedies for body weight correction in obese patients. To achieve indicators of normal body weight and complete normalization of indicators, the duration of rehabilitation of patients with II degree of obesity should be long for one year, and for all patients in this profile, a balanced diet should be maintained for life.

**Prospects for further research** in this direction include a thorough study of the influence of the developed physical therapy program on the state of the cardiovascular system of

**Conflict of interests.** The author declares that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

1. Aravitska, M. (2019), "Analysis of individual ways to improve the compliance of obese patients as an aspect of determining rehabilitation goals", *Ukrayins'kyi zhurnal medytsyny, biolohiyi ta sportu*, tom 4, No. 6 (22), pp. 362-369, doi: 10.26693/jmbs04.06.362. (in Ukr.)
2. Boichuk, T., Aravitska, M., Levandovskyi, O., Tershak, N. & Voichyshyn, L. (2013), "Lifestyle modification as a factor of comprehensive rehabilitation of patients with metabolic syndrome", *Moloda sportyvna nauka Ukrayiny*, No. 17, 3, pp. 25-31, available at: <http://repository.ldufk.edu.ua/handle/34606048/835>. (in Ukr.)
3. Yelnikova, M. (2014), "Physical rehabilitation in metabolic syndrome: from theory to practical implementation", *Moloda sportyvna nauka Ukrayiny*, No. 18 (3), pp. 76-80, available at: <http://repository.ldufk.edu.ua/handle/34606048/374>. (in Ukr.)
4. Korchinskiy, V.S. (2014), "Effectiveness of physical rehabilitation in metabolic syndrome", *Biomedical and biosocial anthropology*, No. 23, pp. 200-203. (in Ukr.)
5. Crook, B.R. (2016), "Physical Rehabilitation of Persons with Metabolic Syndrome as a Factor in Reducing the Risk of Ischemic Stroke", *Naukovyy chasopys NPU imeni M.P. Drahomanova*, 3 (72), pp. 79-81, available at: <http://enpuir.npu.edu.ua/bitstream/123456789/13662/1/Kruk.pdf> (in Ukr.)
6. Alberti, K.G., Zimmet P., Shaw J., IDF Epidemiology Task Force Consensus Group (2005), "The metabolic syndrome – a new worldwide definition", *Lancet*, Sep. 24-30, 366 (9491), pp. 1059-1062.
7. Anderson, P.J., Critchley, J.A., Chan, J.C., Cockram, C.S., Lee, Z.S., Thomas, G.N., et al. (2001), "Factor analysis of the metabolic syndrome: obesity vs insulin resistance as the central abnormality", *Int. J. Obes. Relat. Metab. Disord.*, Dec. 25 (12), pp. 1782-1788.
8. Amato, M.C., Giordano, C., Galia, M., Criscimanna, A., Vitabile, S., Midiri, M., et al. (2010), "Visceral Adiposity Index: a reliable indicator of

visceral fat function associated with cardiometabolic risk", *Diabetes Care*, Apr. 33(4), pp. 920-922, doi: 10.2337/dc09-1825.

9. Cefalu, W.T., Bray, G.A., Home, P.D., Garvey, W.T., Klein, S., Pi-Sunyer, F.X., et al. (2015), "Advances in the Science, Treatment, and Prevention of the Disease of Obesity: Reflections From a Diabetes Care Editors' Expert Forum", *Diabetes Care*, Aug. 38(8), pp. 1567-1582.

10. Garvey, W.T., Mechanick, J.I., Brett, E.M., Garber, A.J., Hurley, D.L., Jastreboff, A.M., et al. (2016), "American association of clinical endocrinologists and American college of endocrinology comprehensive clinical practice guidelines for medical care of patients with obesity", *Endocr Pract.* Jul. 22, Suppl 3, pp. 1-203, doi: 10.4158/EP161365.GL.

11. Lazareva, O., Aravitska, M., Andrieieva, O., Galan, Y. & Dotsyuk, L. (2017), "Dynamics of physical activity status in patients with grade I-III obesity in response to a physical rehabilitation program", *Journal of Physical Education and Sport*, 17(3), pp. 1960-1965, doi:10.7752/jpes.2017.03193.

12. Logue, J., Thompson, L., Romanes, F., Wilson, D.C., Thompson, J. & Sattar, N. (2010), "Guideline Development Group. Management of obesity: summary of SIGN guideline", *BMJ*, Feb 24, 340, pp. 154, doi: 10.1136/bmj.c154.

13. World Health Organization (2003), "Obesity: preventing and managing the global epidemic. Report of a WHO Consultation (WHO Technical Report Series 894)", available at: [http://www.who.int/nutrition/publications/obesity/WHO\\_TRS\\_894/en/](http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/).

Received: 20.07.2019.

Published: 31.08.2019.

## Information about the Authors

---

**Mariia Aravitska:** *PhD (Medicine), Associate Professor of Department of Physical therapy, ergotherapy; Vasyl Stefanyk Precarpathian National University; 57, Shevchenko Str, Ivano-Frankivsk, 76018, Ukraine.*

**ORCID.ORG/0000-0002-3988-1859**

**E-mail: aravmed@i.ua**



# Features of the formation of biochemical mechanisms of energy supply in the process of endurance development female athletes in sports aerobics

Galyna Artemyeva  
Maryna Khorkova

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

*The duration of the competitive program in sports aerobics is about 1.5 minutes, during which the athlete must perform high-intensity complex coordination movements that are combined with acrobatic elements. The implementation of these exercises is necessarily subject to musical accompaniment, which sets the pace of exercise. With the athlete advanced training, the competitive program acquires changes and is saturated with more complex elements. In this regard, the trainers are constantly faced with the task of selecting exercises that would be able to solve the problem of developing the optimal level of endurance, which will allow more technically complete the given exercises. Since sports aerobics is a young sport that is gaining its development, today the basis for many years of training athletes has not yet been formed theoretically. The issues of developing endurance also remain uncertain, and it does not allow coaches to more fully build the training process of their pupils.*

**Purpose:** to find out the features of the formation of biochemical mechanisms of energy supply in the process of endurance development female athletes in sports aerobics.

**Materials & Methods:** the study was organized on the basis of the municipal out-of-school educational institution "Center for Children and Youth Creativity Dream" of the city of Kryvyi Rig, which was attended by 10 female athletes 14–15 years old, at the stage of basic sports training. In the process of the experiment, the following methods were used: theoretical analysis and generalization of scientific and methodological literature; study of documentary materials, video materials of competitions, pedagogical observation, pedagogical testing, methods of mathematical statistics.

**Results:** presented results of a study of the features of the formation of biochemical mechanisms of energy supply in the process of development of endurance athletes in sports aerobics. Experimental data indicate that in the process of developing endurance of athletes in sports aerobics, the efficiency of the glycolytic mechanism of ATP resistance increased, and a positive effect of the proposed funds on the adaptation processes in the test organism during the transition from creatine-phosphate mechanism of energy supply to glycolytic was revealed.

**Conclusions:** compositions in sports aerobics are marked by the complex coordination nature of the exercises, which must also be performed with great intensity and high pace throughout the competition program. Therefore, the development of such a physical quality as endurance is very important for athletes of this sport. The duration of the competitive program in sports aerobics determines the formation of the leading mechanisms of energy supply in the process of endurance development, namely: the efficiency of the glycolytic mechanism of ATP resistance, as well as adaptation processes in the body of athletes during the transition from creatine phosphate to glycolytic mechanisms, increase.

**Keywords:** sports aerobics, endurance, creatine phosphate mechanism of ATP resistance, glycolytic ATP resistance mechanism, energy supply mechanism.

## Introduction

Sports aerobics is a new, modern sport, which in the direction of motor activity is classified as complex coordination, acyclic sports. The competitive program in sports aerobics is represented by a continuous and high-intensity complex of exercises for musical accompaniment with acrobatic and choreographic movements of varying complexity, as well as exercises for strength and flexibility, which requires appropriate physical preparedness [3; 14; 15].

This is a very complex sport, which is an example of extreme physical activity in the zone of mixed (aerobic-anaerobic) energy supply [18].

Despite the fact that compositions in sports aerobics are marked by a complex coordination character, they must also

be performed with great intensity and high pace throughout the entire competitive program. Therefore, when preparing athletes, the trainers are faced with the issue of selecting and including in the training process special exercises for the development of both general and special endurance of athletes.

The foundations of the physiological substantiation of the essence of endurance as the quality of motor activity and the identification of the features of its manifestation in various sports were laid in the works of Yu. V. Verkoshansky [7], V. M. Zatsiorsky [11], V. S. Keller [13] and others specialists. In close connection with the results of these studies, the general principles of endurance were developed, which served as the foundation for the development of various directions for the development of this quality in various sports. These are the works of V. M. Zatsiorsky [11], N. G. Ozolin [20], V. N. Pla-

tonov [21] and others.

According to V. N. Platonov [21], overall endurance should be defined as the ability to perform work of a nonspecific nature for a long and efficient time and creates a positive effect on the formation of specific components of sportsmanship due to increased adaptation to loads and the presence of "transfer" of training from non-specific specific activities. According to the same author, special endurance is the body's ability to perform work and overcome fatigue in conditions determined by the requirements of competitive activity in a particular sport.

The level of development of an athlete's endurance is determined by the energy potential of his body and how it meets the requirements of a particular sport. One of the most important factors affecting the development of endurance of athletes is the effectiveness of energy supply mechanisms, which are formed depending on the characteristics of competitive activity. The formation and dominance of various mechanisms is primarily affected by the duration and intensity of the competitive program.

**Purpose of the study:** to find out the features of the formation of biochemical mechanisms of energy supply in the process of endurance development female athletes in sports aerobics.

**Objectives.** 1. To analyze the data of scientific and methodological literature on the development of endurance in sports aerobics. 2. Given the features of the competitive program, investigate the leading mechanisms that affect the energy supply of the body of female athletes with the development of endurance, and determine the rationality of including funds for its development.

## Material and Methods of the research

The study was organized on the basis of the municipal out-of-school educational institution "Center for Children and Youth Creativity" Dream "of the city of Kriviy Rig, in which 10 female athletes aged 14–15 years participated. In the process of the experiment, the following methods were used: theoretical analysis and generalization of scientific and methodological literature; study of documentary materials, video materials of competitions, pedagogical observation, pedagogical testing, methods of mathematical statistics.

For nine months, during the training sessions, athletes per-

formed sports aerobics exercises that contribute to the development of the studied quality. We used the following methods:

- 1) continuous exercise methods (continuous standardized exercise method, continuous variative exercise method, continuous progressive exercise method, continuous regressive exercise method);
- 2) methods of interval exercise (the method of interval standardized exercise, the method of interval variative exercise, the method of progressive interval exercise, the interval regression exercise method);
- 3) combined exercise methods (the method of continuous-interval standardized exercises, the method of interval-standard progressive exercises, the method of repeated-interval standardized exercises, the method of circular exercises).

Training sessions were held 3 times a week for 90 minutes each.

## Results of the research

In the course of the study, the initial testing of the working capacity of the studied contingent by Ruffier samples and the Harvard step test was carried out, since these indicators are indicators of the development of endurance and reveal the athlete's ability to work of a different nature and form, the basis of which is endurance (Table 1).

According to the initial testing (Table 1), the results of the athletes were distributed by level. In both the IHST and the Ruffier Index, the average score in the study group indicates a good level. IHST=80,5 c. u., IR=6,8 c. u. A high level of uniformity of results can also be noted. (IHST $v$ =5%; IR $v$ =13%).

At the end of the experiment, re-testing was carried out and a comparative analysis of the results of the initial and repeated testing was done, which is reflected in tables 2 and 3.

Analyzing the data presented in Table 2, we can say that the average value of the Harvard step test index during repeated testing increased to an excellent level and amounts to 89,4 c. u. It can be noted that the IHST indicators increased in each athlete in the group. The significance of differences between the results of primary and repeated testing is also traced.  $p < 0,01$  ( $t=4,34$ ).

**Table 1**  
Indicators endurance female athletes (n=10)

Functional tests	The sequence number of the investigated										$\bar{X}$	$\sigma$	$v, \%$
	1	2	3	4	5	6	7	8	9	10			
IHST, c. u.	72	81	78	83	78	87	82	82	84	78	80,5	3,96	5
Ruffier samples, c. u.	7,4	6,2	7,2	7,2	7,4	5,2	6,4	6,4	4,8	6,8	6,5	0,86	13

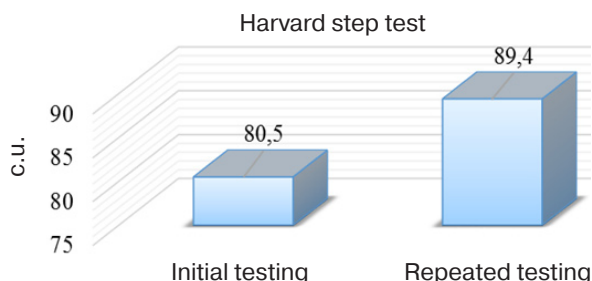
**Table 2**

Comparative analysis of endurance female athletes according to the results of the Harvard step test (n=10)

Test	The sequence number of the investigated										$\bar{X}$	$\sigma$	m	t	P
	1	2	3	4	5	6	7	8	9	10					
Initial testing	72	81	78	83	78	87	82	82	84	78	80,5	3,96	1,4	4,34	<0,01
Repeated testing	82	87	89	92	86	94	90	89	98	87	89,4	4,25	1,5		

**Table 3**  
Comparative analysis of endurance indicators of female athletes according to the results of the Ruffier test (n=10)

Test	The sequence number of the investigated										$\bar{X}$	$\sigma$	m	t	P
	1	2	3	4	5	6	7	8	9	10					
Initial testing	7,4	6,2	7,2	7,2	7,4	5,2	6,4	6,4	4,8	6,8	6,5	0,86	0,3	2,85	<0,05
Repeated testing	5,8	5,4	5,2	5,8	5,8	4,8	5,4	6	4,2	6,2	5,46	0,57	0,2		

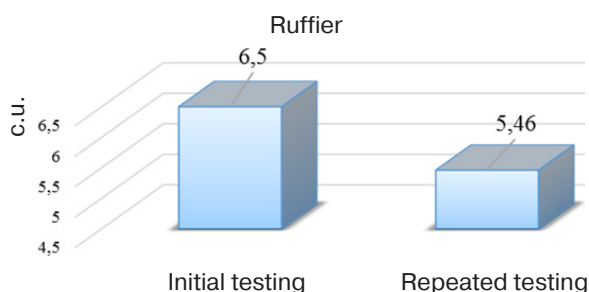


**Fig. 1.** IHST results during the experiment ( $P \leq 0,01$ )

Figure 1 graphically illustrates the increase in performance, Harvard step test.

Analyzing the results presented in table 3, we observe a decrease in the performance of the Ruffier index, which means an improvement in the results. The average index value is 5,46 c. u., which is interpreted as a good level. If we compare the individual results of athletes, we observe an improvement in the results in each of them. The indicators for this breakdown also have significant differences when  $p < 0,05$  ( $t = 2,85$ ).

Graphically, the improvement of the test results for the Ruffier test is presented in Figure 2.



**Fig. 2.** Ruffier test results during the experiment ( $P \leq 0,05$ )

After conducting the experiment, we revealed a change in the test results of varying degrees of reliability (in IGST, changes in the results took place with a degree of reliability of 99%, and in the Ruffier test the reliability of the changes was 95%). This is due to the different nature, structure and timing of the exercises in sports aerobics, therefore, to various energy supply mechanisms. When performing the Harvard step test, the main mechanism of ATP resynthesis is glycolytic, during which muscle glycogen, as well as glucose, are used mainly from the blood. When performing the Ruffier test, energy supply occurs mainly due to the creatine phosphokinase mechanism (within 10–15 s), and then glycolytic is gradually connected. That is, at the beginning of the Ruffier test, ATP resynthesis occurs mainly due to creatine phosphate, and the effectiveness of this process depends on its muscle reserves and the economy of its use.

### Conclusions / Discussion

From the analysis of scientific and methodological literature it was established that today there is too little information that related to the peculiarities of training athletes in sports aerobics in the process of many years of training. Not an exception is the question of a rational combination of means in the process of developing endurance.

It has been established that during exercises aimed at developing endurance in sports aerobics, the leading mechanism that affects the energy supply of the body is glycolytic ATP resynthesis, as well as adaptation processes in the transition from creatine phosphate to glycolytic mechanisms. Therefore, in the process of training for the development of endurance, it is preferable to select funds that affect the increase in the effectiveness of these processes.

**Prospects for further research.** Find out what methods can achieve the most effective impact on the formation of the leading mechanisms of energy supply to achieve a high level of development of special endurance of athletes in sports aerobics, taking into account the features of competitive activity.

**Conflict of interests.** The authors declare that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

### References

- Artemyeva, H. & Moshenska, T. (2017), "Improvement of special physical training of female gymnasts in sports aerobics at the stage of preliminary basic training", *Slobozans'kij naukovo-sportivnij visnik*, No. 6(62), pp.17-20. (in Ukr.)
- Atamanyuk, S.I., Chernenko, K.G. & Atamanyuk, K.V. (2013), "Individualization of the training process of high-skill female athletes in sports aerobics", *Scientific Journal of the National Pedagogical University. MP Dragomanova, "Scientific and pedagogical problems of physical culture / Physical culture and sport": Coll. scientific works, ed. GM Arziutov. K.: NPU them. M. P. Drahomanov*, Issue 4 (29). pp. 53-57. (in Russ.)
- Myakinchenko, E.B. & Shestakova, M.P. (ed.) (2006), *Aerobics: Theory Methodology for conducting classes: a textbook for students of higher education. and medium. spec. training. the established phys. Culture* [Aerobika: teoriya metodika provedeniya zanyatiy: uchebnoe posobie dlya studentov vyssh. i sred. spets. ucheb. zavedeniy fiz. kultury], SportAcademPress, Moscow. (in Russ.)
- FIG (2016), *Aerobic gymnastics. Competition Rules 2016-2020*. (in Russ.)

5. Boliak, A.A. (2002), "New approaches to the process of special physical training in sports aerobics", *Slobozans'kij naukovo-sportivnij visnik*, No. 5, pp. 97-101. (in Russ.)
6. Bolyak, A.A. (2007), *Model characteristics of physical and technical fitness of sports aerobics athletes at the stage of preliminary basic training: PhD thesis abstract* [Modelni kharakteristiki fizichnoi i tekhnichnoi pidgotovlenosti sportsmeniv sportivnoi aerobiki na etapi poperednoi bazovoi pidgotovki: avtoref dis. kand. nauk z fiz. vikhovannya ta sportu], Kharkiv, 22 p. (in Russ.)
7. Verkhoshansky, Y.V. (1988), *Fundamentals of Special Physical Training of Athletes* [Osnovy spetsialnoy fizicheskoy podgotovki sportsmenov], Moscow. (in Russ.)
8. Grishina, M.V. (2009), "Methods of physical training of athletes 9-14 years in sports aerobics", *International Scientific and Practical Conference "Fitness 2009", Sat. materials of conf. (Moscow, November 13, 2009)*, comp. : T.S. Lisitskaya, A.V. Koloditsky, Moscow. (in Russ.)
9. Zavatsky, V.I. (2002), *Course of lectures on physiology* [Kurs lektsiy z fiziologii], in 2 parts: a textbook, Rivne. (in Ukr.)
10. Zaoritsky, V.M. (1984), *Endurance Education. Theory and Methods of Physical Education* [Vospitanie vynoslivosti. Teoriya i metodika fizicheskogo vospitaniya], Vol. 2, Moscow. (in Russ.)
11. Zatsiorsky, V.M. (1966), *Physical qualities of an athlete (basics of theory and methods of education)* [Fizicheskie kachestva sportsmena (osnovy teorii i metodiki vospitaniya)], Moscow. (in Russ.)
12. Kasatkina, N.A. & Nazarenko, L.D. (2011), "Structure and content of reliability of competitive activity in sports aerobics", *Theory and Practice of Phys. Cultures*, No. 9, pp. 77-79. (in Russ.)
13. Keller, B.C. (2010), *Theoretical and methodological bases of athletes training* [Teoretiko-metodicheskie osnovy podgotovki sportsmenov], Norm, Moscow. (in Russ.)
14. Kovshura, T.E. (2011), "Methods of compiling a competitive composition in sports aerobics", *Modern physical and fitness technologies in physical education: Sat. materials of the All-Russian scientific-practical. Conf. Tchaikovsky*, pp. 150-152. (in Russ.)
15. Kokarev, B.V., Atamanyuk, S.I. & Kokareva, S.N. (2014), "Means of complex control of special physical training of qualified athletes in sports aerobics", *Theory and practice of physical training: scientific and methodological journal*, No. 1, pp. 70-77. (in Russ.)
16. Kuramshin, Y.F. (2010) *Theory and Methods of Physical Culture* [Teoriya i metodika fizicheskoy kultury], Moscow. (in Russ.)
17. Matveev, L.P. (2003), *Theory and Methods of Physical Culture: A Textbook. for university students* [Teoriya i metodika fizicheskoy kultury. Vvedenie v predmet], St. Petersburg. (in Russ.)
18. Medvedeva, O.A. (2007), *Fitness aerobics in the student education and training system* [Fitnes-aerobika v sisteme obucheniya i vospitaniya studentov], Moscow. (in Russ.)
19. Moshenskaya, T.V. & Bodrenkova, I.A. (2015), "Special speed-strength training as a basis for improving technical skills in aerobic sports", *Pedagogika, psihologiya medyko-biologichni problem fisychnogo vyhovannya i sportu*, No. 15, pp. 67-73. (in Russ.)
20. Ozolin, N.G. (2004), *Coach's Desk: The Science of Winning* [Nastolnaya kniga trenera: Nauka pobezhdat], Moscow. (in Russ.)
21. Platonov, V.N. (2015), *The system of training athletes in Olympic sports. General theory and its practical applications: a textbook for trainers in 2 books* [Sistema podgotovki sportsmenov v olimpiyskom sporte. Obshchaya teoriya i ee prakticheskie prilozheniya: uchebnik dlya trenerov], Book. 2, Olympic Literature, Kiev. (in Russ.)
22. Rovniy, A.S., Ilyin, V.M., Lizogub, V.S. & Rovna, O.O. (2015), *Physiology of sports activities* [Fiziologiya sportivnoi diyalnosti], Kharkiv. (in Ukr.)
23. Solodkov, A.S. & Sologub, E.B. (2001), *Human Physiology. General. Sports. Age: study. for higher education institutions* [Fiziologiya cheloveka. Obshchaya. Sportivnaya. Vozrastnaya], Moscow. (in Russ.)
24. Tumanyan, G.S. (2006), *The Strategy for the Training of Champions: Coach's Desk* [Strategiya podgotovki chempionov: nastolnaya kniga trenera], Moscow. (in Russ.)

Received: 18.07.2019.

Published: 31.08.2019.

## Information about the Authors

**Galyna Artemyeva:** PhD (Physical Education and Sport), Associate Professor; Kharkiv state Academy of Physical Culture: Klochkivska 99, Kharkiv, 61058, Ukraine.

**ORCID.ORG/0000-0002-6965-4972**

**E-mail: galina9767@gmail.com**

**Maryna Khorkova:** graduate student of the Department of Dance Sports, Fitness and Gymnastics, Kharkov State Academy of Physical Culture, street Klochkovskaya, 99, Kharkov, Kharkov region, Ukraine.

**ORCID.ORG/0000-0001-9474-7110**

**E-mail: marina\_khorkova@i.ua**

# Analysis of the attitude of high school students to innovative types of motor activity in the system of school physical education

Tetiana Bala  
Anhelina Petrova

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

**Purpose:** to study the subjective attitude of high school students to innovative types of motor activity in physical education lessons according to the questionnaire.

**Material & Methods:** theoretical analysis and synthesis of scientific and methodological literature, a survey and methods of mathematical statistics. The study involved 112 students in grades 10–11.

**Results:** it was revealed that the vast majority of schoolchildren are positive about the introduction of CrossFit into the system of school physical education, since students are dissatisfied with the content of existing physical education lessons, the main reason they note the uniformity of the educational material.

**Conclusion:** established a positive attitude of senior students of institutions of general secondary education on the introduction of CrossFit as an innovative means of physical education.

**Keywords:** CrossFit, high school students, system of school physical education, physical education lessons.

## Introduction

Today, the problem of increasing the level of physical preparedness and improving the health of adolescents is becoming increasingly important. Leading experts in the field of physical education note that every year indicators of the level of physical health and fitness of students are significantly reduced [1; 2; 6; 8; 9].

A number of authors note that today a physical education lesson provides on average up to 20% of the required weekly physical activity. Therefore, it is important that students develop a sustained interest in physical exercises and sports, motivate them to have a healthy lifestyle [3; 7; 10–13].

It should be noted that young scientists pay special attention to raising children to introduce innovations in the system of school physical education [2; 4; 5]. The use of innovative technologies allows the teacher to diversify the lesson of physical education, to make it more effective, dynamic, emotionally colored, which will contribute to activity in the classroom and a steady interest of students in physical exercises and sports.

Today, CrossFit is one of the "brands" of fitness classes, which is gaining great popularity among modern youth. Its program includes functional exercises in various sports (kettlebell lifting, weightlifting, gymnastics, rowing, athletics, etc.), which are performed with high intensity.

The uniqueness and uniqueness of CrossFit is that there are many variations of a combination of exercises, mainly a power orientation, and each training session is significantly different from the previous one [2].

**Purpose of the study:** to investigate the subjective attitude of high school students to innovative types of motor activity in

physical education lessons according to the questionnaire.

## Material and Methods of the research

To identify the attitude of senior students to physical education lessons and the introduction of CrossFit in the system of school physical education, a survey was conducted in secondary schools in the city of Kharkiv, in which 112 students of grades 10–11 took part. In the course of the study, the following methods were used: theoretical analysis and synthesis of scientific and methodological literature, a survey and methods of mathematical statistics.

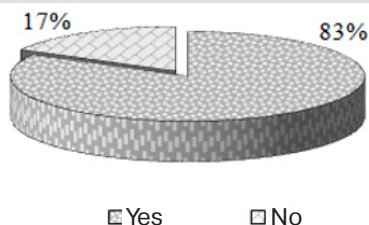
## Results of the research

To achieve the goal, a questionnaire was developed to identify the attitude of high school students of Kharkov secondary schools to physical education lessons and their modernization through the introduction of innovative tools.

Analyzing the answers of respondents, we found that high school students engage in physical education only twice a week. The results of the survey indicate that 56% of students want to increase the number of lessons per week, 44% of students say that two lessons are enough for them (most girls, namely 53%, said they did not want to increase the number of lessons, but 65% of boys, on the contrary, we would like to increase the number of physical education lessons).

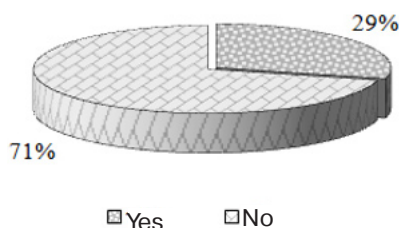
At the same time, we found out that 30% of respondents consider it sufficient to engage in physical education 3 times a week, 27% of students want to attend classes 4 times a week, and only 8% of students expressed a desire to do physical education 5 times or more.

The survey found that the majority of respondents, namely 83%, are happy to attend physical education lessons (Figure 1).



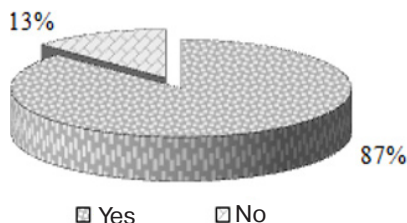
**Fig. 1. "Indicate you are happy to attend physical education lessons?"**

An analysis of the questionnaires showed that the majority of respondents, 71% (73% of girls and 69% of boys) do not agree with the opinion that physical education lessons are necessary only to obtain an assessment and increase the average mark of the certificate, but 29% of respondents agree with the above (Figure 2).



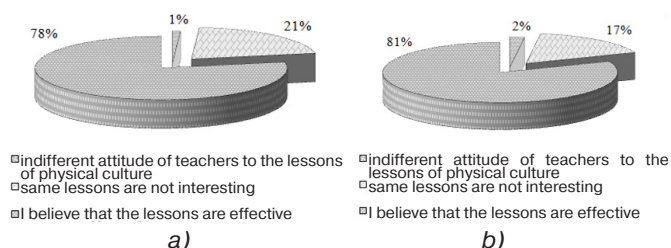
**Fig. 2. Do you agree with the opinion: "Do you need physical education lessons only in order to get an assessment and increase your average score?"**

When analyzing the responses of respondents, 87% (88% of girls and 85% of boys) of students were found to consider physical education lessons useful and contributing to better health (Figure 3).



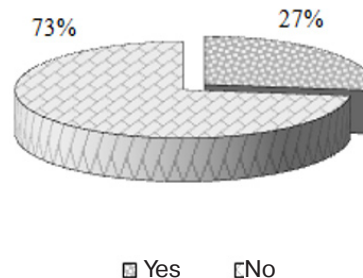
**Fig. 3. "Do you think physical education lessons contribute to your health?"**

Most of the students surveyed (75%) do not consider physical education lessons useful. However, 25% of respondents say that physical education lessons are useful and effective. An analysis of respondents' answers about the reasons why they consider the lessons to be ineffective showed that 73% of students noted the option "not interesting and monotonous" and 2% of schoolchildren noted the indifferent attitude of teachers to their lessons (Fig. 4).

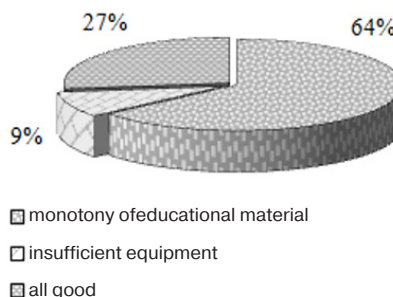


**Fig. 4. Answers of respondents about the reasons why they consider physical education lessons not effective?: a) guys; b) girls**

In the course of the survey, we found that only 27% of respondents were satisfied with physical education lessons, however 73% (68% of girls and 77% of boys) of the respondents noted that they did not like physical education lessons. At the same time, 64% of students say that the monotony of educational material is the reason for dissatisfaction, and 9% of schoolchildren point out the insufficient quantity and variety of equipment (Figure 5–6).

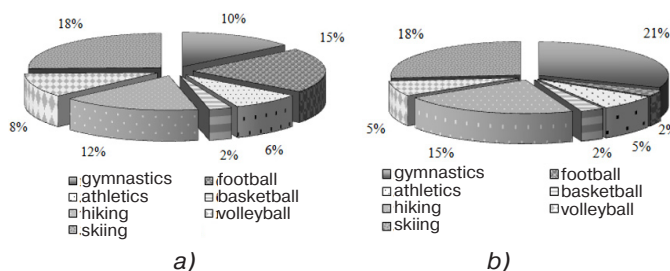


**Fig. 5. Answers of the respondents to the question: "Do you like physical education lessons?"**



**Figure 6. Answers from respondents, for what reasons they do not like the lessons?**

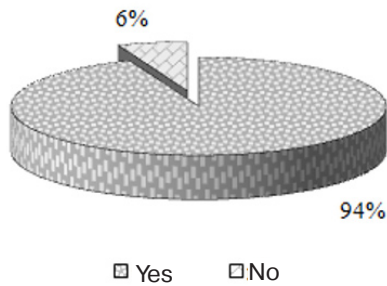
The results of the responses, which reflect the desire of students to change the content of physical education lessons, indicate that the vast majority of students, namely 70%, responded positively, and 30% of respondents said they did not seek changes in the program. At the same time, to the question "What kind of variable modules would you like to exclude?" 18% of respondents noted skiing, 15% indicated gymnastics, 14% expressed a desire to go hiking, 9% – football, 6% – athletics and volleyball, 2% of respondents – basketball (Fig. 7).



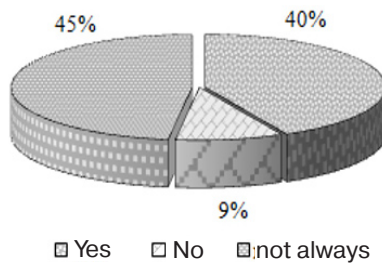
**Fig. 7. Results of the respondents about what types of variable modules they would like to exclude?: a) guys; b) girls**

The survey revealed that the vast majority of students, namely 94%, believe that today it is fashionable and prestigious to engage in physical exercises and sports. When analyzing the answers to the question about students practicing physical exercises and sports, it turned out that 46% of students additionally engaged in physical exercises and sports. However, 45% of respondents noted the answer – "not always" and only

9% noted the option "no" (Fig. 8–9).

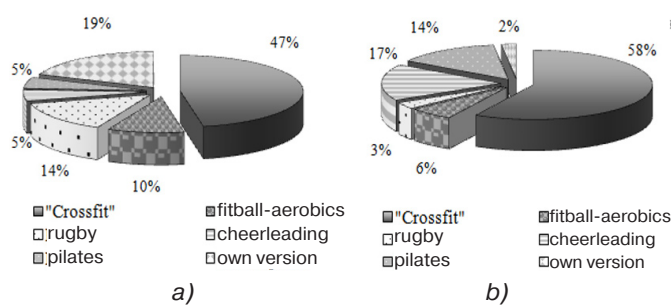


**Fig. 8. Results of respondents' answers to the question: "Do you think that exercise and sports is fashionable and prestigious among modern youth?"**



**Fig. 9. Answers of the respondents to the question: "Do you do physical exercises and sports in your free time?"**

Analyzing the answers of schoolchildren on the popularity of sports among the youth of Ukraine, it was found that the majority, 53% of respondents, noted CrossFit as the most popular sport of our time. Other answers were distributed as follows: 17% of girls and 5% of children noted cheerleading; 6% of students and 10% of students – "fitball-aerobics"; 14% of girls and 5% of children are Pilates; 3% of girls and 14% of boys indicated the option "rugby" and 2% of students and 19% of students wrote their own version, which indicated "martial arts", "table tennis" and "volleyball" (Fig. 10).



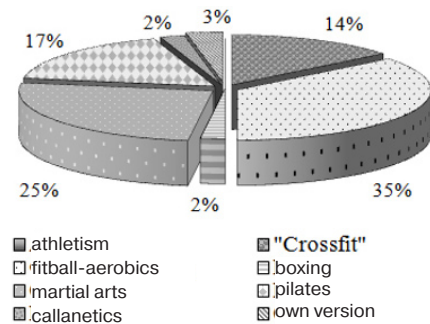
**Fig. 10. Answers of the respondents to the question: "Indicate which sports, in your opinion, are popular among the youth of Ukraine?": a) guys; b) girls**

As a result of the survey, 70% of respondents noted that the introduction of new innovative types of physical activity can positively affect students' attitudes toward physical education lessons.

One of the important aspects of the study was to identify the types of activities that students would like to do in physical education classes.

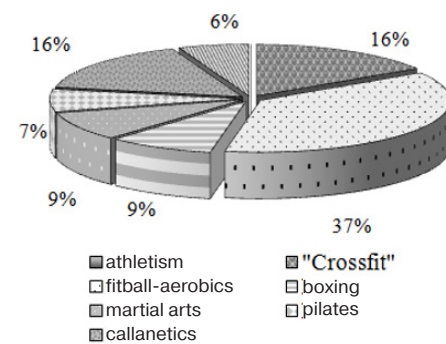
Of the types of motor activity that we proposed, 36% of students expressed a desire to engage in "CrossFit", 17% of those surveyed said "Boxing", 15% of students want to in-

clude "Athletism" in their school curriculum, 12% – "Martial Arts", 9% – "Pilates", 5% of schoolchildren answered "Fitball-aerobics", 4% noted the option "Callanetics" and 2% indicated their option, namely "Aqua-aerobics" (Fig. 11).



**Fig. 11. Answers to the question: "Indicate what new types of variable modules would you include in the school curriculum for physical education?": a) guys; b) girls**

The main aspect of the questionnaire was to identify the interest of schoolchildren in the use of CrossFit exercises in physical education lessons. An analysis of the responses indicates that the vast majority of students, namely 68%, want to engage in this innovative sport (Fig. 12).



**Fig. 12. Answers of the respondents to the question: "Would you like to engage in innovative CrossFit sport in physical education lessons?"**

Thus, the analysis of the results of the survey indicates the advisability of introducing into the educational process for the physical education of high school students new, modern types of motor activity.

## Conclusions / Discussion

As a result of the studies, an unsatisfactory attitude of the majority of students (73%) to the content of physical education lessons was established. The main reason they consider the uniformity of the training material and the lack of sports equipment.

It was determined that a significant number of respondents consider it necessary to introduce new innovative types of motor activity that contribute to the positive attitude of students to physical education lessons.

Based on the analysis of the data obtained, it was found that the majority of students (68%) consider it expedient to include the CrossFit variative module in the system of school physical education, since today it is persistently popular among young people.

Thus, the introduction of CrossFit as an innovation into the system of school physical education is appropriate and relevant, since today it is a sustainable popularity and interest among modern youth. In this regard, the use of crossfit exercises to increase motor activity in the lesson and increase the

interest of students in physical education and sports.

**Prospects for further research** in this direction are to study the effectiveness of the implementation of CrossFit in the system of school physical education.

**Conflict of interests.** The authors declare that no conflict of interest.  
**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

1. Bala, T.M. & Masliak, I.P. (2014), "Dynamics of indices of speed development under the influence of cheerleading exercises", *Visnyk Chernivskoho natsionalnoho pedahohichnoho universytetu imeni T. H. Shevchenka*, Iss. 118, pp. 14-17. (in Ukr.)
2. Bala, T.M. & Svanadze, A.S. (2016), "General Characteristics and Historical Aspects of Crossfit as a Sport", *Fizychna kultura, sport ta zdorovia: stan i perspektyvy v umovakh suchasnoho ukrainskoho derzhavotvorennia v konteksti 25-richchia Nezalezhnosti Ukrainy*, pp. 20-22. (in Ukr.)
3. Kuzmenko, I.O. (2010), "Changing the level of development of individual coordination abilities of middle school students under the influence of specially directed exercises", *Moloda sportyvna nauka Ukrainy*, Iss. 14, Vol. 2, pp. 124-130. (in Ukr.)
4. Kryvoruchko, N. (2017), *Vplyv vprav chyrlidynhu na fizychnyi stan studentiv vyshchykh navchalnykh zakladiv I-II rivnia akredytatsii: avtoref. dys. kand. nauk z fiz. vykhovannia ta sportu, 24.00.02 – fizychna kultura, fizychno vykhovannia riznykh hrup naseleння* [The influence of cheerleading exercises on the physical condition of students of higher education institutions of I-II level of accreditation: PhD thesis abstract], Lviv, 17 p. (in Ukr.)
5. Leonenko, A.V. & Krasilov, A.D. (2017), "Application of innovative technologies in physical education of children and youth", *Molodyi vchenyi*, No. 3.1 (43.1), pp. 190-193. (in Ukr.)
6. Masliak, I.P., Mameshyna, M.A. & Zhuk, V.O. (2014), "The state of use of innovative approaches in physical education of regional general educational institutions", *Slobozhans'kij naukovo-sportivnij visnik*, No. 6(44), pp. 69-72, doi:10.15391/sns.v.2014-6.013. (in Ukr.)
7. Rovnyi, A.S., Ilin, V.M., Lyzohub, V.S. & Rovna, O.O. (2015), *Fiziolohiia sportyvnoi diialnosti* [Physiology of sports activities], KhNADU. (in Ukr.)
8. Shesterova, L.Ye., Kuzmenko, I.O. & Medvedieva, A.L. (2016), "The level of motor readiness of students of grades 7-8", *Aktualni problemy fizychnoho vykhovannia riznykh verstv naseleння*, pp. 221-228. (in Ukr.)
9. Azhyppo, O.Iu. & Kryvoruchko, N.V. (2016), "On the issue of increasing the interest of students in physical education", *II Vseukrainska naukovo-praktychna konferentsiia "Aktualni problemy fizychnoho vykhovannia riznykh verstv naseleння"* [II All-Ukrainian Scientific and Practical Conference "Actual Problems of Physical Education of Different Populations"], pp. 6-11.
10. Ashanin, V.S., Pasko, V.V., Podoliaka, O.B., Rovnyi, A.S. & Yermolaiev, V.K. (2015), "Improving complex special physical training of athletes, rugby players 16-18 years", *Slobozhans'kij naukovo-sportivnij visnik*, No. 1(45), pp. 16-22.
11. Bala T.M. (2015), "Change in the level of strength and endurance development of 5-6 grades pupils under cheerleading exercises influence", *Slobozhans'kij naukovo-sportivnij visnik*, No. 3(47), pp. 14-18, dx.doi.org/10.15391/sns.v.2015-3.003.
12. Martyrosyan, A., Pasko, V., Rovnyi, A., Ashanin, V. & Mukha, V. (2017), "An experimental program for physical education of rugby players at the stage of specialized basic training", *Slobozhans'kij naukovo-sportivnij visnik*, No. 3(59), S.84-91, doi:10.15391/sns.v.2017-3.015.
13. Yarmak, O., Galan, Y., Hakman, A., Dotsyuk, L. & Teslitskyi, Y. (2017), "The use of modern means of health improving fitness during the process of physical education of student youth", *Journal of Physical Education and Sport*, No. 17(3), pp. 1935-1940.

Received: 17.07.2019.

Published: 31.08.2019.

## Information about the Authors

**Tetiana Bala:** PhD (Physical Education and Sport); Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

**ORCID.ORG/0000-0002-5427-6796**

**E-mail:** [tanya.bala2206@gmail.com](mailto:tanya.bala2206@gmail.com)

**Anhelina Petrova:** Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

**ORCID.ORG/0000-0001-6400-8624**

**E-mail:** [petrovaangelina@ukr.net](mailto:petrovaangelina@ukr.net)



# Assessment of functional disorders of the upper limb in individuals with carpal tunnel syndrome

Olena Bismak

National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine

*Carpal tunnel syndrome is the most common form of compression-ischemic neuropathy, found in clinical practice.*

**Purpose:** to evaluate functional disorders of the upper limb in individuals with carpal tunnel syndrome using the Boston questionnaire (Boston Carpal Tunnel Questionnaire, BCTQ).

**Material & Methods:** analysis and synthesis of data from scientific and methodological literature and the Internet information network were used; survey, medical history, mathematical methods. To assess the functional state of the affected upper limb during the initial examination, we used the Boston Carpal Tunnel Questionnaire (BCTQ), which consists of two scales: the Symptom Severity Scale (SSS) and the Function Status Scale (FSS), which was filled by the patient on his own. The study was conducted on the basis of the Kiev City Clinical Hospital No. 4 in the period from 2017 to 2018. The study involved 37 patients with CTS, of which 21 – women (56,8%) people, 16 – men (43,2%) people.

**Results:** analyzed pain and sensory disorders on the scale of symptom severity (Symptom Severity Scale, SSS) and functional disorders on the scale (Function Status Scale, FSS) of the Boston questionnaire. During the initial examination of patients with CTS, we found that mainly moderate (24,3%) and severe pain (37,8%) in the affected upper limb prevailed in patients, which over the past 2 weeks led patients to wake up at night: 1 time – 32,4% of patients, 2–3 times – 29,7% of people. During the day, 29,7% of patients complained of moderate pain in the arm and 43,3% of people were worried about severe pain. Most patients (48,7%) indicated that pain lasts from 10 minutes to 60 minutes. For functional disorders, the greatest difficulties for patients occurred when fastening buttons on clothes – 83,8%, opening a bottle – 86,5% and doing homework – 79,9% of people.

**Conclusion:** an initial examination of patients with carpal tunnel syndrome indicated pain in the affected limb, numbness, decreased sensitivity, muscle weakness on the severity scale of the symptoms of the Boston questionnaire were observed. On the scale of functional impairment, we found difficulties that arose in patients performing everyday activities and self-care.

**Keywords:** carpal tunnel syndrome, neuropathy, questionnaire, functional disorders.

## Introduction

Tunnel neuropathies (tunnel syndromes, compression-ischemic neuropathies, neuropathy / neuralgia traps, trap syndrome – a symptom complex of clinical manifestations (sensory, motor, and trophic) caused by compression-ischemic damage to nerve trunks and blood vessels located in anatomical tunnels (channels) [6].

The prevalence of tunnel neuropathies is higher in individuals engaged in the same type of work: among drivers, musicians, layout designers, gardeners, and stenographers. Also, tunnel neuropathies of the upper limb are often found in office employees, in particular, secretaries, programmers, that is, those who often work at a computer, or who are overly fond of them, etc.

Carpal tunnel syndrome (CTS) is most common in all tunnel syndromes. In people aged 35 years, CTS is found in 3.4% of women and 0.6% of men. Most often, in men, CTS is after 40 years, and in women (especially those engaged in intensive manual labor) – after 50 years, the ratio 1:5 [1; 6].

With this syndrome, compression neuropathy of the fibers of the median nerve or vessels feeding it occurs due to compression in the carpal tunnel, that is, damage to the median nerve occurs in the area of the hand.

The dominant hand suffers, as a rule, more often, in 30–50% of cases of lesion bilateral. Usually, with bilateral carpal tunnel syndrome, especially of professional origin, one arm is first disturbed, and when the other arm begins to disturb, the clinical symptoms remain more pronounced on the arm that began to disturb the first.

A feature of nerve damage due to the tunneling effect is a gradual, long-lasting, imperceptible increase in their compression, which is caused by a thickening of the channel walls. Neuropathy may begin with radicular or tunneling symptoms of irritation and prolapse.

For CTS characteristic symptoms of irritation of the nerve at night and during the day or night - is primarily a burning sensation and numbness, tingling, pins and needles (ie, paresthesia), a heightened perception of normal stimuli (hyperesthesia), increased sensitivity (hyperpathia) against moderate or severe pain syndrome occurs later [3; 8; 11].

Subsequently, it is difficult for patients to perform targeted movements of the hand, which are caused by an insufficient influx of nerve impulses, that is, there is a sensitive neuropraxia (sensitiva – sensitive, praxis – action, movement). Trophic disorders (due to involvement of the vegetative fibers of the nerve) and weakness in the muscles, that is, a decrease in strength in them, in particular, when shaking hands [5; 13]. In this regard, it is important to study the functional state of the

affected limb in CTS.

**Purpose of the study:** to study the functional state of the upper limb in carpal tunnel syndrome in a hospital.

## Material and Methods of the research

To assess the functional state of the affected upper limb during the initial examination, we used the Boston Carpal Tunnel Questionnaire, BCTQ [10; 12], which consists of two scales (Symptom Severity Scale, SSS) and Functional Scale (FSS), which the patient filled out on their own. The study was conducted on the basis of the Kiev City Clinical Hospital No. 4, Kiev During the period from 2017 to 2018, 37 patients with CTS took part in the examination, of which 29 (78,4%) women, 8 (21,6%) men,

Research methods: analysis and synthesis of data from scientific and methodological literature and the Internet information network; survey, medical history, mathematical methods.

## Results of the research

Increasingly, physical therapists in Ukraine, in their practical activities, use the International Classification of Functioning, Disability and Health (ICF) to assess the patient's functional state for a certain pathology. The CTS is no exception [4; 7].

According to the International Classification of Functioning, Disability and Health (ICF), with CTS, there is a violation of the structure of the median nerve (compression, ischemia), hand function and activity, and patient participation in everyday life.

When the median nerve is damaged in CTS, the following functions suffer: flexion of the I, II, III fingers and extension of the middle phalanges of the II and III fingers are impaired, palmar flexion of the hand and pronation are weakened. Muscle atrophy in the defeat of the median nerve is most pronounced in the palm, as a result of which there is flattening of the palm and bringing the thumb close and in the same plane with the index, which creates a kind of hand position, which is called "monkey" [6].

Superficial sensitivity is impaired on the hand in the area free from the innervation of the ulnar and radial nerves. Joint-muscle sensitivity is always excited in the final phalanx of the index and third fingers.

Pain with damage to the median nerve, especially partial, frequent and intense, often take the character of burning pain (causalgic) [8].

Also characteristic of the defeat of the median nerve is vasomotor secretory-trophic disorders: the skin, especially the I, II and III fingers, acquires a bluish or pale color; become "dull", brittle and striped nails; skin atrophy, thinning of the fingers (especially II and III), sweating disorders, hyperkeratosis, hypertrichosis, ulcers and other disorders are observed [2; 6; 9].

The main places for determining motor disorders that occur with damage to the median nerve are as follows:

1. When you squeeze your hands into a fist I, II and partially

III fingers do not bend.

2. The bending of the terminal phalanges of the thumb and forefinger is impossible.

3. It is impossible to "scratch" the index finger on the table when the brush fits snugly against it.

4. The patient cannot hold a sheet of paper with his thumb and forefinger bent.

5. The contraposition of I and V fingers is broken [6].

Many questionnaires have been developed for patients with dysfunction of the upper extremities and neuropathic pain [14]. However, the Boston Carpal Tunnel Questionnaire (BCTQ) is the most specific for diagnosing CTS [12]. The questionnaire was designed to standardize the results of a CTS examination by D. W. Levine et al. [12].

This was necessary because the results of surgical treatment of patients were analyzed using instrumental methods, while patients themselves were more interested in assessing the dynamics of subjective symptoms and changes in the functional capabilities of the hand. But an objective diagnostic tool for assessing changes in complaints and symptoms of CTS at that time did not exist. Thus, in 1993, the BCTQ was created in the USA. During its development, the authors consulted with surgeons, rheumatologists and patients, who identified 6 critical points for CTS, namely: pain, paresthesia, numbness, weakness, nocturnal manifestations of symptoms and general functional status. The result of their work was a specialized questionnaire consisting of two scales (Symptom Severity Scale, SSS) and Functional Scale (FSS), which the patient filled out independently. With the help of this questionnaire, it is easy to count points, and it is convenient to use it to assess the effectiveness of the treatment. This explains the widespread prevalence of BCTQ in clinical and research practice. In addition, there are reports in the literature about the use of this questionnaire for other tunnel neuropathies of the upper limb [10; 12].

The symptom severity scale of this questionnaire consists of 11 questions with several possible answers. Scores for answers vary from 1 to 5, depending on the severity of the symptom. Total score on the scale is calculated by calculating an average value.

The scale of functional disorders includes 8 points. The points for the answers range from 1 to 5, where 1 is "no difficulties", 5 "very strong difficulty". The question is about actions daily performed by a wide range of patients, both young and old. Filling out the questionnaire takes no more than 10 minutes and does not burden the doctor and patient.

Analyzing the spectrum of symptom severity (Symptom Severity Scale, SSS), it can be noted that 5 questions on this scale relate to pain in CTS, 4 more – characterize sensitivity disorders, 2 questions clarify the presence of weakness in the affected limb and the state of fine motor skills.

On the symptom severity scale (Symptom Severity Scale, SSS) during the initial examination, we found that mainly moderate (24.3%) and severe pain (37.8%) in the affected upper limb prevailed in patients, which prompted over the past 2 weeks patients wake up at night: 1 time – 32.4% of patients, 2–3 times – 29.7% of people. During the day, 29.7% of patients complained of moderate pain in the arm and 43.3% of people were worried about severe pain. Most patients (48.7%) noted

that the pain lasts from 10 minutes to 60 minutes (Table 1).

An analysis of sensitivity and fine motor abnormalities in pa-

tients with CTS indicated that most patients had a moderate numbness feeling – 40.5% of patients and a pronounced numbness / decreased sensitivity – 27.1% of people, which

**Table 1**  
**Analysis of sensation of pain in patients with CTS**

Question	Number of patients (n=37)	
	Abs. units	(%)
How much pain do you feel at night in your hand or wrist?		
1. At night, the pain in my arm / wrist does not bother me	2	5,4
2. Light pain	7	18,9
3. Moderate pain	9	24,3
4. Severe pain	14	37,8
5. Very severe pain	5	13,6
How often in the past 2 weeks have you woken up due to pain in your arm / wrist?		
1. Never	6	16,2
2. 1 time	12	32,4
3. 2–3 times	11	29,7
4. 4–5 times	5	13,6
5. More than 5 times	3	8,1
Are you usually bothered by pain in your arm / wrist during the day?		
1. On a day, pain does not bother me	0	0
2. During the day, a slight pain bothers me	4	10,8
3. During the day I am concerned about moderate pain	11	29,7
4. During the day, I am concerned about severe pain	16	43,3
5. During the day, I am concerned about a very strong pain	6	16,2
How often during the day do you feel pain in your arm / wrist?		
1. Never	0	0
2. 1-2 times a day	8	21,6
3. 3-5 times a day	16	43,3
4. More than 5 times a day	7	18,9
5. The pain bothers me constantly	6	16,2
How long does an average day pain episode last?		
1. Afternoon pain does not bother me	0	0
2. Less than 10 min	8	21,6
3. 10–60 min	18	48,7
4. More than 60 minutes	5	13,5
5. Pain bothers me all day long	6	16,2

**Table 2**  
**Analysis of impaired sensitivity and fine motor skills in patients with CTS**

Question	Number of patients (n=37)	
	Abs. units	(%)
Do you have a feeling of numbness (decreased sensitivity) in your hand?		
1. No	2	5,4
2. There is a slight feeling of numbness / decreased sensitivity	9	24,3
3. There is a moderate feeling of numbness / decrease sensitivity	15	40,5
4. There is a pronounced feeling of numbness / decrease sensitivity	10	27,1
5. There is a very pronounced feeling of numbness / decreased sensitivity	1	2,1
Do you have weakness in your hand / wrist?		
1. No	1	2,7
2. There is a slight weakness	10	27,1
3. There is moderate weakness	16	43,2
4. There is a pronounced weakness	8	21,6
5. There is a significant decrease in strength in the arm / wrist	2	5,4
Does the arm / wrist have a tingling sensation?		
1. No	3	8,1
2. Light tingling	11	29,7
3. Moderate tingling sensation	13	35,2
4. Pronounced tingling sensation.	7	18,9
5. Very strong tingling sensation.	3	8,1
How severe is numbness (loss of sensation) or tingling sensation during the night?		
1. I do not have numbness and tingling at night	3	8,1
2. Easy	10	27,1
3. Moderate	14	37,8
4. Strong	9	24,3
5. Very strong	1	2,7
How many times in the past 2 weeks have you woken up from numbness or a tingling sensation in your hand / wrist?		
1. Never	4	10,8
2. 1 time	10	27,1
3. 2–3 times	16	43,2
4. 4–5 times	6	16,2
5. More than 5 times	1	2,7
Do you feel difficulty taking and using small things (key, pencil)?		
1. No	2	5,4
2. I feel light difficulties	6	16,2
3. I feel moderate difficulties	17	45,9
4. I feel great difficulties	10	27,1
5. I feel very great difficulties	2	5,4

corresponds to the typical clinical picture of CTS. 16 patients (43.2%) complained of moderate weakness in the affected limb. Fine motor skills of the fingers were impaired in almost half of the patients – 45.9% (Table 2).

The Functional Scale (FSS) of the Boston Questionnaire describes the difficulties that arise when certain actions are performed due to problems with the hands or wrists over the past 2 weeks. These actions are determined by the performance of everyday tasks and self-care: writing, fastening buttons on clothes, keeping a book while reading, keeping a telephone handset, opening a bottle, doing homework, carrying food bags, bathing and putting on clothes.

As can be seen from the table 3, the greatest difficulties for patients arise when buttoning buttons on clothes – 83,8%, opening a bottle – 86,5%, and doing homework – 79,9% of people.

All of the above indicates that CTS negatively affects the daily activity of patients and reduces the quality of life.

### Conclusions / Discussion

An initial examination of patients with CTS indicated pain in

**Table 3**  
**Analysis of functional disorders in patients with CTS**

Actions	Number of patients (n=37)	
	Abs. units	(%)
Writing difficulties	29	78,4
Button fastening on clothes	31	83,8
Reading book content	26	70,2
Phone handset content	22	59,5
Bottle opening	32	86,5
homework	34	79,9
Carrying food bags	28	75,7
Bathing and putting on clothes	24	64,9

the affected limb, numbness, decreased sensitivity, muscle weakness on the Symptom Severity Scale (SSS) scale of the Boston questionnaire.

On the scale of functional disorders (Function Status Scale, FSS), we found difficulties that patients experienced when doing everyday tasks and self-care (fastening buttons on clothes, opening a bottle, homework, writing difficulties).

**Prospects for further research** are to study the quality of life in peripheral neuropathies of the upper limb.

**Conflict of interests.** The author declares that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

### References

1. Belova, N.V. (2015), "Modern understanding of the diagnosis and treatment of carpal tunnel syndrome", *Russian Medical Journal*, No. 24, pp. 1429-1432. (in Russ.)
2. Bismak, O.V. (2019), "Rehabilitation examination of patients with upper limb compression-ischemic neuropathy", *Slobozhans'kij naukovno-sportivnij visnik*, No. 3 (71). pp. 72-76, doi: 10.15391/snsv.2019-3.012. (in Ukr.)
3. Gilveg, A.S., Parfenov, V.A. & Evzikov, G.Yu. (2018), "The immediate and long-term results of decompression of the median nerve in carpal tunnel syndrome", *Neurology, neuropsychiatry, psychosomatics*, No. 3, pp. 79-85. (in Russ.)
4. Golik, V.A., Moroz, E.N. & Pogorelova, S.A. (2011), "Using the international classification of functioning, disability and health in expert neurological practice". *International Neurological Journal*, No. 5 (43). (in Russ.)
5. Demin, Yu.V. (2010), *Kliniko-neurofiziologicheskaya kharakteristika i metody lecheniya tunnel'nykh kompressionno-ishemicheskikh nevroptiy sredinnogo i loktevegogo nervov: dissertatsiya kand. med. nauk* [Clinical and neurophysiological characteristics and treatment methods for tunnel compression and ischemic neuropathies of the median and ulnar nerves: the dissertation of the medical sciences doctor], Ekaterinburg, 101 p. (in Russ.)
6. Dovhyi, I.L. (2016), *Peripheral nervous system disease*, in 3 volumes, Vol. 1, Kyiv. (in Ukr.)
7. Melnikova, E.V., Buylova, T.V., Bodrova, R.A., Shmonin, A.A., Maltseva, M.N. & Ivanova, G.E. (2017), "Using the International Classification of Functioning (ICF) in outpatient and inpatient medical rehabilitation: a guide for professionals", *Messenger of Recovery Medicine*, No. 6 (82). (in Russ.)
8. Pizova, N.V. & Druzhinin, D.S. (2014), "General and local risk factors for neuropathic pain in carpal tunnel syndrome", *Concilium medicum*, Vol. 16, No. 9, pp. 41-44. (in Russ.)
9. Shavlovskaya, O.A. (2015), "Impairment of the function of the neuromotor apparatus of the upper limbs caused by local vibration", *Neurology, neuropsychiatry, psychosomatics*, No. 7 (2), pp. 67-74. (in Russ.)
10. Yusupova, D.G., Suponeva N.A., Zimin A.A. et al. (2018), "Validation of the Boston carpal tunnel questionnaire in Russia", *Neuromuscular diseases*, Vol. 8, No. 1, pp. 38-45, doi: 10.17650/2222-8721-2018-8-1-38-45. (in Russ.)
11. Chang, Y.-W., Hsieh, S.-F., Horng, Y.-S., Chen, H.-L. & Lee, K.-C. (2014), "Comparative effectiveness of ultrasound and paraffin therapy in patients with carpal tunnel syndrome: a randomized trial", *BMC Musculoskeletal Disorders*, No. 26(15), p. 399, doi: 10.1186/1471-2474-15-399.
12. Levine, D.W., Simmons, B.P., Koris, M.J., Daltroy, L.H., Hohl, G.G., Fossel, A.H. & Katz, J.N. (1993), "A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome", *J Bone Joint Surg Am.*, No. 75(11), pp. 1585-1592.
13. Nourbakhsh, M.R., Bell, T.J., Martin, J.B. & Arab A.M. (2016), "The Effects of Oscillatory Biofield Therapy on Pain and Functional Limitations Associated with Carpal Tunnel Syndrome: Randomized, Placebo-Controlled, Double-Blind Study", *The Journal of Alternative and Complementary Medicine*, Vol. 22, No. 11, doi: 10.1089/acm.2016.0083.
14. Yücel, H. & Seyithanoğlu, H. (2015), "Choosing the most efficacious scoring method for carpal tunnel syndrome", *Orthop Traumatol Turc*, No. 49(1), pp. 23-29, doi: 10.3944/AOTT.2015.13.0162.

Received: 14.07.2019.

Published: 31.08.2019.

## Information about the Authors

---

**Olena Bismak:** *PhD (Physical Education and Sport), Associate Professor: National University of Ukraine on Physical Education and Sport: Fizkul'tury str. 1, Kyiv, 03150, Ukraine.*

**ORCID.ORG/0000-0002-6495-6170**

**E-mail: ebismak@gmail.com**

# Students' understanding of physical culture and sports as a factor of health protection

Taras Bondar  
Iryna Holoviichuk

University of Customs and Finance, Dnipro, Ukraine

**Purpose:** determination of the state of the relationship between students' knowledge on the factors of maintaining human health and the real state of their physical culture and sports activities.

**Material & Methods:** students from the specialties "Finance", "Banking and Insurance", "Economics", "Accounting and Taxation", "Management", "Psychology", "Law" took part in a sociological study.

**Results:** in the process of analyzing the survey data it was found that on the one hand, most students are aware of the factors of maintaining health and the benefits of physical activity to strengthen it. On the other hand, only a small part of students consciously use physical exercises to strengthen their own body.

**Conclusions:** the results obtained during the study showed that there is a need to improve pedagogical and organizational and managerial work on physical culture and sports leisure for children and youth, in particular, their involvement in modern forms of outdoor activities.

**Keywords:** physical education, health, students, physical activity, organization, management.

## Introduction

The state order for the education of a healthy young generation is formulated in a number of normative acts, namely: the Constitution of Ukraine, the laws of Ukraine "On Education", "On Higher Education", "On Physical Culture and Sport". In particular, the Law of Ukraine "On Education" [2] and the Family Code of Ukraine [8], the responsibility for maintaining the health of the younger generation and young people by society lies with family members and educational institutions at all levels. Therefore, the capabilities of these social institutions to organize the physical activity of children and youth as the most effective way to strengthen their health, as well as the formation of their physical culture as an indispensable condition for a healthy lifestyle, are of particular importance.

The results of the analysis of scientific and methodological sources indicate the presence of a large number of studies on the physical education of youth. Important in the context of our study is the methodological foundations of pedagogical theory, scientific approaches to physical education as a leading component of a healthy lifestyle, the formation of a value-based attitude of the younger generation towards their own health (L. Ivanova [3], T. Krutsevich [4; 5], B. Shiyan [11]). A number of modern scientific studies are devoted to highlighting certain provisions of physical education as an important component of the educational process (Yu. Vaskov [1], V. Lozova [6], G. Trotsko [6]).

From our point of view, the conclusions of the research of L. Lubyshev [7], V. Sutula [9; 10] regarding the mechanisms of formation of the physical culture of a person's personality. These authors noted that the active participation of a person in physical education and sports is based on the existing need for a variety of physical activity.

At the same time, in the scientific literature there are no ways

to overcome the contradiction between the importance of physical activity in the process of formation and strengthening of youth's health and the low level of organizational and managerial work to attract students to physical education and the latest forms of organization of recreational and recreational activities, especially outside academic work.

Therefore, there is a need to clarify the relationship between students' knowledge regarding the factors of maintaining human health and the real state of their physical culture and sports activities, which determines the **purpose of this study**.

## Material and Methods of the research

In May 2019, the authors conducted a sociological study among students of 1–4 years of the University of Customs and Finance of 6 specialties in health protection and the organization of their leisure. During the survey, a closed questionnaire was used. The results are summarized in table. In total, 599 future specialists in the field of economics, finance, law and psychology took part in the survey. The sampling error is 2,5% with 95% reliability of the survey results.

## Results of the research

From the analysis presented in table. 1 of the materials it follows that the vast majority of students (88.1%) consider it important to maintain health. In the context of faculties, we note that the low percentage of students (80.7%) who think so are students in the specialty "Psychology", and the highest (92.2%) – in the direction "Economics". At the same time, the students surveyed have the opinion that the most important factor in maintaining health is the absence of bad habits in a person (38.2%), then (in importance) – a healthy and rational diet, an optimal regime of physical activity, an optimal mode of training and rest, active leisure in recreational areas. However,

## Students' Attitudes to Health Factors

Survey directions	Finance, Banking and Insurance n=100	Economics n=98	Accounting and Taxation n=101	Management n=103	Psychology n=97	Law n=100	Averages n=599
<i>Most important factors maintaining health</i>							
Healthy eating	33,1	28,2	35,8	29,1	29,6	26,9	30,5
Mode of work (study) and rest	30,1	28,2	29,5	41,7	27,4	18,8	29,3
Optimal physical activity	36,2	20,9	30,6	27,2	22,4	43,8	30,2
Lack of bad habits;	37,7	41,8	39,3	35	30	45,6	38,2
Outdoor activities in recreational areas	23,1	12,7	16,8	8,7	15,2	15	15,3
<i>Determine the importance of health</i>	86,2	90,9	87,9	92,2	80,7	90,6	88,1
<i>Student leisure</i>							
Friends	61,5	46,4	60,1	57,3	38,1	56,3	53,3
Entertainment facilities (disco, club, cafe, etc.)	27,7	17,3	24,9	23,3	23,8	19,4	22,7
The television	16,9	17,3	16,8	11,7	15,7	16,3	15,8
Internet	24,6	26,4	30,1	32	15,3	23,8	25,4
Computer games	6,2	2,7	9,2	4,9	6,7	8,8	6,4
Sports facilities (sports section, fitness club, pool, water park, dance groups, etc.)	13,1	16,4	15,6	22,3	14,8	34,4	19,4
<i>Lack of bad habits</i>	71,5	66,4	53,2	60,2	49,8	67,5	61,4
<i>Bad habits</i>							
Smoking	5,4	11,8	21,4	16,5	20,2	14,4	15
Alcohol use (low alcohol drinks, beer)	10	10,9	23,7	16,5	19,7	18,1	16,5
Alcohol consumption (strong alcoholic drinks - vodka, cognac)	1,5	3,6	4	9,7	3,1	2,5	4,1
Alcohol consumption (alcoholic beverages - wine, champagne)	8,5	9	19,7	9,7	11,2	7,5	10,9
<i>Those wishing to participate in physically active leisure</i>	81,5	86,4	78,3	76,7	69,5	93,8	81
<i>Participation in sports activities</i>							
Professional sports activities	1,5	9	3,5	1	2,2	21,3	6,4
Visit to the sports section	10,8	16,4	6,9	9,7	12,1	34,4	15,1
Exclusively in the physical education classes of universities	73,8	44,5	62,4	51,5	48	30,6	51,8
A visit to the gym on the territory of the university	3,9	6,4	4	2,9	4,9	11,3	5,6
A visit to the gym or sports section outside universities	10	12,7	8,1	14,6	10,8	22,5	13,1
Do not participate in physical education sports	14,6	14,5	16,2	27,2	16,6	3,1	15,4
<i>Most significant motivational factors for students to conduct physical education classes</i>							
Evaluation	35,4	33,6	29,5	26,2	30,9	20	29,3
Lesson content	9,2	10	13,9	24,3	12,1	23,1	15,4
Result of testing the development of physical qualities	6,2	2,7	5,8	29,1	4,9	12,5	10,2
desire to move	20,8	17,3	18,5	21,4	14,8	30,6	20,6
Desire for emotional satisfaction	28,5	20	42,8	27,2	23,8	23,1	27,6
Positive effects of physical activity on one's own health	38,5	30,9	27,8	35,9	24,2	46,9	34
<i>Motivational factors for physical exercise in their free time</i>							
Desire to be healthy (including deprivation of a chronic disease)	43,1	36,4	49,1	39,8	30	49,4	41,3
Desire to have a beautiful (athletic) physique	57,7	39,1	47,4	49,5	36,3	38,8	44,8
Financial motives	7,7	0,9	5,8	-	3,1	8,8	5,3
Desire to see the world	7,7	5,5	5,8	4,6	6,3	13,8	7,3
It's fashionable	1,5	3,6	6,9	-	5,4	3,8	4,2
Desire to assert oneself among peers	4,6	1,8	2,3	1	2,2	6,9	3,1
Forced parents or educators (including training)	2,3	6,4	3,5	4,9	5,8	1,3	4
Desire to improve your body	29,2	27,3	27,2	42,7	29,6	42,5	33,1
<i>Reasons that interfere with physically active leisure</i>							
Not enough time	81,5	74,6	74,6	65	58,7	55,6	68,3
Believe that sport is a futile exercise	0,8	1,8	2,3	1	1,8	0,6	1,4
The lack of conditions in universities for sports	8,5	8,2	6,9	4,9	9,4	16,9	9,1
Lack of information about where in the university you can play sports	6,2	9	8	12,6	10,3	13,1	9,9
<i>Participate in the university's public sports</i>	20,8	15,5	38,2	30,1	22	50,6	29,5
<i>Those wishing to participate in the public sports life of the university</i>	30	14,6	39,9	14,6	25,1	61,9	31

despite the prevailing opinion among students that one of the main factors in maintaining human health is the absence of bad habits, only 61.4% (on average) do not have them. At the same time, 15% of students smoke, 16.5% drink low-alcohol drinks, and 10.4% drink wine.

For almost all the students surveyed (except for the specialties "Accounting and Taxation" and "Law"), such an important factor in strengthening human health and preventing disease, as physical activity, is not significant. This is evidenced by the results of a further analysis of the sociological survey. So, students spend leisure time in communication with friends (53.3%), instead of classes in sports clubs, fitness clubs, swimming pools, dance groups, pools and water parks.

Only 19.4% of students organize their active leisure, and thus put spending their free time only in fourth place, and students in the specialties "Finance, Banking and Insurance" and "Psychology" generally rank fifth in their priorities, respectively 13.1%, 16.4%, 15.6%, 14.8%, and only future jurists – in the second (34.4%). The vast majority (68.3%) of students are justified by the fact that they do not have time for physical education and sports. Moreover, most of these students study in the specialties "Finance, banking and insurance" – 81.5%, "Economics" – 74.6%, "Accounting and taxation" – 74.6%. Therefore, for the majority of students (51.8%) physical education classes during school hours is the only way to organize motor activity. Most of these students are in the specialties "Finance, Banking and Insurance" (73.8%) and "Accounting and Taxation" (62.4%), the smallest – "Law" (30.6%).

The most significant motivating factors regarding attending physical education classes for future financiers, economists, lawyers and psychologists indicate an understanding of the positive impact of physical exercises on their own health (average 34%), the ability to get a positive assessment (average 29.3%), and the opportunity to get emotional satisfaction from classes (on average 27,6%).

Further analysis of the materials of the sociological survey confirmed this contradiction. So, the main motives that prompt extracurricular activities in physical exercises (recreational and health-improving activities) and sports, respondents indicated a desire to have a good figure (44.8%), health (41.3%) and a desire to improve the condition of the body (33.1%). Other answers are not significant. Moreover, this trend is characteristic of most areas of specialist training, except for the specialties "Accounting and Taxation" and "Law". Students of these specialties are the most important factor in motivation

for physical exercises and sports outside the classroom, consider the positive impact of such classes on human health, in accordance with 49.1% and 49.4%.

So, there is a contradiction – on the one hand, most students are aware of the benefits of physical exercise to maintain health, and on the other hand, only a small part of them voluntarily uses to strengthen their own body. This may be due both to the content of curricula for the formation of a worldview and an active attitude towards physical education at all levels of education, and to the imperfection of the management of physical culture and sports work with the population.

There is a contradiction, which is also confirmed by students' responses to participation in the self-government of physical education and sports activities in an educational institution. So, on average, only 29.5% of respondents participate in various social activities (student council commissions, refereeing, organizing and conducting competitions, the work of a sports club, etc.) related to physical education. Most of these students are students in the specialties of "Accounting and Taxation" (38.2%) and "Law" (50.6%), the least – "Economics" (15.5%) and "Management" (22%). A similar situation has developed with regard to students' desire to participate in such social activities – an average of only 31%. Most of all those wishing to take part in it also study in the specialties "Accounting and Taxation" (39.9%) and "Law" (61.9%).

## Conclusions / Discussion

The results of a sociological study showed that among students, to a certain extent, health and safety competencies were not formed. In particular, in the presence of theoretical knowledge, the motivation of students for active physical education and sports and active participation in social activities in the health field is at a low level.

Most students do not associate their leisure time with physical exercises, although the modern market of recreational and recreational services has a wide selection of forms of outdoor activities, have the main signs of fitness, and sometimes sports activities.

The results obtained suggest either the imperfection of the curriculum for secondary and higher schools, or the insufficient level of organizational and managerial work on the physical culture and sports leisure of children and youth. Therefore, there is a need for further research in this direction, which determines the **prospects for future research**.

**Conflict of interests.** The authors declare that no conflict of interest.  
**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

1. Vaskov, Yu.V. (2013), *Teoretychni i metodychni zasady navchannia fizychnoi kultury uchniv osnovnoi shkoly: avtoref. dys. d-ra ped. nauk* [Theoretical and methodological foundations of physical education teaching of primary school students: Dr. of Sciences thesis abstract], Nat. ped. them. M.P. Dragomanov, Kyiv. (in Ukr.)
2. VRU (2017), Law of Ukraine "On Education", available at: <https://zakon.rada.gov.ua/laws/show/2145-19>. (in Ukr.)
3. Ivanova, L.I. & Omelchuk, OV (2018), "Separate issues of optimization of the legal framework for improving the efficiency of physical education of students", *Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Drahomanova. Seriya 15 : Naukovo-pedahohichni problemy fizychnoi kultury (fizychna kultura i sport)*, Iss. 3K (97), pp. 228-231. (in Ukr.)
4. Kutsevich, T. (2008), *Teoriia i metodyka fizychnoho vykhovannia* [Theory and Methods of Physical Education], Vol.2, Olympic Literature, Kiev. (in Ukr.)
5. Kutsevich, T. (2012), "On the Effectiveness of the Physical Education System in Secondary Schools of Ukraine", *Sportyvnyi visnyk Prydniprovshchyny*, No. 1, pp. 10-15.



provia, No. 1, pp. 239-243. (in Russ.)

6. Lozova, V.I. & Trotsko, G.V. (2002), *Teoretychni osnovy navchannia i vykhovannia* [Theoretical Foundations of Learning and Education], OVC, Kharkiv. (in Ukr.)

7. Lubyshcheva, L.I. (2016), *Sotsyolohyia fizycheskoi kultury i sporta* [Sociology of Physical Education and Sport], Academia, Moscow. (in Russ.)

8. VRU (2002), The Family Code of Ukraine (2002), available at: <https://zakon.rada.gov.ua/laws/show/2947-14>. (in Ukr.)

9. Sutula, V.O. (2012), *Teoretyko-metodychni zasady formuvannia fizychnoi kultury osobystosti v umovakh tsilisnoi sotsialno-pedahohichnoi systemy: dys. ... d-ra ped. nauk* [Theoretical and methodological foundations of formation of physical culture of personality in the conditions of holistic social-pedagogical system: Dr. of Sciences diss.], Kharkiv State Academy of Physical Culture, Kharkiv. (in Ukr.)

10. Sutula, V., Shuteev, V., Lutsenko, L., Kolisnichenko, A., Ispravnikov, V., Deyneko, A. & Bodrenkova, I. (2017), "Features of the influence of sports on the personality of students", *Slobozans'kij naukovo-sportivnij visnik*, No. 1 (57), pp. 100-105. (in Ukr.)

11. Shiyan, B.M. & Papusha, V.G. (2000), *Teoriia fizychnoho vykhovannia* [Theory of physical education], Zbruch, Ternopil. (in Ukr.)

Received: 19.07.2019.

Published: 31.08.2019.

## Information about the Authors

---

**Taras Bondar:** *PhD (Physical Education and Sport); University of Customs and Finance: 2/4 Volodymyr Vernadsky Street, Dnipro, Dnepropetrovsk Region, 49000, Ukraine.*

**ORCID.ORG/0000-0002-1389-6614**

**E-mail: tsbondar@gmail.com**

**Iryna Holoviichuk:** *PhD (Physical Education and Sport); University of Customs and Finance: 2/4 Volodymyr Vernadsky Street, Dnipro, Dnepropetrovsk Region, 49000, Ukraine.*

**ORCID.ORG/0000-0001-9259-8203**

**E-mail: irinaucf@gmail.com**

# Physical activity of adolescents in health and recreation facilities: motives and interests

Taras Bondar  
Iryna Holoviichuk

University of Customs and Finance, Dnipro, Ukraine

**Purpose:** elucidation of the motives and interests of adolescents regarding forms of physical activity in health and recreation facilities.

**Material & Methods:** in a sociological study, adolescents aged 10–15 years participated in children's health and recreation facilities.

**Results:** in the process of analyzing the survey data, it was found that for adolescent boys, regardless of age, in the exercise and sports, the existence of certain rules and boundaries is very important, which affects their interest and motivation. For girls, on the contrary, the existence of rules and boundaries is a factor that reduces the interest in physical exercises. The presence of emotional coloring and a variety of motor modes, on the contrary, stimulate girls' creativity and imagination, which leads to their enjoyment of motor activity.

**Conclusions:** in the process of analyzing the survey data, the diversity and non-standard interests of adolescents in physical education and sports and the gender characteristics of their motivation were established. The identified need for the development of organizational and managerial technologies that will take into account the interests and motives of adolescents, with the aim of their active involvement in motor activity.

**Keywords:** physical education, permission, health care, motivation, tourism.

## Introduction

Human health is laid from the moment of conception in the womb. Further, at the initial stage of life after birth, it is formed in the family; then it is strengthened and supported in pre-school, educational, out-of-school, higher educational institutions; in the process of adulthood – it is supported independently (mainly by means of physical culture). Such a paradigm is embedded in the regulatory framework of Ukraine, programs for educational institutions, etc. [4–6]. However, an analysis of the scientific and methodological literature shows that such a model is somewhat ideal. First of all, it is effective only under one condition - a person must consciously actively act in this direction. That is, strengthening and maintaining human health depends on the effectiveness of the process of educating the individual, the formation of her relevant needs and motivations [10].

A large number of studies are devoted to physical education in preschool, general educational and higher educational institutions. The scientific literature discusses ways to solve the problems of reducing the motor activity of children and youth, an increase in the incidence rate, and shortcomings in the educational process [2; 7–10]. However, a small number of publications have been devoted to the study of the organizational and managerial foundations of physical education of children during leisure time, in particular, to the study of the forms of organization of physical education in children's institutions for health and recreation (CIHR). Although, according to the State Statistics Service of Ukraine, CIHR annually visits from 900 thousand to 1,5 million children every summer – this is about 25% of the total number of students [3].

One of our previous studies [1] compared the intensity of

physical education in schools and summer camps. Conclusions were drawn, in children's health and recreation facilities there is a more intensive process of physical education compared to secondary schools and school institutions of health and recreation. Children are more likely to participate in physical education and sports events. It was suggested that this was due to the use of non-standard means and forms of increasing physical activity in the camps, which determined the **purpose of this study** – to clarify the motives and interests of adolescents regarding forms of physical activity in health and recreation facilities.

## Material and Methods of the research

During May-July 2019, a sociological study was conducted among adolescents aged 10–15 years in the amount of 836 people. In the process of the survey, a closed-ended questionnaire was used, the question of which was aimed at clarifying the interests of respondents, their motives and attitudes toward sports and fitness activities. The results are summarized in tables 1–3. The sampling error is 2,5% with 95% reliability of the survey results.

## Results of the research

The generalized responses of the respondents presented in table. 1, show that the vast majority of adolescents (from 66,7% to 94,1%) believe that their health depends on daily exercise. In their opinion (from 70% to 100%), physical education and sport are the basis of a healthy lifestyle (Table 1). However, it should be noted that on average 20,9% of adolescents have no idea about the benefits of physical culture for the human body, and 14% do not understand the place of physical activity among the components of a healthy lifestyle.

The main motives for doing physical exercises girls indicate the formation of grace and posture – the importance of this motive is growing from 51,9% at the age of 10 years to 68,2% – at the age of 14–15 years.

Among young men, the dominant motive at the age of 10 years is the influence of physical exercise on the formation of will and perseverance (56,7%), however, starting from the age of 11 years gradually (at 11 years old – 40,0%, at 12 years old – 52,9%, at 13 years old – 63,6%) motivation to form masculinity is growing. At the age of 14-15 years, this motive and motivation for the formation of will and perseverance acquire equal values for adolescents (47,4%). These data confirm the data of special psychological and pedagogical literature on the formation of pronounced gender characteristics of girls and boys in adolescence.

Also analysis of the materials presented in table. 1, showed that the interests of adolescents in sports classes also have their own gender characteristics. So, for collective independent studies in their free time, children mainly choose sports games: at 10 years old – 70%, at 11 years old – 50%, at 12 years old – 47,1%, at 13 years old – 36,4%, at 14–15 years – 52,6%. As you can see, interest in sports games gradually fades with age, and resumes at an age older than teens.

Among girls, the most favorite types of motor activity are various games (at the age of 10 years – 51,9%, 11 years old – 41,7%, 12 years old – 46,7%, 13 years old – 40,9%, 14–15 years old – 22,7%), which are not related to sports, and starting from the age of 12 years, there is an interest in sports games (12 years old – 73,3%, 13 years old – 40,9%, 14–15 years old – 36,4%), which also fades away, as in men.

Further analysis of the survey materials showed a similar attitude of adolescents to the choice of independent exercise. So, if at the age of 10 years old girls indicate badminton (29,6%), and guys indicate table tennis (56,7%), then from the age of 11 years old adolescents leave the standard set of sports and fitness camp shift services and choose the category "other sports".

Considering the dynamics, we notice that such girls at the age of 11 years old – 50%, at 12 years old – 33,3%, at 13 years old – 50%, at 14–15 years old – 36,4%; children at 11 years old – 22,7%, at 12 years old – 47,1%, at 13 years old – 45,5%, at 14–15 years old – 47,4%. In addition, in the sample as a whole, up to 20% of adolescents indicate that they do not have physical education and sports interests and do not participate in such events.

So, the interests of adolescents are diverse, and overwhelmingly non-standard. The only type of motor activity that most adolescents (from 68,2% to 93.3%), regardless of age and gender, choose to organize active leisure – there are hiking trips.

The above is confirmed by the analysis of data on the physical education and health-improving activities offered by the teaching staff (Table 2). So, for children, the most favorite measures are sports (from 54,5% to 73,7%), of which the guys who are interesting for themselves usually choose team sports: at 10 years old – 50%, at 11 years old – 40,9%, at 12 years old – 76,5%, at 13 years old – 45,5%, at 14-15 years old – 68,4%.

For girls, their favorite types of physical activity are dance

**Table 1**  
**Motives and interests of adolescents at the expense of fitness classes in CIHR**

Survey directions	Age, gender of adolescents and the number of respondents (total n=836 people)									
	10		11		12		13		14–15	
	B n=120	G n=108	B n=88	G n=96	B n=68	G n=60	B n=44	G n=88	B n=76	G n=88
Adolescents who believe that physical education is the foundation of a healthy lifestyle	70	88,9	72,7	87,5	94,1	100	90,9	81,8	84,2	90,1
Adolescents who believe that health depends on active daily exercise	80	66,7	59,1	75	94,1	86,7	90,9	77,3	84,2	77,3
<i>The opinion of adolescents for the formation of the body and personality traits under the influence of physical training and sports activities</i>										
• grace and posture	23,3	51,9	13,6	50	11,8	53,5	–	54,5	5,3	68,2
• courage	37,5	7,7	40,9	–	52,9	–	63,6	9,1	47,4	–
• will and perseverance	56,7	37	36,4	41,7	58,8	53,5	36,4	50	47,4	31,8
• ability to communicate with friends	37,5	7,4	4,5	12,5	5,9	20	–	18,2	15,8	–
• nothing is formed	–	7,4	4,5	4,2	–	–	–	–	–	4,5
<i>The interests of adolescents regarding independent physical education and health classes in the camp</i>										
• play table tennis	56,7	11,1	36,4	4,2	29,4	13,3	9	13,6	10,5	27,3
• exercise on the bar	16,7	7,4	4,5	4,2	17,6	–	45,5	–	26,3	–
• run cross	6,7	22,2	22,7	4,2	17,6	13,3	9	–	21,1	4,5
• play badminton	6,7	29,6	22,7	33,3	–	40	9	40,9	10,5	31,8
• engage in another sport	16,7	3,7	22,7	50	47,1	33,3	45,5	50	47,4	36,4
• not involved	13,3	33,3	4,5	20,8	11,8	20	18,2	–	15,8	9,1
<i>Interests of adolescents about collective fitness classes in a camp organized independently</i>										
• play sports	70	18,5	50	29,2	47,1	73,3	36,4	40,9	52,6	36,4
• play other games	10	51,9	22,7	41,7	29,4	46,7	9	40,9	36,8	22,7
• go in for athletics	10	33,3	18,2	16,7	–	13,3	45,5	4,5	–	13,6
• not involved	10	18,5	4,5	20,8	23,5	–	9	22,7	15,8	27,3
Having a desire to go hiking	93,3	85,2	68,2	79,2	76,5	93,3	90,9	72,7	73,7	68,2

**Table 2**

**The attitude of adolescents to physical training and sports activities in the summer camp**

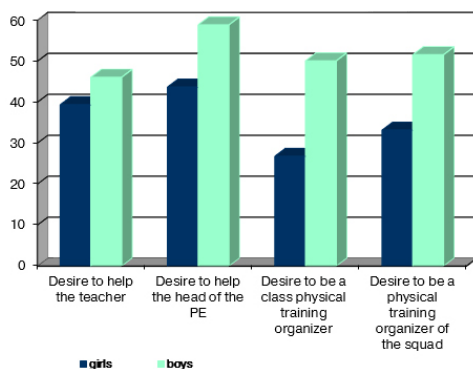
Survey directions	Age, gender of adolescents and the number of respondents (total n=836 people)									
	10		11		12		13		14–15	
	B n=120	G n=108	B n=88	G n=96	B n=68	G n=60	B n=44	G n=88	B n=76	G n=88
<i>The most favorite activities in the camps</i>										
• dance	3,3	33,3	4,5	58,3	11,8	53,3		50	5,3	63,6
• sports	73,3	22,2	54,5	16,7	82,4	6,7	54,5	27,3	73,7	9,1
• cultural	6,7	11,1	18,2	8,3	11,8	20	45,5	22,7	21,1	13,6
• contests	16,7	51,9	31,8	20,8	-	46,7	-	31,8	10,5	13,6
<i>The most interesting sports events in the camp</i>										
• team sports (football, mini-volleyball, basketball, etc.)	50	44,4	40,9	29,2	76,5	26,7	45,5	54,5	68,4	54,5
• outdoor games, folk games	16,7	51,9	22,7	50	11,8	26,7	36,4	31,8	26,3	31,8
• relay races	23,3	11,1	36,4	29,2	11,8	60	27,3	40,9	15,8	4,5
• morning gymnastics	3,3	-	4,5	16,7	11,8	13,3	-	-	-	9,1

events (from 33,3% to 63,6%) and contests (from 20,8% to 51,9%), among which the most interesting for them are those associated with mobile and folk games (especially at 10 (51,9%), 11 (50%), 14–15 (31,8%) years) and relay races (especially at 12 (60%) and 13 (40,9%) years). Also for girls 10, 13 and 14–15 years old, sports games remain, respectively 44,4%, 54,5%, 54,5%.

So, from the foregoing, we can conclude that for adolescent boys, regardless of age, in the exercise and sports, the existence of certain rules and boundaries is very important, which affects their interest and motivation. For girls, on the contrary, the existence of rules and boundaries is a factor that reduces the interest in physical exercises. The absence of such, a variety of emotional colors and motor modes, on the contrary, stimulate the creativity of girls, imagination, which leads them to enjoy motor activity.

This also finds confirmation by comparing the attitude of adolescents to the organization of physical education in the camp and school, namely the presence of adolescents' desire to be a physical officer of the detachment and class, and the desire to help the physical education teacher at school and the head of physical education in the camp (Figure 1).

So, the activities of the class and group physical training organizer are always associated with the implementation of all the rules and regulations, according to the guys are more will-



**Fig. 1. Average indicators of the correctness of adolescents to participate in the organization of their own physical education**

ing to agree to such functions: in school (50,1%) and in the camp (51,6%). Whereas the number of such girls in school is 28,8%, in the squad – 33,2%. At the same time, more girls want to be the physical training organizer of the detachment than the physical training organizer of the class, due to the greater freedom of choice of forms and means of physical education in children's institutions for recreation and recreation. However, it should be noted that with age, interest decreases and at the age of 14–15 years, children who want to be the group's physical training organizer make up 42,1%, class – 31,6%, among girls, 18,2% and 18,2%, respectively (Table 3).

A similar situation has developed regarding the desire of teenagers to help a physical education teacher and the head of the PE camp. So, the number of children assisting assistants in the camp is 58,9%, while in school – 46,1%. The difference is 12,8% (!). Among girls, the difference is less and is 4,3%. However, the total number of female assistants is less and amounts to 39,4% at school, in camps – 43,7%.

In general, the analysis of the materials of Table 3 allows us to conclude that among adolescents, the authority of teachers of physical culture of a school is lower than the authority of the leaders of PE camps. The relatively low authority of these workers among teenage girls. In our opinion, this is due to the standardization of forms of physical education in secondary schools and the personal qualities of teachers, determines the direction of future research.

## Conclusions / Discussion

Thus, the materials of a sociological study showed the diversity and non-standard interests of adolescents in physical education and sports and the gender characteristics of their motivation.

For adolescent boys, regardless of age, the existence of certain rules and boundaries in physical exercise and sports is very important, which affects the growth of their interest. However, the rules and limits at the same time is a factor in reducing the motivation to exercise.

The priority place in the formation of interests and motivations

Table 3

Attitude of adolescents to participate in the organization of physical education in the camp and school

Survey directions	Age, gender of adolescents and the number of respondents (total n=836 people)									
	10		11		12		13		14-15	
	B n=120	G n=108	B n=88	G n=96	B n=68	G n=60	B n=44	G n=88	B n=76	G n=88
Those wishing to help the head of the physical culture of the camp	56,7	44,4	45,5	50	70,6	46,7	63,6	45,5	57,9	31,8
Teens helping physical education teacher	46,7	33,3	45,5	33,3	47,1	53,3	54,5	45,5	36,8	31,8
Wishing to be physical training organizer at school	63,3	44,4	45,5	33,3	64,7	20	45,5	18,2	31,6	18,2
Wishing to be a physical training organizer at squad	50	40,7	31,8	37,5	70,6	46,7	63,6	22,7	42,1	18,2

of adolescent girls is taken by creative activities and forms of physical education, changes in motor regimes, combination with other educational forms and directions that lead to girls getting pleasure from physical activity.

Among most adolescents, hiking is equally interesting. Both boys and girls equally want to participate in them, regardless of age.

**Prospects for further research.** Based on the findings of this study, there is a need to study the motivation and interests of adolescents in motor activity during leisure time during the school year. They also require the development of organizational and managerial technologies that will take into account the interests and motives of adolescents, with the aim of actively involving them in motor activity.

**Conflict of interests.** The authors declare that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

- Bondar, T.S. (2012), "Characterization of the intensity of physical education in the structure of educational and wellness and upbringing processes", *Pedahohika, psykholohiia ta med.-biol. probl. fiz. vykhovannia i sportu*, No. 12, pp. 28-31. (in Ukr.)
- Vaskov, Yu.V. (2013), *Teoretychni i metodychni zasady navchannia fizychnoi kultury uchniv osnovnoi shkoly: avtoref. dys. d-ra ped. nauk* [Theoretical and methodological foundations of physical education teaching of primary school students: Dr. of Sciences thesis abstract], *Nat. ped. them. M.P. Dragomanov, Kyiv*. (in Ukr.)
- State Statistics Committee of Ukraine (2017), Children's Health Improvement in Children's Health and Recreation Institutions in Summer 2017, available at: [https://ukrstat.org/uk/druk/publicat/Arhiv\\_u/15/Arch\\_ozd\\_bl.htm](https://ukrstat.org/uk/druk/publicat/Arhiv_u/15/Arch_ozd_bl.htm). (in Ukr.)
- VRU (2017), Law of Ukraine "On Education", available at: <https://zakon.rada.gov.ua/laws/show/2145-19>. (in Ukr.)
- VRU (1994), Law of Ukraine "On Physical Culture and Sports", available at: <https://zakon.rada.gov.ua/laws/show/3808-12>. (in Ukr.)
- VRU (2008), Law of Ukraine "On children's health and recreation", available at: <https://zakon.rada.gov.ua/laws/show/375-17>. (in Ukr.)
- Ivanova, L.I. & Omelchuk, O.V. (2018), "Separate issues of optimization of the legal framework for improving the efficiency of physical education of students", *Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Dragomanova. Seriya 15 : Naukovo-pedahohichni problemy fizychnoi kultury (fizychna kultura i sport)*, Iss. 3K (97), pp. 228-231. (in Ukr.)
- Krutsevich, T. (2012), "On the Effectiveness of the Physical Education System in Secondary Schools of Ukraine", *Sportyvnyi visnyk Prydniprovia*, No. 1, pp. 239-243. (in Russ.)
- Ponomaryova, G.F., Bondar, T.S. & Zolochovsky, V.V. (2013), *Pedahohika fizychnoho vykhovannia: suchasni orhanizatsiini tekhnolohii u zahalnoosvitnikh navchalnykh zakladakh* [Pedagogy of Physical Education: Modern Organizational Technologies in Secondary Schools], Kharkiv. (in Ukr.)
- Sutula, V.O., Bondar, T.S. & Vaskov, Yu.V. (2009), "Formation of physical culture of personality strategic task of physical education of students of secondary schools", *Slobozhans'kij naukovo-sportyvnyj visnyk*, No. 1, pp. 100-105. (in Ukr.)

Received: 19.07.2019.

Published: 31.08.2019.

## Information about the Authors

**Taras Bondar:** PhD (Physical Education and Sport); University of Customs and Finance: 2/4 Volodymyr Vernadsky Street, Dnipro, Dnepropetrovsk Region, 49000, Ukraine.

**ORCID.ORG/0000-0002-1389-6614**

**E-mail: tsbondar@gmail.com**

**Iryna Holoviichuk:** PhD (Physical Education and Sport); University of Customs and Finance: 2/4 Volodymyr Vernadsky Street, Dnipro, Dnepropetrovsk Region, 49000, Ukraine.

**ORCID.ORG/0000-0001-9259-8203**

**E-mail: irinaucf@gmail.com**

# Optimization of the training method for the turns of young gymnasts, taking into account the level of development of the ability to maintain balance

**Alfiia Deineko**  
**Olha Riabchenko**

*Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine*

**Purpose:** substantiate the effectiveness of using the methodology for developing the ability to maintain balance, which affects the technique of turns 13–15 years old athletes in rhythmic gymnastics.

**Material & Methods:** study involved 13–15 years old athletes, engaged in rhythmic gymnastics. The control group consisted of 10 gymnasts and the experimental group of 10 gymnasts. To solve the tasks, the following research methods were used: theoretical analysis and generalization of literary sources; pedagogical observations; pedagogical testing of the level of development of the ability to maintain balance; expert assessment method; pedagogical experiment; methods of mathematical statistics.

**Results:** the author's method of developing the ability to maintain balance by young gymnasts was developed. The positive influence of using means of developing the ability to maintain balance on the technique of turns by athletes 13–15 years old in rhythmic gymnastics was revealed.

**Conclusion:** an analysis of the results of the study shows that increasing the level of development of the ability to maintain balance by athletes 13–15 years old directly affects the improvement of the technique for turns competitive programs in rhythmic gymnastics.

**Keywords:** rhythmic gymnastics, gymnasts 13–15 years old, ability to maintain balance, technique of turns.

## Introduction

The intensification of sports competition of national teams makes it necessary to pay special attention to coaches and scientists to increase the effectiveness of long-term training of athletes, to search for various training tools that contribute to more effective mastery of competitive exercises [1]. Modern fierce competition in rhythmic gymnastics leads to constant changes in the competitive programs of gymnasts. With the introduction of the FIG (2017) competition rules in rhythmic gymnastics [2], the development of complex competition programs that are complex in terms of technical base became a priority. This is possible only if modernization and increase the effectiveness of the training process, which is directly dependent on the means used in the classroom with athletes [3–5]. One of the most important categories of movements that are widely used in rhythmic gymnastics is turns, that is, movements with rotation of the athlete's body along its longitudinal axis [6]. In recent years, the arsenal of turns in gymnasts has been significantly enriched with new forms. Complex turns in the squat are officially recognized and included in the table [2], with the gradual bending and straightening of the supporting leg, turns with tilts forward and backward, turns on the knees and the like. Therefore, in modern conditions of training young gymnasts, mastering the practical skills of performing complex turns is relevant, it makes it possible to receive allowances for difficulty in connecting with other structural groups, in risks and in mastery of the subject.

**Purpose of the study:** substantiate the effectiveness of using the methodology for developing the ability to maintain balance, which affects the technique of turns 13–15 years old athletes in rhythmic gymnastics.

## Material and Methods of the research

The study was conducted on the basis of the Children and Youth Sports School No. 16 in rhythmic gymnastics in Kharkov. The experiment involved 20 athletes 13–15 years old. In the course of the study, the following methods were used: theoretical analysis and generalization of literary sources; pedagogical observations; pedagogical testing of the level of development of the ability to maintain balance; expert assessment method; pedagogical experiment; methods of mathematical statistics.

Testing the level of development of the ability to maintain balance and an expert assessment of the technique of turning competitive programs by young gymnasts was carried out at the beginning and at the end of the summer training cycle. According to the results of initial testing of the level of development of the ability to maintain equilibrium and expert evaluation of turning techniques, gymnasts of the study group were divided into two equivalent groups - control (CG) and experimental (EG) of 10 athletes. Training sessions of the control group of gymnasts were conducted according to the generally accepted Rhythmic Gymnastics Curriculum [7]. In the training process of the gymnasts of the experimental group, the author's technique was specifically developed to develop the ability to maintain balance. The author's technique was used in the main part of the training session (15–20 minutes), where the technical element BD (equilibria, turns, jumps) was performed. During the study, in the training process in rhythmic gymnastics, specially developed sets of exercises were used in equilibrium in place (various racks on socks, on heels, on one leg, movements of the arms, legs, body with reduced support) in motion – varieties of walking, jogging and dance

steps. Of particular value in the framework of the developed methodology were exercises in pairs, as well as performing the original, non-traditional for rhythmic gymnastics, exercises – disagreements on the gymnastic bench (on the bottom of the lava). It should be noted that the author's methodology, aimed at developing the ability to maintain the balance of gymnasts of 13–15 years old, provided for the following complications when mastering basic exercises: use of various positions of the arms, the tilts of the head and asymmetric positions of the arms when performing a basic exercise, excluding support on the floor of the exercise on toes, without visual control; an increase in the number of repetitions and retention time of the static position of the body, as well as the use of rhythmic gymnastics (rope, hoop, ball, maces, ribbon) – that is, a combination of the proposed basic exercises with the dynamic work of the subject. Thus, at the end of the experiment, the gymnasts of the experimental group had to perform the proposed exercises according to the following scheme:

**BASIC EXERCISE + PROPOSED COMPLICATIONS +  
+ DYNAMIC WORK WITH THE SUBJECT**

Due to the fact that the results of expert evaluations are points, then for their analysis it is necessary to use rank (nonparametric) methods. Three experts participated in the study and to determine the consistency of their opinions, the method of calculating the concordance coefficient, as proposed by Kendall [8], was used. The concordance coefficient varies in the range  $0 < W < 1$ ; in this case, if  $0 - 0,1$  – the opinion of experts is inconsistent;  $0,1 - 0,3$  – low consistency;  $0,3 - 0,7$  – average consistency;  $0,7 - 1,0$  – high consistency.

## Results of the research

To test the effectiveness of using the author's technique, at the end of the experiment, a second test was carried out to test the level of development of the ability to maintain the balance of gymnasts in the control and experimental groups (Table 1).

As can be seen from the research materials, in the test "statodynamic balance "yule", the athletes of the control group showed an average group result of  $9,3 \pm 0,59$  s, and the athletes of the experimental group  $12,6 \pm 0,94$  s. The difference between these indicators is statistically significant. Insofar as  $t_p = 2,96 > t_{gr} = 2,10$ . This means that in the experimental group, in relation to the control, the results of performing this test objectively improved. When performing the exercise

"Pase balance without visual control" gymnasts of the CG showed an average result on the right –  $28,7 \pm 2,58$  s; on the left –  $27,7 \pm 2,92$  s, while gymnasts of the EG on the right –  $37,2 \pm 3,10$  s and on the left –  $30,2 \pm 2,83$  s. Comparison of the results obtained on the right foot according to Student's criterion shows that the difference between the average group values is statistically significant ( $p < 0,05$ ) as opposed to the result on the left, where the difference between the average result of the experimental group relative to the control is statistically unreliable ( $p > 0,05$ ) (Table 1). Similar changes in the test results of athletes in the control and experimental groups were also observed with the exercise "Pase balance at half fingers", namely: athletes from the CG showed an average result on the right –  $54,9 \pm 3,11$  s; on the left –  $55,9 \pm 3,36$  s, and EG on the right –  $65,6 \pm 3,29$  s on the left –  $63,2 \pm 3,47$  s. Comparison of the results obtained on the right foot according to the student criterion shows that the difference between the average group values is statistically significant, since  $t_p > t_{gr}$ , in contrast to comparing the results to the left, where the difference between the average results in the experimental group and the control is statistically unreliable, since  $t_p < t_{gr}$ . The results of introducing the developed author's technique for developing the ability to maintain balance indicate that when performing the test exercise "Tilt to the right", the gymnasts of the CG showed an average group result of  $103,3 \pm 3,74$  s, and the gymnasts of the EG –  $123,1 \pm 5,78$  s. Thus, the results of the study indicate a significant ( $p > 0,05$ ) improvement in the result. To assess the development of the ability to maintain balance of gymnasts 13–15 years old, the test "Tilt to the left" was also used. The results of the study showed that the control group performed this exercise with an average group result of  $88,5 \pm 4,31$  s, and the experimental group –  $105,6 \pm 3,8$  s. It should be noted that according to Student's criterion, the difference between these average group values is statistically significant, since  $t_p > t_{gr}$ . Over the period of the experiment, the results of the test exercise "Tilt back, the number of times in 15 s" underwent significant changes. So, CG girls showed an average result  $16,2 \pm 0,87$  s, and EG –  $19,8 \pm 0,98$  s. According to Student criterion, the difference between the group average in this test is statistically significant ( $p < 0,05$ ).

To solve this goal, the next component of the study was re-evaluation by experts of the technique of turning competitive programs by gymnasts of the control and experimental groups (Table 2).

An expert assessment of the gymnasts' technique of performing the "Ring" with the help of the arm on the right foot

**Table 1**  
**Changes in the level of development of the ability to maintain balance of gymnasts 13–15 years old at the end of a pedagogical experiment ( $t_{gr} = 2,10$  at  $p < 0,05$ )**

No.	Name of test	CG (n=10)		EG (n=10)		$t_p$	p
		$\bar{X} \pm m$		$\bar{X} \pm m$			
1.	Statodynamic balance of "yule", s	$9,3 \pm 0,59$		$12,6 \pm 0,94$		2,96	<0,05
2.	Pase balance without visual control, with	right	$28,7 \pm 2,58$		$37,2 \pm 3,10$	2,11	<0,05
		left	$27,7 \pm 2,92$		$30,2 \pm 2,83$	0,61	>0,05
3.	Pase balance at half fingers, s	right	$54,9 \pm 3,11$		$65,6 \pm 3,29$	2,36	<0,05
		left	$55,9 \pm 3,36$		$63,2 \pm 3,47$	1,51	>0,05
4.	Tilt to the right, s	$103,3 \pm 3,74$		$123,1 \pm 5,78$		2,88	<0,05
5.	Tilt to the left, s	$88,5 \pm 4,31$		$105,6 \pm 3,87$		2,95	<0,05
6.	Tilt back, number of times in 15 s	$16,2 \pm 0,87$		$19,8 \pm 0,98$		2,75	<0,05

**Table 2**

**Results of evaluations by experts of the technique for performing turns of gymnasts 13–15 years after the introduction of the author’s technique ( $t_{gr}=2,10$  at  $p<0,05$ ), points**

No.	Turn name		CG(n=10)	EG (n=10)	$t_p$	P
1.	Turn ""Ring" with the hand"	right	6,2±0,30	7,1±0,34	1,96	>0,05
		left	4,5±0,24	5,3 ±0,33	1,94	>0,05
2.	Turn "Front twine with the hand"	right	5,9±0,32	7,1±0,25	2,95	<0,05
		left	4,5±0,27	5,4±0,39	1,88	>0,05
3.	Turn "Penche" leg into twine	right	6,4±0,29	7,7±0,37	2,74	<0,05
		left	4,8±0,31	5,9±0,40	2,18	<0,05
4.	Turn "Penche" with a bent leg	right	5,7±0,33	7,3±0,45	2,82	<0,05
		left	4,2±0,30	4,8±0,20	1,98	>0,05

at the end of the pedagogical experiment is as follows: in the control group – 6,2±0,30 points, in the experimental group – 7,1±0,34 points. The difference in the results of this exercise is statistically unreliable, since  $t_p=1,96<t_{gr}=2,10$  (Table 2). Similar changes in the results were observed when the gymnasts on the left leg performed this turn, so the gymnasts of the CG received an average group score of 4,5±0,24, and the gymnasts of the EG received 5,3±0,33 points. According to student criterion, the difference between these average values is statistically unreliable ( $p>0,05$ ). The gymnasts performed the control group of the "Front twine with the hand" turn on the right foot, experts rated it 5,9±0,32 points, and the experimental 7,1±0,25 points. The difference between these indicators is statistically significant, since  $t_p=2,95>t_{gr}=2,10$ . This means that at the end of the study, the assessment of the technique of performing the "Front twine with the hand" twist by the EG gymnasts objectively improved with respect to the CG. When performing this turn on the left leg, the gymnasts showed the following results: in the control group – 4,5±0,27 points, in the experimental group – 5,4±0,39 points. The difference between these indicators, according to student criterion, is statistically unreliable, since  $t_p<t_{gr}$  (Table 2).

In the process of turning the "Penche" leg into twine on the right foot by athletes 13–15 years old, the components of the technique of this exercise were estimated by experts in gymnasts of the CG at 6,4±0,29 points, and gymnasts in the EG 7,7±0,37 ball (Table 2). Comparison of these results by the Student criterion shows that the difference between these average group values is statistically significant ( $p<0,05$ ). When performing this rotation on the left foot, the following was observed: the average group score of the gymnasts of the CG is 4,8±0,31 points, and the gymnasts of the EG – 5,9±0,40 points. Because  $t_p=2,18>t_{gr}=2,10$ , it cannot be concluded that the difference between these indicators is statistically significant. This means that in the experimental group, the results objectively improved in relation to the control group.

According to experts, the gymnasts of the experimental group performed the "Penche with bent leg" turn on the right better than the gymnasts of the control group with a significant difference ( $p<0,05$ ), in contrast to the difference in the results of expert evaluation of this turn on the left leg, which is statistically unreliable ( $t_p=1,98<t_{gr}=2,10$ ). Thus, the analysis of the study showed that the developed methodology for developing the ability to maintain balance by gymnasts of 13–15 years old improves the technique of turning by young athletes (the majority of the average group expert estimates of the technique of turning by gymnasts of the control and experimental groups received significant differences ( $p<0,05$ )).

Let us analyze the consistency of expert assessments of the technique of performing basic turns by gymnasts 13–15 years after the experiment using the calculation of the Kendall concordance coefficient (Table 3–4).

Arithmetic average number of ranks  $Q_{av}=(4+4+4+6+14+16,5+15,5+16)/8=10$ .

Sum of squared deviations from the mean  $S=259$ .

Value of the coefficient of concordance:  $W = \frac{12S}{n^2(m^2 - m)}$ ,

where S – the sum of the squares of the deviations of all rank estimates of each examination object from the average n is the number of experts; m is the number of objects of expertise.

Thus,  $W=0,69$ , which indicates the average level of consistency of expert estimates.

$Q_{av}=(15,5+3+5+4+13,5+18+4+16,5)/4=9,9$ .  
 $S=294,2$

$W = 12 \times 294,2 / 9 \times (512 - 8) = 0,78$ , which indicates a high level of consistency of expert assessments.

**Table 3**

**Calculation of the Kendall concordance coefficient of the results of expert evaluation of the turning technique by CG gymnasts**

Turn name		Expert rating			Sum of ranks	Deviation from the mean	Deviation square
		1	2	3			
1. Turn ""Ring" with the hand", points	right	1	2	1	4	-6	36
	left	1	1	2	4	-6	36
2. Turn "Front twine with the hand", points	right	1	1	2	4	-6	36
	left	1	2	3	6	-4	16
3. Turn "Penche" leg into twine, points	right	6	3	5	14	4	16
	left	5,5	6	5	16,5	6,5	50
4. Turn "Penche" with a bent leg, points	right	5,5	5,5	4,5	15,5	5,5	33
	left	6	5,5	4,5	16	6	36



Table 4

Calculation of the Kendall concordance coefficient of the results of expert evaluation of the turning technique of the gymnasts

Turn name		Expert rating			Sum of ranks	Deviation from the mean	Deviation square
		1	2	3			
1. Turn "Ring" with the hand", points	right	6	5	4,5	15,5	5,6	31,3
	left	1	1	1	3	-6,9	47,6
2. Turn "Front twine with the hand", points	right	1,5	2,5	1	5	-4,9	24,0
	left	1	2	1	4	-5,9	34,8
3. Turn "Penche" leg into twine, points	right	4,5	3	6	13,5	3,6	12,9
	left	6	6	6	18	8,1	65,6
4. Turn "Penche" with a bent leg, points	right	1	2	1	4	-5,9	34,8
	left	5	6	5,5	16,5	6,6	43,5

Thus, the obtained indicators of the Kendall concordance coefficient provide a basis for the conclusion about the uniformity of the results of the technique of performing basic turns by gymnasts 13–15 years after the implementation of the developed technique. According to all criteria, an average and high level of consistency of expert estimates was recorded [8].

### Conclusions / Discussion

The results of the study complement the theoretical provisions formulated in the works of A. Aftimichuk, A. Krajdan [9], G. Andreeva, [10], N. Bateevo, P. Kyzim [11], twists / turns in rhythmic gymnastics is one of the main of basic groups of components of competitive compositions in each all-around event, and their clear implementation requires athletes of a high level of development to maintain balance. However, the problem of cornering technique remains relevant today, since the complexity of performing this type of exercise lies in its biomechanical features, which provide for a number of spatio-temporal characteristics. The study also confirms the conclusions of V. Sutula, A. Deineko, A. Ryabchenko [1],

A. Mullagildina [5], A. Aftimichuk, A. Krazhdan [9], G. Andreeva [10] and other scientists that the constant complication of the components of competitive activity and the ultimate realization of the individual capabilities of gymnasts result in the exhaustion of reserves for improving their sportsmanship and require the search for new ways to increase results. Specialists L. Karpenko [6], A. Aftimichuk, A. Krazhdan [9], V. Sosina, A. Dovganovska [12] emphasize that the ability to maintain a stable position of the body plays a universal role in rhythmic gymnastics – it is necessary as a base for mastering competitive exercises. Therefore, the results of the study led to the assumption that the level of development of the ability to maintain balance by athletes 13–15 years old affects the technique of cornering in the competitive program.

**Prospects for further research** are to introduce the developed author's methodology for developing the ability to maintain balance by young gymnasts in the educational process of the Children's and Youth Sports School, Children's and Children's Sports School, clubs and specialized educational institutions to further improve it.

**Conflict of interests.** The authors declare that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

### References

- Sutula, V.O., Deineko, A.Kh. & Ryabchenko, O.V. (2019), "Enhancing the Culture of Performing Track Competitions by Young Gymnasts by Using Non-Traditional Training Tools", *Slobozans'kij naukovno-sportivnij visnik*, No. 2(70), pp. 44-49, doi:10.15391/snsv.2019-2.007. (in Ukr.)
- Rhythmic Gymnastics Technical Committee: FIG (2017), Rhythmic Gymnastics Competition Rules (2017-2020). (in Ukr.)
- Deineko, A.Kh., Mullagildina, A.Ya. & Krasova, I.V. (2016), "Improving the coordination skills of gymnasts in the initial training in rhythmic gymnastics", *Osnovy pobudovy trenuvalnogo protsesu v tsykhlichnykh vydakh sportu. Zbirnyk naukovykh prats II Vseukrainskoi naukovno-praktychnoi internet konferentsii, 24-25 bereznia 2016 r.*, KhSAPC, Kharkiv, pp. 86-89. (in Ukr.)
- Deineko, A.Kh. & Krasova, I.V. (2018), "Changes in the level of coordination training of gymnasts 10-12 years as a result of the use of special exercises on the Bossu Balance Trainer", *Slobozans'kij naukovno-sportivnij visnik*, No. 4(66), pp. 19-24, doi:10.15391/snsv.2018-4.003. (in Ukr.)
- Mullagildina, A.Ya. (2017), "The effect of sensorimotor coordination on the technical preparedness of young athletes in rhythmic gymnastics", *Slobozans'kij naukovno-sportivnij visnik*, No. 2(58), pp. 62-66, doi:10.15391/snsv.2017-2.011. (in Russ.)
- Karpenko, L.A. (2003), *Khudozhestvennaya gimnastika: ucheb. dlya trenerov, prepodavateley i studentov fiz. Kultury* [Rhythmic gymnastics: textbook. for trainers, teachers and physical students Culture], Moscow. (in Russ.)
- Bilokopytova, Zh.A., Nesterova, T.V., Deriuhina, A.M. & Biezsonova, V.A. (1999), *Khudozhnia himnastyka: navchalna prohrama dlia dytiachoyunatskykh sportyvnykh shkil, spetsializovanykh shkil Olimpiiskoho rezervu, shkil vyshchoi sportyvnoi maisternosti* [Rhythmic Gymnastics: Curriculum for Children's and Junior Sports Schools, Specialized Schools of the Olympic Reserve, Schools of Higher Sporting Skills], Republican Scientific and Methodological Cabinet, Kyiv. (in Ukr.)
- Koeffitsient konkordatsii Kendela (2019), available at: <http://math.semestr.ru/corel/concordance.php>. (in Russ.)
- Aftimichuk, O. & Krazhdan, O. (2014), "Specificity of the classification of turns in rhythmic gymnastics", *Fizichna aktivnist, zdorov'ya i sport*, No. 1(15), pp. 70-76. (in Russ.)
- Andrieieva, R.I. (2011), *Tekhnolohiia navchannia tekhniki vprav z obruchem na osnovi spetsialnoi fizychnoi pidhotovky yunyykh himnastok: avtoref. dys. kand. nauk z fiz. vykhovannia i sportu* [Technology training in hoop exercises based on the special physical training of young gymnasts: PhD thesis abstract], KhSAPC, Kharkiv, 21 p. (in Ukr.)
- Bateeva, N.P. & Kyzim, P.N. (2014), "The use of classical dance to improve the technique of turning by young gymnasts", *Slobozans'kij naukovno-sportivnij visnik*, No. 3(41), pp. 19-22. (in Russ.)
- Sosina, V. & Dovhanovska, A. (2008), "Indicators of static and dynamic equilibrium in high-skill athletes engaged in rhythmic gymnastics",

*Suchasni problemy rozvytku teorii i metodyky himnastyky*, pp. 16-19. (in Ukr.)

Received: 07.07.2019.

Published: 31.08.2019.

## Information about the Authors

---

**Alfiia Deineko:** *PhD (Physical Education and Sport); Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.*

**ORCID.ORG/0000-0001-7990-7999**

**E-mail: snosocio@gmail.com**

**Olha Riabchenko:** *Kharkiv State Academy of Physical Culture: Str. Klochkovsky 99, Kharkov, 61058, Ukraine.*

**ORCID.ORG/0000-0003-2868-0637**

**E-mail: riabchenko.ov@gmail.com**

# Assessment of the effectiveness of biological and pharmacological support for training at the preparatory stage for handball players

Vladimir Favoritov  
Vadim Gostishchev

Zaporizhzhya National University, Zaporizhzhya, Ukraine

*Based on the analysis of the biological and pharmacological support of athletes, a dietary supplement was chosen to study the effectiveness of the application at the preparatory stage. The presented experimental data indicate that there are positive significant differences between the control and experimental groups of athletes who took dietary supplements of NSP Defense Maintenance. The conducted studies confirm the need for planning the biological and pharmacological support of sports activities in order to increase sports results and prevent and restore athletic health and athletic disabilities.*

**Purpose:** to study the effectiveness of the use of dietary supplements with antioxidant effects and with an immunostimulant effect to optimize the functional state of athletes at the preparatory phase.

**Material & Methods:** the studies were organized on the basis of the laboratory of "Biochemistry and Pharmacology of Sports" of Zaporizhzhya National University with the participation of 28 athletes aged 17 to 23 years. In the process of the experiment, the following methods were used: analysis of scientific and methodological literature, generalization of practical experience, pedagogical observations, methods for assessing functional readiness using computer technologies, methods of mathematical statistics.

**Results:** the use of dietary supplements of the NSP Defense Maintenance company positively affected the growth of overall physical performance in athletes in the preparatory period.

**Conclusion:** it is shown that the biological and pharmacological support of training at the preparatory stage is one of the important factors in increasing the efficiency of the training process.

**Keywords:** biological and pharmacological support, functional preparedness, preparatory period, dietary supplement, antioxidants, immunostimulants.

## Introduction

Very high physical and mental stress, bordering on the capabilities of the human body of highly qualified athletes, also require high technologies of medical and biological support, which allows to increase athletic performance [1; 2; 10].

According to scientists [4; 5; 8; 13], the incorrect organization of the training process, its insufficient individualization, the combination of sports training with intensive work or study in the presence of even compensated defects in a state of health can lead to the appearance of various pathological conditions.

At present, quite a lot of factual material has been accumulated on the etiology, pathogenesis and clinic of disorders that occur under the influence of physical activity of varying intensity. According to modern concepts [4; 6] about the pathogenesis of various disorders that occur in individual organs and tissues of the body under the influence of intense physical activity, the most important pathogenetic link is a violation of energy metabolism.

R. D. Seifulem [9] believes that pharmacological, especially immunopharmacological, correction is one of the main modern directions in the prevention and recovery of health disorders and athletic form of athletes.

Pharmacological preparations that can improve the endurance of training and competitive loads due to a decrease in the formation of toxic metabolites during intense muscle activity include antioxidants – substances of various chemical nature that can inhibit or eliminate non-enzymatic free radical oxidation of organic substances by oxygen [11–13]. In the body, antioxidants protect lipids from oxidation, including membrane cell formation. But the main advantage of antioxidants is the ability to withstand the destruction of lipid cells by free radicals during oxidation. Free radicals occur during stress, which is physical activity. Antioxidants, interacting with them, block free oxidation [5].

There is positive practical experience [12] of the use of individual antioxidants to increase physical performance. So, for athletes specializing in rowing, as well as middle-distance runners, lipoic acid contributes to less inhibition of speed and speed endurance after a great physical load of an aerobic nature, justifies the possibility of its use as a means of increasing physical performance.

The synergistic effect of the use of a combination of phyto-collection of medicinal herbs (root and rhizome of licorice and calamus swamp, rosehips, peppermint leaves and bird highlander) and the drug "Selenium-active"; the drug "Selenium-active", ascorbic acid and sorbitol [5]. The combination gives the greatest antioxidant effect and more stimulates the immune system than the use of these drugs separately.

Modern multivitamin complexes include important additives-electrolytes and trace elements, the concentration of which in the process of intense physical work can be significantly reduced. Therefore, the advantage can be given precisely to vitamin complexes balanced for these important ingredients. As practice shows, complex vitamin preparations are best used in combination with adaptogens of animal and plant origin, nootropics, antioxidants, and plastic energy-stimulating drugs. So, Supradin (12 vitamins and 8 microelements) in combination with Elton or Leveton, which expand the spectrum of its action in the body as an antioxidant, immunomodulator, turned out to be effective in the recovery period. Recommended 1 capsule 2 times a day after meals for three weeks with Elton 2 tablets 3 times a day or leveton. The result – increased adaptation of the body of athletes to physical exertion (speed-strength types, endurance, mental stability) [10].

Despite various positive facts about the effectiveness of the use of pharmacological agents in sports, issues related to the biological and pharmacological support of athletes at various stages of training and various physical activities in aerobic-anaerobic zones of power and restoration of athletic performance are far from fully studied and require research that has both theoretical and practical value for many sports.

**Purpose of the study:** to test the hypothesis that the use permitted antioxidants together with immune stimulants leads to optimization of the functional state and improves the quality of functional preparedness of athletes in speed-strength sports.

## Material and Methods of the research

The study involved 28 volunteer athletes aged 17–23 years of secondary qualification specializing in handball and had a sports rank of 1 category and Candidate in masters of sport. The study was conducted in September – November 2018. All athletes were acquainted with the purpose of the study, medical monitoring of their condition was constantly carried out. No pathological reactions were detected. The obtained numerical results were processed by the method of variation statistics using Student's criterion. The data were taken as reliable when  $P < 0,05$ .

We formed two groups – a control and a research group of 14 volunteer athletes at each age of 17–23 years old, of secondary qualification, specializing in handball and had a sports rank of 1 category and Candidate in masters of sport.

It was logical to assume that the use of antioxidants together with immunostimulants may be one of the ways to correct physical performance and, in particular, in conditions of intense training activity. The Defense Supplement NSP (Defense Maintenance NSP) supplement was selected. NSP Defense Maintenance dietary supplement contains a specially selected spectrum of vitamins - antioxidants (A, C and E), minerals (zinc, selenium) and medicinal plants that restore and strengthen the immune system. The research team at the preparatory stage took the biologically active additive "Protective formula NSP" according to the scheme: the use of dietary supplements – 3 weeks; break 1 week; the use of dietary supplements for 3 weeks. Dose – 1 capsule per day with meals.

To assess the level of functional preparedness and its components in the study, a computer program was used to expressly assess the level of general functional preparedness

of athletes. The examination algorithm within the framework of this program included the performance of the standard submaximal bicycle ergometric test PWC170, as well as measurements of the length (cm) and weight (kg) of the body of athletes. The program automatically calculated the values of general physical performance (rPWC170), aerobic capacity (VO<sub>2</sub>max), values of alactate and lactate power and capacity, threshold of anaerobic metabolism (TANM), heart rate at the threshold level of anaerobic metabolism (HR<sub>TANM</sub>), total metabolic capacity (TMC), reserve capacity (RC), efficiency of the muscular energy supply system (EES), and general level of functional preparedness (LFP) of the body of athletes. All quantitative values that were used in the program were calculated and distributed on functional levels: "low", "below average", "medium", "above average", "high" [7].

## Results of the research

At the first stage of the study, we evaluated the parameters of the functional preparedness of handball players at the beginning of the preparatory period (Table). It was found that the values of almost all indicators of functional fitness corresponded to the average value for athletes of this age and did not have a significant difference between the control and the experimental group ( $p > 0,05$ ).

This conclusion was made on the basis of appropriate scales developed by the authors of the Sports School of high sportsmanship program and taking into account literature data [7].

So, the value rPWC170 and rMOC, reflecting the level of development of the general physical performance and endurance of the body, corresponded to the average values of these parameters for athletes of this age. At the level of the "average" indicator were indicators characterizing the speed endurance of athletes (ALAKp and ALAKc). At the "average" level, the value of the total metabolic capacity of the body of athletes (TMC) was also recorded.

The general level of functional preparedness (LFP) of the subjects in the control group was  $71,33 \pm 1,94$  points and  $73,27 \pm 1,54$  points in the experimental group, which corresponds to the "average" level.

A second examination of a group of handball players was carried out in the middle of the preparatory period (after 4 weeks).

At this stage of the study, the examined handball players of both groups determined the positive dynamics of almost all functional parameters used in the study. It is noteworthy that for most indicators almost the same growth rates were recorded, which indirectly may indicate the harmony of the training sessions of handball players in the process of their preparation for the season. Significant differences between the indicators of the control and experimental groups have not been established.

The final stage of the study was an assessment of the effectiveness of the use of dietary supplements from NSP Defense Maintenance.

The results of the study indicate (Table) that at the end of the preparatory period, athletes noted a further significant im-

Indicators of functional fitness of athletes in the control and experimental groups during the experiment

Indicators	Groups	Beginning of the preparatory period	End of the preparatory period	Increase, %
rPWC170, kgm·min <sup>-1</sup> ·kg <sup>-1</sup>	CG	20,89±0,34	22,72±0,53	8,74
	EG	21,05±0,32	23,97±0,37*#	13,87
VO <sub>2</sub> max, ml·min <sup>-1</sup> ·kg <sup>-1</sup>	CG	62,16±0,98	66,96±1,12	7,72
	EG	62,46±1,58	69,16±1,44*	10,72
Alactate power, W·kg <sup>-1</sup>	CG	6,35±0,26	6,95±0,39	9,41
	EG	6,48±0,21	7,45±0,32*	14,31
Alactate capacity, conventional units	CG	38,33±1,34	41,79±1,34	8,83
	EG	39,13±1,07	44,43±1,29*#	15,4
Lactate power, W·kg <sup>-1</sup>	CG	55,78±0,21	6,07±0,24	8,73
	EG	5,61±0,16	6,35±0,21*	14,15
Lactate capacity, conventional units	CG	30,63±0,95	33,41±1,32	9,07
	EG	31,58±0,72	36,18±1,12*	13,59
TANM, %	CG	62,22±1,65	66,59±1,72	7,03
	EG	61,28±1,53	66,21 ±1,63*	7,67
HR <sub>tanm</sub> , beats·min <sup>-1</sup>	CG	161,12±4,87	173,61±4,51	7,75
	EG	156,36±4,39	172,13±4,32*	10,13
TMC, conventional units	CG	194,39±5,12	210,89±5,99	8,49
	EG	191,89±3,29	213,11±5,39*	10,88
PC, points	CG	74,86±0,44	80,87±2,13	8,03
	EG	73,57±0,37	79,61±1,19*	8,21
EES, points	CG	75,23±0,89	80,33±1,49	6,78
	EG	74,08±0,77	79,69±1,33*	7,57
LFP, points	CG	71,33±1,94	81,73±2,21	14,58
	EG	73,27±1,54	89,43±2,56*#	22,06

**Remark.** \* –  $p < 0,05$  in comparison with the beginning of the preparatory period; # –  $p < 0,05$  in comparison to the control group.

provement in almost all indicators characterizing the general, speed, speed-strength endurance, efficiency of the energy supply system and reserve capacity of the body. This increase in all indicators characterizing the functional preparedness of handball players was also reflected in the scoring of the general level of functional preparedness, which amounted to 81,73±2,21 points in the control group (relative increase – 14,58%) and 89,43±2,56 points in the experimental group (relative increase – 22,06%).

The ALAKp and ALAKc indicators characterizing speed endurance increased from the beginning of the experiment by 9.41% and 8.83% in the control group. In the experimental group, they were significantly higher than in the control, and their growth from the beginning of the experiment was 14.31% and 15.4%, respectively. The largest relative increase in these indicators (speed-power and speed endurance) in both groups indicates that they are one of the main qualities of handball players and therefore a lot of time was devoted to the preparatory period for the development of these qualities.

The smallest relative increase in the results in both groups was recorded in indicators characterizing the efficiency of the energy supply system of muscle activity (EES CG – 6,78%; EG – 7,57%) and the total metabolic capacity of the body of athletes (TMC CG – 8,49%; EG – 10,88%). In our opinion, this is due to the fact that in the preparatory period, athletes perform large volumes of loads, and the body of athletes is not sufficiently adapted to such loads, which does not allow them to work in an economical mode.

At the end of the 8-week experiment, we note significantly higher differences in the experimental group compared to the control group in terms of rPWC170 (indicates the level of general physical performance and endurance of the body), alac-

tate capacity (characterizes speed endurance), LFP (indicator of the general level of functional preparedness).

## Conclusions / Discussion

Thus, it can be assumed that the use of Defense Maintenance NSP according to the recommended dietary supplement plan had a positive effect on the growth of overall physical performance among athletes in the preparatory period.

Our results coincide with the positive effect of using a complex antioxidant complex (selenium – 500 mg/day, lipoic acid – 400 mg/day, vitamin C – 500 mg/day, vitamin E – 400 mg/day) [3]. The authors established a significant increase in special physical performance in middle-distance runners in the preparatory period.

There are a number of groups of pharmacological preparations, a large number of biologically active food additives and products of specialized sports nutrition, which, with a skillful approach, will solve almost all the tasks of biological and pharmacological support. It must be remembered that there can be no pattern, since genetically gifted athletes differ significantly from each other not only in anthropometric parameters, metabolic characteristics, functioning of the nervous and endocrine systems, molecular structure of muscle fibers, but also in pharmacogenetic qualities that determine individual sensitivity to one or another medicine.

**Prospects for further research.** Further research will be aimed at studying the optimization of specialized nutrition for athletes during the organization of a long-term training process for athletes of various training orientations. Research in these areas can provide more precise control of the training process, improve athletic performance and prevent maladaptation processes.

**Conflict of interests.** The authors declare that no conflict of interest.  
**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

1. Vodlozerov, V. (2016), "Biological and pharmacological support for training, competition and recovery of triathletes", *Slobozhans'kij naukovno-sportivnij visnik*, No. 4, pp. 26-31. (in Russ.)
2. Volkov, L.V. (2016), *Teoriya i metodika dityachogo ta yunackogo sportu* [Theory and methodology of children's and youth sports], Osvita Ukraini, Kyiv. (in Ukr.)
3. Drozdovskaya, S.B., Cirulnikov, A.V., Ivaschenko, O.S. & Voronina, Yu.A. (2004), "The effect of the antioxidant complex on the activity of the surfactant system of athletes specializing in middle-distance running", *Pedagogika psihologiya ta mediko-biologichni problemi fizichnogo vihovannya i sportu*, No. 6, p. 104-112. (in Russ.)
4. Evdokimov, E.I. & Golec, V.A. (2004), "The Possibility of Using Metabolic Correction Means to Improve Physical Performance", *Pedagogika, psihologiya ta mediko-biologichni problemifizichnogo vihovannya i sportu*, No. 6, pp. 112-118. (in Russ.)
5. Kazimirko, N.K., Shan'ko, V.M., Mochalova, I.S., Andreyeva, V.V., Stupnitskaya, N.S. & Perfil'yeva, M.YU. (2017), "Features of the pathogenesis of immune and metabolic disorders in athletes at different periods of the training cycle and their correction with antioxidants", *Meditsina i zdavookhraneniye: materialy V Mezhdunar. nauch. konf.*, Buk, Kazan', pp. 111-114. (in Russ.)
6. Levchenko, L. (2014), "Correction of the physical performance of football players in the competitive period by exogenous macroergic phosphates", *Moloda sportivna nauka*, Vol. 3, pp. 114-118. (in Russ.)
7. Malikov, N.V., Bogdanovskaya, N.V. & Kuznetsov, A.A. (2005), "The use of new computer technologies in assessing the functional preparedness and functional state of the body", *Slobozhans'kij naukovno-sportivnij visnik*, No. 8, pp. 237-340. (in Russ.)
8. Mirzoyev, O.M., Bodrova, N.D. & Bodrov, I.V. (2014), "Athletics. Current Trends in the Development of 100 Meter Running", *Slobozhans'kij naukovno-sportivnij visnik*, No. 1 (39), pp. 66-74. (in Russ.)
9. Seyfulla, R.D. (1999), *Sportivnaya farmakologiya: spravochnik* [Sports Pharmacology: Handbook], IPK "Moskovskaya pravda", Moscow. (in Russ.)
10. Seyfulla, R.D. (2004), "Pharmacological correction of performance during the training of highly qualified athletes", *Sportivna meditsina*, No. 1-2, pp. 110-121. (in Russ.)
11. Smul'skiy, V.L., Zemtsova, I.I. & Sutkovoy D.A. (1999), "Improving the Correction of the Body's Resistance to Strenuous Muscular Activity Through the Condition of its Antioxidant System", *Nauka v Olimpiyskom sporte*, Special. Issue, pp. 87-92. (in Russ.)
12. Tkachenko, N.V. (1998), "Pharmacological correction of the thiol-disulfide link of the antioxidant system as a way to increase physical performance", *Pedagogika, psikhologiya ta mediko-biologichni problemi fizichnogo vykhovannya i sportu*, No. 6, pp. 27-30. (in Russ.)
13. Shkrebtiy, Yu.M. & Futornyi, C.M. (2010), "Correction of the functional state of the athlete's organism in modern sports medicine", *Pedahohika, psykholohiya ta medyko-biologichni problemy fizychnoho vykhovannya i sportu*, No. 4, pp. 167-170. (in Ukr.)

Received: 10.07.2019.

Published: 31.08.2019.

## Information about the Authors

**Vladimir Favoritov:** PhD (Pharmacology), Associate Professor; Zaporizhzhya National University; Zhukovsky str. 66, Zaporizhzhya, 69000, Ukraine.

**ORCID.ORG/0000-0002-8806-0512**

**E-mail: favn1956@gmail.com**

**Vadim Gostishchev:** PhD (Medicine), Associate Professor; Zaporozhia National University, Zhukovskogo str. 66, Zaporozhia, 69000, Ukraine.

**ORCID.ORG/0000-0003-1837-9058**

**E-mail: waddim@ukr.net**

## Vegetative reactivity in athletes in a state of overtraining

Larysa Ruban<sup>1</sup>  
Oleksandr Khatsaiuk<sup>2</sup>  
Oleh Yareshchenko<sup>3</sup>  
Artem Korolov<sup>2</sup>  
Viacheslav Olenchenko<sup>2</sup>

<sup>1</sup>Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

<sup>2</sup>National Academy of the National Guard of Ukraine,  
Kharkiv, Ukraine

<sup>3</sup>Kharkiv National University of Internal Affairs, Kharkiv, Ukraine

**Purpose:** to determine the state of the autonomic regulation of heart rhythm in athletes at various stages of overtraining from the results of an analysis of heart rate variability.

**Material & Methods:** under our supervision there were 49 athletes with signs of overtraining of the I-II stage. To determine vegetative reactivity, an analysis of cardiointervalography data with an orthostatic test was performed.

**Results:** revealed that the most often overtraining of the II stage was found among athletes of playing sports, and with athletic qualifications more often occurs among athletes of the I category than among masters of sports. The results of cardiointervalography indicated that in highly qualified athletes in a state of overtraining, the index of autonomic reactivity does not bring the value of the stress index beyond the balanced work of the ANS. In athletes from the 1st category, compared with masters of sports, hypersympathicotonic activity of the ANS occurs against the background of overtraining.

**Conclusions:** a high indicator of the stress index after an orthostatic test indicates the development of the strain of autonomic and regulatory systems in the body of athletes of the first category, which can lead to a breakdown in the adaptive capabilities of the body.

**Keywords:** athletes, overtraining, cardiointervalography, heart rate variability.

### Introduction

Achieving high athletic performance is closely related to the correct construction of the training process. In this case, one of the most important principles in the preparation of an athlete is the compliance of the load with the functional state of the body. In recent years, there has been a progressive increase in physical activity, the athlete's body is transferred, both during training, and even more during competitions, when a neuropsychic load also joins. Due to this, more and more often, athletes of various specializations, regardless of the orientation of the training process, observe a state of overtraining [3; 4; 7; 11; 16].

Overtraining is a pathological condition in which there is a violation of the ratio of the processes of excitation and inhibition in the cerebral cortex, due to various reasons, such as: monotonous, long-term highly specialized physical activity; violation of the regime of training, rest, nutrition; the use of certain medicinal substances (sometimes even prohibited in sports) training against a background of acute or chronic diseases; in violation of the didactic principles of building the training process [2; 6; 10].

Starting from the first stage, the regulatory role of the nervous system in the function of the systems and organs of the athlete's body is sharply violated, and a focus of stagnant excitation or inhibition is observed. These processes extend to most parts of the brain, leading to inhibition or increase in the function of the humoral regulation link through the system of the hypothalamus – pituitary gland – endocrine glands [9; 12]. This, in turn, leads to a violation of the autonomic regulation

of the function of internal organs, including the cardiovascular, respiratory, digestive, excretory systems. In addition, all types of metabolism in the body are disrupted: proteins, carbohydrates, lipids, vitamins, water, macro- and microelements. That is, there are not only functional changes in the athlete's body, but also an organic restructuring of the structure of some organs. The state of all parts of the immune system is sharply disturbed: both nonspecific resistance of the body and specific immunity (its humoral and cellular link). In addition, due to the above reasons, the basic motor qualities of a trained person are violated, that is, first speed, then coordination of movements, strength indicators, and, last but not least, endurance [8; 14; 17].

The organs and systems of the human body are under constant neuro-humoral control, therefore, the close relationship of the sympathetic and parasympathetic departments of the autonomic nervous system and humoral influences ensure optimal results in terms of adaptation to changing conditions of the internal and external environment. Deviations arising in regulatory systems, as a rule, precede hemodynamic, metabolic, energy disturbances, and are the earliest prognostic signs of an imbalance in the athlete's body. Heart rate is an indicator of these deviations, therefore, the study of heart rate variability has important diagnostic and prognostic value for various pathologies, including overtraining in athletes.

The organs and systems of the human body are under constant neuro-humoral control, therefore, the close relationship of the sympathetic and parasympathetic departments of the autonomic nervous system and humoral influences ensure optimal results in terms of adaptation to changing conditions of the

internal and external environment. Deviations arising in regulatory systems, as a rule, precede hemodynamic, metabolic, energy disturbances, and are the earliest prognostic signs of an imbalance in the athlete's body. Heart rate is an indicator of these deviations, therefore, the study of heart rate variability has important diagnostic and prognostic value for various pathologies, including overtraining in athletes [1; 5; 13; 15].

Based on the foregoing, the question of a careful approach to the early diagnosis of overtraining in athletes, the current analysis of HRV is appropriate and relevant, which will allow the timely introduction of methods for adjusting the training process.

**Purpose of the study:** to determine the state of the autonomic regulation of heart rhythm in athletes at various stages of overtraining from the results of an analysis of heart rate variability.

## Material and Methods of the research

The study was conducted in the scientific-problem laboratory of the KSAPC. Under our supervision there were 49 athletes, sports qualifications from the first sports category to the master of sports (MS) with signs of overtraining of the I-II stage. According to demographic indicators, the groups of subjects were homogeneous by sex, age, height and weight indicators. The stage of overtraining was established by clinical signs (Table 1).

To assess the state of the autonomic nervous system, cardiointervalography was performed. The method is based on a mathematical analysis of the variability of the sinus heart rhythm, as an indicator of the adaptive-compensatory activity of the whole organism. Cardiointervalography was performed in continuous recording over 100 consecutive cardiocycles (R-R intervals) in the II standard ECG lead. After a 10-minute rest in a horizontal position, the first CIG record (initial) was recorded, the second was recorded immediately after moving to a vertical position. The integral parameter of cardiointervalography (CIG) was calculated as the resting stress index (SI<sub>1</sub>) – an indicator of the initial vegetative tone, and its dynamics in response to changes in the functional state (SI<sub>2</sub>), which is a reflection of vegetative reactivity (SI<sub>2</sub>/SI<sub>1</sub>).

CIG indicators were taken into account:

Mo (mod) – the most common value of the duration of the R-R interval, expressed in seconds.

Amo (mode amplitude) – the number of intervals equal to Mo as a percentage of the total number of registered cardiocycles.

**Table 1**  
Characteristics of the examined contingent athletes with signs of overtraining I-II stage

Kind of sport	MS	CMS	I sports category	Total
1. Martial Arts	4	6	5	15
2. Athletics	2	5	3	10
3. Football	2	4	6	12
4. Volleyball	3	5	4	12
Total	11	20	18	49

DX (variational range) – the difference between the maximum and minimum values of the duration of the R-R interval.

SI (stress index) – the most fully informed about the degree of tension of the body's compensatory mechanisms, the level of functioning of the central contour of regulation of heart contractions in arbitrary units, calculated by the formula: **SI=Amo+(2xMoxDX)**.

Statistical analysis of the results was performed using EXCEL tables. For parameters that meet the criteria of normal distribution, parametric statistical methods were used. In this case, the arithmetic mean value –  $\bar{X}$ ; was calculated; the average error of the arithmetic mean is  $\pm m$ .

All ethical principles for medical research have been followed according to the WMA declaration (Helsinki, 2013).

## Results of the research

The studies were carried out at the beginning of the training preparatory period, when the athletes did not show signs of overtraining, and then in the main (base) period, when the training loads are combined with the competitive ones. According to the results of the study, it was revealed that stage I overtraining was observed in 28 (57,1%) athletes with signs of this syndrome. The second stage of overtraining was determined in 21 (42,9%) athletes (Table 2).

When analyzing the data on the distribution of the stages of overtraining by type of sports provided in Table 2, it was found that the second stage overtraining was most common among

**Table 2**  
The distribution of the studied athletes by type of overtraining, sport, sports qualification (number of persons, %)

Sports / Qualifications	Stage of overtraining	
	I st.	II st.
	28 (57,1%)	21 (42,9%)
<b>За видом спорту:</b>		
martial arts	12 (80%)	3 (20%)
athletics	7 (70%)	3 (30%)
football	4 (33,3%)	8 (66,7%)
volleyball	5 (41,7%)	7 (58,3%)
<b>By sports qualification:</b>		
MS (11)	8 (72,7%)	3 (27,3%)
CMS (20)	13 (65%)	7 (35%)
I category (18)	7 (38,9%)	11 (61,1%)

athletes in sports, and it was more common among athletes of first category athletes than MS.

One of the objectives of our work was to study the characteristics of HRV at rest and after an orthostatic test. Table 3 presents the indicators of cardiointervalography of athletes of various sports qualifications.

Masters of sports (MS) in various sports are characterized by relatively high heart rate variability.

Given the value of the stress index (SI<sub>1</sub>=53,92±6,66), the tension of the mechanisms of autonomic regulation of the ANS in athletes of this group is low. After performing an or-



Table 3

Indicators of cardiointervalography of athletes of various qualifications in a state of overtraining,  $\bar{X} \pm m$ 

Indicators	MS (n=11)	CMS (n=20)	I category (n=18)	p <sub>1</sub>	p <sub>2</sub>
Mode (Mo) <sub>1</sub>	0,84±0,03	0,87±0,02	0,89±0,09	>0,05	>0,05
Amplitude mode (Amo) <sub>1</sub>	18,12±1,19	19,65±1,07	25,89±3,24	>0,05	<0,05
Dx <sub>1</sub>	0,26±0,03	0,28±0,02	0,29±0,09	>0,05	>0,05
Stress index (SI) <sub>1</sub>	53,92±6,66	56,81±7,06	90,88±28,67	>0,05	<0,05
Mode (Mo) <sub>2</sub>	0,69±0,02	0,64±0,02	0,63±0,04	>0,05	>0,05
Amplitude mode (Amo) <sub>2</sub>	19,18±1,10	22,13±1,12	39,33±4,60	<0,05	<0,05
Dx <sub>2</sub>	0,21±0,02	0,19±0,01	0,25±0,07	<0,05	<0,05
Stress index (SI) <sub>2</sub>	81,92±10,71	117,4±15,66	207,7±48,41	<0,01	<0,01
SI <sub>2</sub> /SI <sub>1</sub>	1,82±0,21	2,83±0,31	2,91±0,54	<0,01	<0,01

**Remark.** p<sub>1</sub> – comparison the MS group with the CMS group; p<sub>2</sub> – comparison of the MS group with group I category.

thostatic test, activation of the sympathetic nervous system moderately increases in MS, as evidenced by a mode indicator (Mo<sub>2</sub>=0,69±0,02), an increase in mode amplitude (Amo<sub>2</sub>=19,18±1,10) and stress index (SI<sub>2</sub>=81,92±10,71), but its activation does not bring the value of the stress index beyond the balanced operation of the ANS, as indicated by the indicator of vegetative reactivity (SI<sub>2</sub>/SI<sub>1</sub>=1,82±0,21).

According to cardiointervalography, in the group of athletes of the CMS, in comparison with MS, activation of both the sympathetic and parasympathetic parts of the nervous system was noted: indicators of Mo increased (0,87±0,02 against 0,84±0,03), variational range (0,28±0,02 against 0,26±0,03), mode amplitude (19,65±1,07 against 18,12±1,19) and stress index (56,81±7,06 against 53,92±6,66). After performing an orthostatic test in CMS, a decrease in the mode parameter (0,64±0,02 against 0,69±0,02) and the variation range (0,19±0,01 against 0,21±0,02), as well as an increase in the mode amplitude (22,13±1,12 against 19,18±1,10) and the stress index (117,40±15,66 against 81,92±10,71), which indicates activation as cute and parasympathetic divisions of the ANS. However, against the background of a normal initial tone (eutonia) with orthostatic test, hypersympathicotonic reactivity occurs (SI<sub>2</sub>/SI<sub>1</sub>=2,83±0,31 against 1,82±0,21 in MS). These changes indicate sympathicotonic control of the heart rhythm during an orthostatic test. In a small number of athletes, CMS (18,73%) revealed a decrease in resting SI to 30 c. u. due to the prevalence of the parasympathetic division of the autonomic nervous system in the regulation of heart rhythm. The initial vagotonia may have had a compensatory character, since autonomic reactivity should be hypersympathicotonic type.

In the group of athletes of the 1st category, it was found that against the background of an increase in the amplitude of the mode (25,89±3,24 against 18,12±1,19) and the stress index (90,88±28,67 against 53,92±6,66), there is an increase in the mode (0,89±0,09 against 0,84±0,03) and the variation range (0,29±0,09 against 0,26±0,03), which indicates an increase in the activation of sympathetic and parasympathetic impacts. However, during an orthostatic test, against the background of a decrease in the Mo indicator (0,63±0,04 against 0,69±0,02), a statistically significant increase in Amo occurs (39,33±4,60 against 19,18±1,10) and Dx (0,25±0,07 against 0,21±0,02), and a significant increase in SI<sub>2</sub> was also

observed (207,70±48,41 against 81,92±10,71). In athletes of the first category, compared with MS, in terms of cardiointervalography, hypersympathicotonic activity of the ANS occurs against the background of overtraining; at the same time, a high SI<sub>2</sub> indicator indicates the development of tension of regulatory autonomic and regulatory systems in the body of athletes of the first category, and this can lead to a breakdown in the adaptive capabilities of the body.

Thus, in athletes of the I category in a state of overtraining, in most cases hypersympathicotonic reactivity was noted, confirms the more active contribution of the sympathetic nervous system.

### Conclusions / Discussion

According to the results of the study, it can be argued that at the main stage of the training period, the athletes we studied were in a state of overtraining. According to clinical signs, 57,1% of athletes were at stage I, 42,9% at stage II. The most often overtraining of stage II was found among athletes of playing sports: among football players 66,7%, among volleyball players 58,3%, as well as stage II overtraining is more common among first-rate athletes than MS, which confirms the data of A. V. Peshkova and contradicts the data of A. M. Alaverdyan et al, who claimed that the first type of overtraining is more common in novice athletes, and type II – among high-class athletes [10]. According to the results of cardiointervalography in athletes of the 1st category, in comparison with MS, the parasympathetic division of the nervous system is activated, a high SI<sub>2</sub> indicator indicates the development of tension of regulatory autonomic and regulatory systems in the body of athletes of the 1st category, and this can lead to a breakdown in the adaptive capabilities of the body. In studies of O. B. Zapovitrenoy, G. V. Korobeinikova, L. G. Korobeynikova (2015), S. V. Pogodina, G. D. Aleksanyants (2015), D. S. Lysenko (2017) activation of neurohumoral was revealed in athletes of various sports and age groups centers and parasympathetic link of the autonomic nervous system, which was confirmed in our work [4; 6; 17].

**Prospects for further research** are to develop programs for pre-nosological diagnosis and medical-pedagogical correction of functional disorders of the autonomic regulation of heart rhythm in athletes.

**Conflict of interests.** The authors declare that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

1. Ban, A.S. & Zagorodnyy, G.M. (2010), *Vegetativnyy pokazatel dlya otsenki variabelnosti ritma serdtsa sportsmenov* [A vegetative indicator for assessing heart rate variability in athletes]. (in Russ.)
2. Badietva, V.A., Pavlov, V.I., Sharykin, A.S., Khokhlova, M.N., Pachina, A.V. & Vybornov, V.D. (2018), "Overtraining syndrome as a functional disorder of the cardiovascular system caused by physical exertion", *Rossiyskiy kardiologicheskiy zhurnal*, No. 23 (6), pp. 123-128. (in Russ.)
3. Goncharov, A., Ruban, L. & Ananchenko, K. (2017), "Uroven fizicheskogo sostoyaniya zdorovya i fizicheskoy podgotovlennosti organizma bortsov-veteranov sporta", *Slobozans'kij naukovno-sportivnij visnik*, No. 5 (61), pp. 42-47. (in Russ.)
4. Zapovitryana, O.B., Korobeynikov, G.V. & Korobeynikova, L.G. (2015), "Features of the vegetative regulation of the heart rhythm in the wrestlers of the new age groups", *Pedagogika, psikhologiya ta mediko-biologichni problemi fizichnogo vikhovannya i sportu*, №4, S. 22-26. (in Ukr.)
5. Legotkin, A.N. (2016), "Vegetative Status in Sport", *Mezhdunarodnyy nauchno-issledovatel'skiy zhurnal*, No. 11-2, pp. 134-135. (in Russ.)
6. Lysenko, D.S. (2017), "Analysis of heart rate variability for the diagnosis of overtraining syndrome in athletes", *Tavrisheskiy nauchnyy obozrevatel*, No. 10-2(27), available at: <https://cyberleninka.ru/article/n/analiz-variabelnosti-ritma-serdtsa-dlya-diagnostiki-sindroma-peretrenirovannosti-u-sportsmenov> (accessed by: 29.06.2019). (in Russ.)
7. Markov, K.K., Ivanova, O.A., Sivokhov, V.L. & Sivokhova, Ye.L. (2015), "Features of autonomic reactivity in athletes with different orientations of the training process", *Fundamentalnye issledovaniya*, No. 2-19, pp. 4304-4308. (in Russ.)
8. Minko, O.V. (2015), "Features of heart rate variability in response to an orthostatic test in young athletes specializing in judo and sambo", *Fizicheskaya kultura, sport – nauka i praktika*, No. 2, available at: <https://cyberleninka.ru/article/n/osobennosti-variabelnosti-ritma-serdtsa-v-otvet-na-ortostaticheskuyu-probu-u-yunyh-sportsmenov-spetsializiruyuschih-sya-v-dzyudo-i-sambo> (accessed by: 29.07.2019). (in Russ.)
9. Nekrasova, M.M., Fedotova, I.V., Blinova, T.V., Parin, S.B. & Polevaya, S.A. (2017), "Study of the stages of stress in athletes during physical exertion", *Materialy XXIII sezda Fiziologicheskogo obshchestva im. I.P. Pavlova s mezhdunarodnym uchastiem*, pp. 2054-2056. (in Russ.)
10. Pieshkova, O.V. (2009), "Types of overtraining syndrome in athletes of game sports", *Medichni perspektivi*, Vol. XIV, No. 3, pp. 91-97. (in Ukr.)
11. Pieshkova, O.V. (2013), "Influence of physical rehabilitation on the condition of the cardiorespiratory system of athletes at the initial degrees of overtraining", *Slobozans'kij naukovno-sportivnij visnik*, No. 3 (36), pp. 108-113. (in Ukr.)
12. Mironov, S.P., Polyayev, B.A. & Makarova, G.A. (2013), *Sportivnaya meditsina: natsionalnoe rukovodstvo* [Sports medicine: national leadership], GEOTAR-Media, Moscow. (in Russ.)
13. Khaspekova, N.B. (2003), "Diagnostic information content of monitoring heart rate variability", *Vestnik aritmologii*, No. 32, pp. 15-19. (in Russ.)
14. Shilovich, L.L. (2012), "Perspektivy diagnosticheskogo primeneniya metoda analiza variabelnosti serdechnogo ritma v sporte (obzor literatury)", *Problemy zdorovya i ekologii*, No. 3(33), available at: <https://cyberleninka.ru/article/n/perspektivy-diagnosticheskogo-primeneniya-metoda-analiza-variabelnosti-serdechnogo-ritma-v-sporte-obzor-literatury> (accessed by: 26.06.2019). (in Russ.)
15. Petruhnov, A., Ruban, L., Okun, D., Honcharov, A., Lytovchenko, A., Ananchenko, K., Khatsayuk, O., Turchynov, A. & Garkavy, O. (2019), "A Quality Factor Of Cardiovascular System Reaction On A Daily Physical Exertion Of Students", *Research Journal of Pharmaceutical, Biological and Chemical Sciences Volume*, Vol. 10, Issue 2, pp. 521-525.
16. Podrigalo, L.V., Volodchenko, A.A., Rovnaya, O.A., Ruban, L.A., & Sokol, K.M. (2017), "Analysis of adaptation potentials of kick boxers' cardio-vascular system", *Pedagogika, psikhologiya i mediko-biologicheskie problemy fizicheskogo vospitaniya i sporta*, No. 4, pp. 33-37. (in Russ.)
17. Pogodina, S.V. & Aleksanyants, G.D. (2015), "The heart rate variability and hemodynamic response of the female athletes in the age range of 17-45 years", *Fundamentalnye i prikladnye nauki segodnya. Materialy V mezhdunarodnoy nauchno-prakticheskoy konferentsii*, p. 1. (in Russ.)

Received: 20.07.2019.

Published: 31.08.2019.

## Information about the Authors

**Larysa Ruban:** PhD (physical rehabilitation) candidate of Physical Training and Sport. Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.

**ORCID.ORG/0000-0002-7192-0694**

**E-mail: slarisaruban@gmail.com**

**Oleksandr Khatsaiuk:** Honored coach of Ukraine, Deputy Head of the Department of Physical Training and Sports: National Academy of the National Guard of Ukraine: Kharkiv, Ukraine.

**ORCID.ORG/0000-0002-4166-9099**

**E-mail: hatsa@ukr.net**

**Oleh Yareshchenko:** Candidate of Science in Physical Education and Sports, Associate Professor, Associate Professor of the Department of Tactical and Special Physical Training; Kharkiv National University of Internal Affairs: Ukraine.

**ORCID.ORG/0000-0002-2475-7572**

**E-mail: slarisaruban@gmail.com**

**Artem Korolov:** Lecturer in the Department of Physical Training and Sports; National Academy of National Guard of Ukraine: Kharkiv, Ukraine.

**ORCID.ORG/0000-0002-4136-5204**

**E-mail: slarisaruban@gmail.com**

**Viacheslav Olenchenko:** Lecturer in the Department of Physical Training and Sports; National Academy of National Guard of Ukraine: Kharkiv, Ukraine.

**ORCID.ORG/0000-0002-2331-4577**

**E-mail: slarisaruban@gmail.com**

# Legal regulation of labor of specialists in the field of physical education and sports in Ukraine

Marina Sannikova

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

**Purpose:** to identify areas for improving the legal regulation of labor of specialists in the field of physical education and sports in Ukraine.

**Material & Methods:** in this study, a methodological approach was used, according to which the legal regulation of labor of specialists in the field of physical culture and sports in Ukraine was considered from the point of view of the interaction of systems of different orders. Theoretical analysis and systematization of literary sources on the topic of the study made it possible to find out the problem field of the legal regulation of labor of specialists in the field of physical education and sports in Ukraine. The analysis of documentary materials made it possible to characterize the system of legal regulation of labor of specialists in the field of physical education and sports. The application of the system analysis method made it possible to understand the logic of the deployment of the entire system of labor relations at the national and world levels, to penetrate deeply into the content and industry specifics of labor relations, to analyze in general the general trends. Methods of mathematical statistics allowed us to determine the dynamics of indicators of staffing in the field of physical education and sports in Ukraine over the past 10 years.

**Results:** the system of legal regulation of labor of specialists in the field of physical culture and sports is described, which includes the norms of domestic labor legislation, international legal acts on the protection of labor rights, as well as industry legislative and regulatory and program documents in the field of physical culture and sports. It was found that the number of full-time employees over the past 10 years has decreased by 8,3%, in particular, due to a decrease in the number of employees of higher educational institutions, sports facilities, sports trainers, trainers, teachers and sports teachers.

**Conclusion:** the need for improving the legal regulation of labor of specialists in the field of physical culture and sports in Ukraine in the following areas has been clarified: the creation of a unified system of certification of fitness trainers and other fitness personnel, fixed at the state level; determination of common principles for the legal regulation of labor of professional athletes; monitoring the economic feasibility of training specialists of certain specialties in the field of physical education and sports by universities.

**Keywords:** law, state, labor legislation, specialists, professional athletes, physical education and sports.

## Introduction

In Ukraine, there has long been an urgent need for a quality regulation of the activities of specialists in the field of physical education and sports. This is evidenced by existing practice, in particular, the sphere of the fitness industry is developing so rapidly that the state training system does not have time to graduate qualified specialists. This, in turn, leads to the fact that many trainers begin to work without specialized education. In addition, it should be noted and such an important factor that confirms the relevance of the chosen topic – this is the importance of the profession of a trainer, physical education teacher, physical education teacher, etc., because their activities are aimed at maintaining the health of the nation, are the highest social values the state.

The special nature and working conditions of specialists in the field of physical education and sports determined the specifics of its legal regulation. Domestic legislation should ensure the effective observance of their rights and real protection of interests. Given the fact that the sports law industry in Ukraine is at the formation stage, it will be easier to accomplish this task than to change outdated standards.

Domestic scientists such as M. V. Dutchak [3], I. L. Gasyuk [1], A. V. Gorbenko [2], A. A. Polyansky [10], S. Moiseeva [8] in-

vestigated various aspects staffing in the field of physical education and sports. The scientific interest in the literature is also caused by the problems of managing the sphere of physical culture and sports, as well as their legal regulation, are examined in the works of I. E. Rybichich [11], A. Zayarn [6], S. Nikitenko [9], Antonio Di Marco [14]. An analysis of domestic and foreign studies indicates that today the issue of legal regulation of the labor of specialists in the field of physical education and sports in Ukraine remains insufficiently covered.

**Purpose of the study:** to identify urgent problems of legal regulation of labor of specialists in the field of physical education and sports in Ukraine.

## Material and Methods of the research

In this study, a methodological approach was used, according to which the legal regulation of labor of specialists in the field of physical culture and sports in Ukraine was considered from the point of view of the interaction of systems of different orders. The theoretical analysis and systematization of literary sources on the topic of the study made it possible to find out the problematic field of legal regulation of labor of specialists in the field of physical culture and sports in Ukraine. The analysis of documentary materials made it possible to characterize the system of legal regulation of labor of specialists in the

field of physical education and sports. The application of the system analysis method made it possible to understand the logic of the deployment of the entire system of labor relations at the national and world levels, to penetrate deeply into the content and industry specifics of labor relations, to analyze in general the general trends. Methods of mathematical statistics allowed us to determine the dynamics of indicators of staffing in the field of physical education and sports in Ukraine over the past 10 years.

## Results of the research

In our study, it was found that the system of legal regulation of the work of specialists in the field of physical culture and sports includes the rules of domestic labor legislation, international legal acts protecting labor rights, as well as sectoral legislative and regulatory documents of the sphere of physical culture and sports.

It is known that the labor relations of employees, including specialists in the field of physical culture and sports, are governed by the current labor legislation, in particular, the Labor Code of Ukraine [7], the rules of which are supplemented by the rules of international law.

Modern international legal regulation of labor occurs in concert in the complex of other socio-economic rights. International legal acts contain a list of social rights and other human rights – political, civil (personal), economic, social, cultural, among which labor rights have a proper place. For example, the International Covenant on Economic, Social and Cultural Rights, the European Social Charter, the Charter of Fundamental Rights of the European Union, etc. [14].

The main legislative document that regulates relations in the field of physical culture and sports is, of course, the Law of Ukraine "On Physical Culture and Sport" [5], in article 49 of which it is emphasized that the state provides training and re-training of personnel in the field of physical culture and sports, special attention is paid to their preparation for work in rural areas.

To implement this provision of the Law of Ukraine "On Physical Culture and Sport", the government develops and adopts the relevant by-laws and regulations. In the analysis of the last

three state programs for the development of physical culture and sports, which are developed every 5 years by the Ministry of Youth and Sports of Ukraine and approved by the Decree of the Cabinet of Ministers of Ukraine, we must pay attention to the fact that proper training of a personnel reserve is one of the priority strategic directions for the development of physical culture and sports at state and regional, as well as at local levels.

According to statistics, the Ministry of Youth and Sports of Ukraine annually reports that in our country at the end of 2018 there were only 70,135 full-time employees (Table).

As can be seen from the Table, the largest share of the total number of full-time employees is made up of employees of general educational institutions (in 2018 – 23,674 people) and sports trainers, trainers, teachers, and sports teachers (in 2018 – 14691 people). The smallest share of the total number of full-time employees is made up of physical education instructors from rural and village councils and united territorial communities (in 2018 – 810 people).

An analysis of the dynamics of the indicators of staffing in the field of physical education and sports indicates that the number of full-time employees over the past 10 years has decreased by 8,3% and amounted to 76,447 people in 2008. If we analyze the indicators of staffing for various categories of full-time employees, then from 2008 to 2018 there was a noticeable decrease in the number of employees of higher educational institutions (by 30,9%) and sports facilities (by 27,7%), and trainers in sports, trainers, teachers of sports (19,7%). Such a massive reduction in workers is due to changes in the state course on the activities of higher education institutions, which included a reduction in the hours allocated to physical education and sports and fitness work, a decrease in the financing of higher education institutions for physical education and sports, and a significant decrease in the number of sports schools and specialized educational institutions sports profile, as well as the political situation in the country, crisis phenomena in the economy, etc.

However, during the period under study, there was an increase in full-time employees of preschool educational institutions (by 34,8%), physical education and sports societies and departmental physical education and sports organizations at all

**Full-time workers in the field of physical education and sports, according to the Ministry of Youth and Sports of Ukraine**

No. i/o	Indicator Name	Number of employees (person)		Dynamics of indicators (%)
		2018	2008	
1.	Workers in the field of physical education and sports:	<b>70135</b>	<b>76447</b>	<b>-8,3</b>
1.1.	preschool educational institutions	3432	2236	+34,8
1.2.	general educational institutions	23674	27635	-14,3
1.3.	vocational schools	1648	1778	-7,3
1.4.	institutions of higher education	5539	8027	-30,9
1.5.	sports facilities	1926	2664	-27,7
1.6.	educational institutions, enterprises, institutions, organizations of all types	3098	3787	-18,2
1.7.	structural units for physical culture and sports of executive authorities (local government) at all levels	1867	1550	+16,9
1.8.	physical culture and sports societies and departmental physical culture and sports organizations of all levels	1627	1350	+17,02
1.9.	sports trainers, trainers, teachers from sports	14691	18291	-19,7
1.10.	physical trainers of rural and village councils, united territorial communities	810	787	+2,8

levels (by 17,02%), structural units for physical culture and sports of organs executive power (local government) at all levels (by 16,9%).

According to the current legislation, the state provides all specialists in the field of physical education and sports:

- appropriate conditions for work, leisure, medical care;
- advanced training once every five years;
- legal and social protection;
- compensation established by the labor legislation;
- appointment and payment of pensions in accordance with the law;
- the establishment of allowances for sports titles to Masters of Sports of Ukraine, Masters of Sports of International Class Of Ukraine, Honored Masters of Sports of Ukraine in the manner determined by the Cabinet of Ministers of Ukraine [5; 7].

Executive bodies for physical education and sports, for education, healthcare, taking into account the proposals of relevant public organizations, determine the need for specialists in sports and fitness and sports profile. The central executive body in the field of physical culture and sports takes part in licensing and accreditation of higher educational institutions in which specialists in the field of physical culture and sports are trained in the manner determined by the Cabinet of Ministers of Ukraine.

It is especially worth paying attention to the provisions of the Law of Ukraine "On Physical Culture and Sport" that citizens with special education received in accredited educational institutions have the right to conduct pedagogical, educational, training and health-improving work in the field of physical culture and sports. However, in practice, the activities of fitness institutions can be observed as trainers, fitness instructors, etc. They can accept people without education, without transparent certification and experience. Fitness institutions mainly carry out internal work to enhance the competence of their employees, opening a school of fitness trainers, fitness managers. Firstly, the indicated activity, of course, is not regulated by the state, and, secondly, the competence of such "specialists" who receive a certificate of a trainer in a rather short period of time is very doubtful.

Moreover, at the legislative level, fitness facilities, despite a significant increase in their number in recent years, carrying out business activities, are not subject to licensing by the state. Indeed, in the Law of Ukraine "On licensing of types of economic activity" [4], adopted on 03.03.2015, the latest revision of which was July 01, 2019, in article 7 "List of types of economic activity subject to licensing" of such type of economic activity as providing fitness-services to the population, not specified.

Another urgent problem in the context of the legal regulation of labor of specialists in the field of physical culture and sports is the definition of common principles for the legal regulation of labor of professional athletes. This will save the foundations of state regulation of labor relations and at the same time provide broad powers to the parties to the labor relationship with independent determination of the necessary conditions of the labor contract. In the international sports arena, the level of achievements is growing extremely rapidly, so professional sports can be considered one of the most difficult human activities. It follows from this that every professional athlete has

the right to fair remuneration of labor, self-realization, a safe ecological environment, etc. Moreover, the legal consolidation of the rights and interests of professional athletes should be not only in labor contracts, but also at the legislative level. However, in the main legislative document - the Law of Ukraine "On Physical Culture and Sport" only general principles of activity in the field of professional sports are defined. The law does not even contain a definition of such a thing as a contract with an athlete.

Article 38 of the Law of Ukraine "On Physical Culture and Sport" states that "activities in professional sports of athletes, coaches and other specialists, which consists in preparing and participating in sports competitions among professional athletes and are the main source of their income, are carried out in accordance with from this Law, the Code of Labor Laws of Ukraine and other regulatory legal acts, as well as statutory and regulatory documents of the relevant entities of the sphere of physical education and sports and international portable organizations" [5]. However, legal scholars believe that a contract with a professional athlete contains all the signs of a civil law contract, and therefore it should be governed by civil rather than labor law.

In addition, it is necessary to take into account the specific features of each sport. Indeed, for team and individual sports, a different specificity of relations is characteristic. Team sports have an employer-employee relationship, where the club is the employer and the athlete is the employee. In individual sports, the athlete's activities are inherently independent of the club, aimed at making a profit, and contracts are concluded with the aim of providing access to certain competitions.

So, in 2015, the Regulation on working with FIFA intermediaries (agents) was adopted, which confirmed an important change in the approach to managing this category of specialists in the field of physical education and sports. This emergency reform has had a huge and lasting impact on the consolidated national rules for agents [16].

From a legal point of view, the observance of human rights in contracts and agreements to which professional athletes are parties is also an important issue. So, in the work of foreign legal specialist Daniela Heerdt [15], devoted to the study of human rights violations during mega-sports events, we find that in May 2017, UEFA announced its updated requirements for the 2024 tournament, which now directly refer to the protection of rights of man. In addition, the IOC developed host city contracts for the summer Olympic Games 2024 and 2028 for the first time in the history of the Olympic Games, include human rights provisions. Issues of legal protection of the rights to the image of athletes are also interesting for jurisprudence. As Simon Boyes [13] points out in his work, the image provides significant commercial opportunities for well-known athletes, which requires legal protection in order to preserve their exclusivity and, thus, value such rights.

## Conclusions / Discussion

The sphere of physical education and sports in Ukraine is regulated by the state with legislative, sub-legislative and regulatory and program documents that regulate the activities of organizations for the development of physical education, mass sports, professional sports, fitness, physical rehabilitation

and the like. At the same time, the issue of staffing remains a problem in Ukraine [8].

So, I. L. Gasyuk [1] gives the following definition of the term "personnel policy in the field of physical culture and sports" – it is "systematic activity of government bodies aimed at the formation, improvement, implementation of a set of standards, professional requirements for employees, pedagogical and other industry workers, criteria for their selection, training and retraining, advanced training, the rational use of human resources and their preservation based on quantitative and qualitative forecasts and development prospects physical education and sports in Ukraine ...".

Characterizing the peculiarities of the personnel policy in the field of physical culture and sports, A. V. Gorbenko [2] gives his own definition of personnel management – this is "a strategy that combines various forms of personnel work, in particular, personnel planning in various links of the physical culture movement".

We agree with the opinion of these authors and give our own definition of the concept of "legal regulation of labor of specialists in the field of physical education and sports" as a system of standards for the regulation of labor relations in the field of physical education established by legislative, subordinate and local regulatory documents, as well as domestic and international acts and sports.

We also confirmed the opinion of domestic scientists S. Moiseeva [8], M. V. Dutchak [3], I. L. Gasyuk [1], personnel and their level of professional competence is a decisive and main condition for the development of the sphere of physical culture and sports in Ukraine.

We have confirmed the data of the authors S. Nikitenko [9], I. E. Rybichich [11], A. A. Polyansky [10] and the data of our previous studies [12] on the existence of urgent problems in the context of legal regulation of labor by specialists in the field of physical education and sport and the need to improve the system of norms in the field of sports relations at the legislative level, in particular, the creation of a unified system of certification of fitness trainers and other fitness personnel, fixed at the state level, the definition of common principles for legal labor regulation of professional athletes.

We agree with the opinion of foreign authors [15; 17] that the constant disclosures of human rights violations in world sports reduce the level of trust in international sports authori-

ties. An urgent issue, according to Brendan Schwab, is the development of a number of sports laws that would actively protect, respect and support internationally recognized human rights and that would be enforced by a properly designed complaints mechanism [17].

It has been established that the staffing indicators for various categories of full-time employees in the field of physical education and sports over the past 10 years have decreased by 6312 people. An analysis of the dynamics of the indicators of staffing in the field of physical education and sports indicates, firstly, the lack of a coordinated and well-functioning mechanism that would ensure timely monitoring of the economic feasibility of training specialists of certain specialties in the field of physical education and sports, and, secondly, the problematic provision countryside workers in the field of physical education and sports. These conclusions are confirmed by the data of previous studies of the authors A. V. Gorbenko [2] and S. Moiseeva [8].

So, the rapid development of the sphere of physical education and sports, in particular, the fitness industry and professional sports, necessitates improving the legal regulation of labor of specialists in the field of physical education and sports in Ukraine in the following areas:

- firstly, it is necessary to create a unified system of certification of fitness trainers and other fitness personnel, fixed at the state level, with the aim of providing high-quality fitness and fitness services to the population and in the future - strengthening the health of the nation;
- secondly, it is necessary to determine uniform principles for the legal regulation of the work of professional athletes, and will provide the proper conditions for the implementation of their activities;
- thirdly, it is necessary to monitor the economic feasibility of training specialists of certain specialties in the field of physical education and sports by universities, which will ensure the creation of a coordinated and streamlined mechanism of state personnel policy.

These areas are of particular importance, given the fact that Ukraine has announced a European development vector.

**Prospects for further research** associate with the need for development and validation of specific measures to improve legislation in the sphere of physical culture and sport, taking into account the positive foreign experience of legal regulation of sporting activities.

**Conflict of interests.** The author declares that no conflict of interest, which can be perceived so that it can harm the impartiality of the article.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

## References

1. Hasiuk, I.L. (2013), *Mekhanizm derzhavnoho upravlinnia fizychnoiu kulturoiu i sportom v Ukraini: avtoref. dys. doktora nauk z derzhavnoho upravlinnia* [The Mechanism of State Management of Physical Culture and Sports in Ukraine: Doctor of Science thesis abstract], Kyiv, 36 p. (in Ukr.)
2. Horbenko, O.V. (2002), *Naukovo-metodychne obgruntuvannia kadrovoi potreby sfery fizychnoi kultury i sportu v Ukraini: avtoref. dys. kand. nauk z fiz. vykh. i sportu* [Scientific and methodological substantiation of personnel needs of the sphere of physical culture and sports in Ukraine: PhD thesis abstract], Lviv, 19 p. (in Ukr.)
3. Dutchak, M.V. (2010), "Classification of professions in the field of physical culture and sports in Ukraine: the state and prospects", *Sportyvna nauka Ukrainy*, No. 2, pp. 25-41. (in Ukr.)

4. Verkhovna Rada of Ukraine (2019), Law of Ukraine "On Licensing of Economic Activities". Database "Legislation of Ukraine", available at: <https://zakon.rada.gov.ua/laws/show/222-19>. (in Ukr.)
5. Verkhovna Rada of Ukraine (2012), Law of Ukraine "On Physical Culture and Sports". Database "Legislation of Ukraine" / BP of Ukraine, available at: <http://zakon.rada.gov.ua/laws/show/en/3808-12>. (in Ukr.)
6. Zaiarnyi, O. (2011), "Subjects of sports relations", *Yurydychnyi visnyk Ukrainy*, No. 52, pp. 110. (in Ukr.)
7. Verkhovna Rada of Ukraine (2008), Code of Laws on Labor of Ukraine. Database "Legislation of Ukraine" / VR of Ukraine, available at: <https://zakon.rada.gov.ua/laws/show/322-08>. (in Ukr.)
8. Moisieieva, S. (2012), "Problems of State Personnel Policy of Ukraine in the Field of Physical Culture and Sports", *Derzhavne upravlinnia ta mistseve samovriaduvannia*, Iss. 4(15), pp. 243-251. (in Ukr.)
9. Nikitenko, S. (2016), "Features of the legal regulation of physical education and sport in Ukraine", *Derzhavne upravlinnia ta mistseve samovriaduvannia*, Iss. 1(28), pp. 95-100, available at: [https://protocol.ua/ua/sportivne\\_pravo\\_oglyad\\_natsionalnogo\\_zakonodavstva\\_i\\_mignarodnih\\_standartiv/](https://protocol.ua/ua/sportivne_pravo_oglyad_natsionalnogo_zakonodavstva_i_mignarodnih_standartiv/) (accessed by: 5.07.2019). (in Ukr.)
10. Poliianskyi, A.O. (2011), "Legal Problems of Regulation of Professional Athletes in Ukraine", *Zbirnyk naukovykh prats Kharkivskoho natsionalnogo pedahohichnogo universytetu imeni H. S. Skovorody "PRAVO"*, Iss. 16, pp. 47-53. (in Ukr.)
11. Rybchych, I.Ye. (2015), "Legal Aspects of Public Administration in the Field of Physical Culture and Sports in Ukraine", *Derzhavne budivnytstvo*, No. 1, pp. 1-10. (in Ukr.)
12. Sannikova, M.V. (2019), "Actual Problems of Legal Regulation and Legislation in the Field of Physical Culture and Sport in Ukraine", *Slobozhans'kij naukovo-sportivnij visnyk*, No. 3(71), pp. 37-42, doi:10.15391/snsv.2019-3.006. (in Ukr.)
13. Boyes, S. (2015), "Legal protection of athletes' image rights in the United Kingdom", *The International Sports Law Journal*, Volume 15, Issue 1-2, pp 69-82, doi:10.1007/s40318-015-0067-7.
14. Di Marco, A. (2019), "The internal governance of sporting organisations: international convergences on an idea of democracy", *The International Sports Law Journal*, pp. 1-13, doi:10.1007/s40318-019-00144-9.
15. Heerdt, D. (2018), "Tapping the potential of human rights provisions in mega-sporting events' bidding and hosting agreements", *The International Sports Law Journal*, Volume 17, Issue 3-4, pp 170-185, doi:10.1007/s40318-018-0129-8.
16. Rapacciuolo, D. (2016), "Michele Colucci (ed.): The FIFA Regulations on Working with Intermediaries", *The International Sports Law Journal*, Volume 16, Issue 1-2, pp. 123-125, doi:10.1007/s40318-016-0093-0.
17. Schwab, B. (2018), "Embedding the human rights of players in world sport", *The International Sports Law Journal*, Volume 17, Issue 3-4, pp 214-232, doi:10.1007/s40318-018-0128-9.

Received: 12.07.2019.

Published: 31.08.2019.

## Information about the Authors

**Marina Sannikova:** Candidate of Juridical Sciences (Ph.D), Kharkiv State Academy of Physical Culture: 99 Klochkivska Str., Kharkiv, 61058, Ukraine.

**ORCID.ORG/0000-0003-2931-2190**

**E-mail: svetlanastadnik87@gmail.com**

# Innovative programs for recreational swimming and their impact on the physical development of women 30–40 years old

Liliia Sheiko

Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

**Purpose:** to analyze the impact indicators of recreational swimming classes on the physical development of women 30–40 years old.

**Material & Methods:** data collection was carried out in the fitness groups of the Pioneer pool sport school on water sports named after Yana Klochkova. The study involved 20 women aged 30–40 years, 2–3 times a week, attend fitness groups swimming. The duration of one lesson is 45–60 minutes. A comparative analysis of changes in the physical development of the studied contingent in the process of applying innovative programs from recreational swimming was carried out. The methods used were: survey, testing, biomedical control. The obtained quantitative data were processed by methods of mathematical statistics.

**Results:** study suggests that in women 30–40 years old, recreational swimming classes cause positive changes in physical development. In both groups of the studied, significant changes in anthropometric indicators and indicators of the state of the cardiovascular and respiratory systems took place.

**Conclusions:** the targeted use of innovative recreational swimming programs positively influenced the anthropometric indicators of women aged 30–40. A significant improvement in the indicators of the functional state of the cardiovascular and respiratory systems of women involved in swimming was established. It was revealed that anthropometric indicators and indicators of the functional state of the cardiovascular system after a year of classes are significantly high compared to the initial data ( $P(t) < 0,01$ ;  $P(t) < 0,001$ ).

**Keywords:** recreational swimming, women, innovative programs, indicators.

## Introduction

Recently, there has been a significant increase in attention to the means and methods of promoting health and preventing disease in the population. The leading role in the formation of a healthy lifestyle is assigned to optimizing a person's physical activity in combination with hardening, rational nutrition, and appropriate rest. According to experts, physical education and sports is a preventive means of maintaining and strengthening the health and prevention of various noncommunicable diseases and bad habits, and the use of physical activity and sports in order to prevent morbidity requires insignificant additional costs of the state [4].

The physical education of women is considered as an integral part of the general system of their education and upbringing. Physical education is designed to maintain the high performance of women throughout all years of their life, they need to have the necessary knowledge and skills in the field of physical education, and ensure comprehensive development [1; 3; 5; 7]. However, at this time, as V.V. Ponomarev notes, the real volume of motor activity of women aged 30–40 does not ensure the full development and strengthening of the health of this contingent. According to A. P. Romanchuk, in recent years, as a result of a high load at work and at home, most women have a lack of movement during the day. A sedentary lifestyle affects the functioning of many systems of the body of women, especially the cardiovascular and respiratory, which leads to a decrease in the efficiency of the whole organism and especially the brain: attention is reduced, memory is weakened, coordination of movements is disturbed, the time

of mental operations increases [5; 6; 10–13]. Therefore, the search for new forms of motor activity of women is currently relevant. One of these forms is recreational swimming. Many experts argue that recreational swimming turns into a lifestyle that leads to the physical and mental health of a person. Recreational swimming was also widely known among women of all ages. Swimming lessons are necessary in order to make a woman's figure more beautiful, and health better.

According to a number of domestic and foreign authors [6; 12], with regular swimming exercises, the cardiovascular and respiratory systems are improved, metabolic processes are activated, physiological capabilities of the body increase, posture improves, vitality, good mood and other favorable changes that increase a person's working capacity are acquired. However, in their works there remain many unresolved issues of the methodology for conducting recreational swimming classes; insufficient scientific data are provided on changes in the level of health and anthropometric indicators during recreational swimming exercises. The lack of information about changes in the physical development of people involved in recreational swimming, and prompted us to conduct this study [11].

The relevance of the chosen topic is that the dissemination of the experience of such work meets the needs of practice, and the proposed information will help teachers, instructors, physical education practitioners, doctors, as well as those who are engaged in their own activities, to use recreational swimming facilities more effectively to improve health and increase physical preparedness.



**Purpose of the study:** to analyze the impact indicators of recreational swimming classes on the physical development of women 30–40 years old.

*Objectives of the study:*

1. Determine the initial level of physical development of women 30–40 years old, engaged in groups of recreational swimming.
2. To conduct a comparative analysis of changes in the physical development of the studied contingent in the process of applying recreational swimming programs.
3. Develop practical recommendations for teachers on the use of recreational swimming in health groups.

## Material and Methods of the research

Data collection was carried out in the fitness groups of the Pioneer pool (sport school on water sports named after Yana Klochkova). Our study involved 20 women 30–40 years old who regularly attend swimming and fitness groups 2–3 times a week. The duration of one lesson is 45–60 minutes.

At the beginning of the study, a preliminary familiarization with the level of swimming preparedness of the subjects was carried out. In terms of swimming skills, subjects were divided into 2 groups. The first group included women who had a low level of swimming training – low swimming ( $n=10$ ), the second – women swimming well ( $n=10$ ).

In groups for weakly swimming (I group of women), it was first proposed, using the re-interval method, to study the technique of at least one swimming method (crawl on the chest or on the back, breaststroke, on the side) in order to master the wellness in 20–30 workouts distance corresponding to age (the norm of recreational swimming for persons of retirement age from 14 to 50 years is a distance of 1000 m [9]).

As you know, during training in swimming for adults, the applied task of mastering the technique of one, and not necessarily sports, swimming method is primarily related. Some experts also emphasize that the modern swimming technique should be at the heart of adult swimming training, since sports swimming methods have significant advantages over original ones, primarily in terms of speed. Many authors argue that most likely adults can be taught to swim on their backs, breaststrokes or on their sides, since when swimming with these methods it is not necessary to exhale into the water. When determining a swimming method, age, individual abilities to master one method (because adults are more capable of mastering one swimming method) are taken into account. In order to establish a method of swimming it will be easier to master give the task to try to swim in known ways. Observations and fixation of various movements of the arms and legs in distinctive swimming methods are carried out, with particular attention being paid to what kind of foot movements the subjects perform. If these movements are reminiscent of the movement of the legs when swimming with a crawl, breaststroke or on the side, then those who are engaged are offered one of these swimming methods for training. However, the final choice of the method remains with the person, mastering swimming skills, since many people have a coordination tendency to certain movements - in particular, to more effi-

ciently perform movements of the legs with a crawl or breaststroke [8; 12].

Women who had sufficient knowledge of the technology of at least one of the swimming methods (II group of women) were offered to overcome the wellness distance using elements of the technique of various methods. They were recommended to swim on their side, with a crawl on their chest and back, breaststroke on their chest and back with gradual acceleration and at high speed; in the classroom, repeated, remote, uniform methods were used. Classes began from 300–500 m and for 10–20 classes, the distance increased to 800–1000 m.

In the process of the study, the state of the physical development of the subjects was tested at the beginning and after a year of regular classes (in October 2018 – the initial indicators were taken; in June 2019 – the indicators were recorded after a year of swimming). A comparative analysis of changes in the physical development of the studied contingent was carried out.

Having previously familiarized with the level of swimming training; taking into account the level of health, interests and needs of women, as well as adhering to the main stages of planning, recreational swimming programs have been drawn up.

Innovative wellness training programs included exercises that stimulate aerobic and anaerobic sources of energy production. When compiling programs, we were guided by the methodology for constructing and conducting training sessions of a health-improving orientation [3; 15–18]. So, in the process of training loads were dosed; constant pedagogical control of well-being, working capacity, desire to engage was ensured. To organize motor activity by means of swimming, the standard form of classes was used – wellness training, in each of which specific tasks were solved. So, in the preparatory part of the lesson, which was usually conducted on land, exercises were used that provided a gradual increase in heart rate and body temperature, preparation of the musculoskeletal system for further loads and increased blood flow to the muscles; increased mobility in the joints. The main part (conducted in water) was devoted to increasing heart rate to the level of the "target zone"; increasing the functionality of various body systems (cardiovascular system, respiratory, muscle) increase the necessary calorie costs when performing special exercises. In the final part of the exercises, exercises were used that gradually reduced metabolic processes in the body, relieved tension from working muscles, relaxed and stretched certain muscle groups, and reduced heart rate to a level close to normal.

The developed programs contained various training options for the content and duration of both its individual parts and the entire lesson. So, the recommended duration of classes ranged from 45 to 60 minutes. For the development of general endurance in certain types of classes, sometimes a power series of exercises was absent and due to this the aerobic part increased. For a group of weakly swimming women, the time allotted for a warm-up increased, and the number of stretching and relaxation exercises increased accordingly.

In the study, during data collection, methods of testing, interrogation, biomedical control were applied. The obtained quantitative data were processed by methods of mathemati-

cal statistics.

## Results of the research

During the study, measurements were made of anthropometric indicators (body length, body weight, chest, waist, hips) in both age groups. The data obtained as a result of the study are shown in Table 1.

Having examined and carefully analyzed the data obtained as a result of a survey of the contingent of both groups, it can be stated that under the influence of recreational swimming classes, significant changes took place in most indicators. So, after a year of regular swimming in the I group of women, we have significant differences to a smaller side from the initial data for such indicators as body weight ( $P(t) < 0,001$ ), waist and hips ( $P(t) < 0,01$ ). The exceptions were parameters such as body length and chest circumference ( $P(t) > 0,05$ ).

We can observe a similar picture in the second group of respondents, where the indicators of body weight, chest circumference and waist ( $P(t) < 0,01$ ) and hips ( $P(t) < 0,001$ ) significantly changed. An indicator such as body length remained virtually unchanged ( $P(t) > 0,05$ ).

At the beginning of the study, primary tests and tests were carried out, which helped to determine the initial level of physical fitness of women in both groups and contributed to the development of health training programs for swimming for the studied women of both groups [6]. Such primary data were recorded as: heart rate at rest, blood pressure, VC, respiratory retention on inhalation and exhalation (Stange and Genchi tests), respiratory rate.

In our study, samples and tests were performed twice: in October 2018 – using primary indicators of the functional state of the body at the time of registration, and after a year of systematic, focused exercises (June 2019). The data of physiological and functional indicators of women of I and II groups are given in Table 2.

The most important indicators of the functional state of the cardiovascular system are two highly informative and simple indicators that are widely used in practice – heart rate and blood pressure (Table 2) [12]. As can be seen from the table. 2, under the influence of swimming, significant changes took place in all indicators of the functional state of the cardiovas-

cular system of the women studied. The significance of differences in systolic blood pressure after a year of classes was found in both groups of subjects (I group –  $P(t) < 0,001$ ; II group –  $P(t) < 0,01$ ,  $P(t) < 0,001$ ).

During the study period, systolic blood pressure indicators in the I group of women decreased from  $135,34 \pm 1,25$  to  $127,82 \pm 1,53$  mmHg., and in the II group of women – from  $132,17 \pm 1,63$  to  $126,97 \pm 1,84$  mmHg.

In all the women studied, there were noticeable differences in these indicators of diastolic blood pressure ( $P(t) < 0,001$ ). During the year of systematic swimming classes in women of group I, the indicators of diastolic pressure decreased from  $87,56 \pm 1,95$  mmHg. to  $79,15 \pm 1,67$  mmHg. and in the II group of women – from  $85,34 \pm 1,95$  mmHg. to  $76,83 \pm 2,01$  mmHg. As you know, a factor in the positive effects of swimming on the cardiovascular system is the normalization of blood pressure [11; 12]. Analyzing the results of a study of blood pressure indicators in both groups of subjects, it can be stated that as a result of recreational swimming exercises for most of the tested women, it was possible to reduce the amplitude of blood pressure (the difference between the maximum and minimum pressure) and bring the pressure indicators closer to the age norm [2; 14; 16; 17].

An extremely important indicator for assessing the functional state of the body and the effectiveness of training is such an indicator as heart rate (pulse). It is known that an increase in fitness is accompanied by a decrease in heart rate [1; 15; 18]. In our study, as a result of the regular use of the proposed swimming programs, after a year of training heart rate in group I decreased by  $6,13 \text{ beats} \cdot \text{min}^{-1}$  ( $P(t) < 0,001$ ). In group II, a decrease in heart rate occurred by  $5,91 \text{ beats} \cdot \text{min}^{-1}$  and stabilized on indicators  $80,27 \pm 1,74 \text{ beats} \cdot \text{min}^{-1}$  ( $P(t) < 0,01$ ).

The analysis of the results of the functional state of the respiratory system revealed the absence of significant differences between the VC indicators at the beginning and at the end of the study, both in women of the first and second groups of women. These data show that, under the influence of recreational swimming, the vital capacity of the lungs improves, but the differences are not significant ( $P(t) > 0,05$ ). When analyzing the results of the Stange and Genchi tests in both groups, significant changes are observed between the indicators at the beginning and at the end of the study ( $P(t) < 0,001$ ). Posi-

**Table 1**  
Anthropometric indicators of the I and II groups of women 30–40 years old who are engaged in recreational swimming

No. i/o	Measurement indicators	Initial data	Data after 1 year	t	P(t)
<b>I group, n=10</b>					
1.	Body length, cm	168,54±1,23	168,39±1,37	0,08	>0,05
2.	Body weight	66,27±1,41	63,58±1,47	3,4	<0,001
3.	Chest circumference, cm	97,83±1,92	92,95±1,87	1,83	>0,05
4.	Waist circumference, cm	78,01±1,37	72,42±1,31	2,98	<0,01
5.	Hip circumference, cm	91,92±1,36	86,81±1,52	2,51	<0,01
<b>II group, n=10</b>					
1.	Body length, cm	174,78±1,36	174,45±2,41	0,11	>0,05
2.	Body weight	69,94±1,53	64,38±1,39	2,72	<0,01
3.	Chest circumference, cm	108,27±1,53	102,62±1,86	2,37	<0,01
4.	Waist circumference, cm	81,93±1,47	76,69±1,32	2,65	<0,01
5.	Hip circumference, cm	96,78±1,35	90,63±1,37	3,20	<0,001

Table 2

Dynamics of functional indicators of the I and II groups of women 30–40 years old under the influence of recreational swimming

No. i/o	Measurement indicators	Initial data	Data after 1 year	t	P(t)
<b>I group, n=10</b>					
1.	Heart rate at rest, beats. min <sup>-1</sup>	87,29±1,39	81,16±1,32	3,20	<0,001
2.	Blood pressure (systolic), mmHg	135,34±1,25	127,82±1,53	3,80	<0,001
3.	Blood pressure (diastolic), mmHg	87,56±1,95	79,15±1,67	3,28	<0,001
4.	VC, L	2,90±0,17	3,32±0,29	1,39	>0,05
5.	Sample Stange, s	48,86±1,23	54,66±1,36	3,16	<0,001
6.	Sample Genchi, s	37,19±1,78	45,50±2,34	3,55	<0,001
7.	Respiratory rate at rest (per minute.)	15,34±0,96	12,92±1,18	1,46	>0,05
<b>II group, n=10</b>					
1.	Heart rate at rest, beats. min <sup>-1</sup>	86,18±1,25	80,27±1,74	2,76	<0,01
2.	Blood pressure (systolic), mmHg	132,17±1,63	126,97±1,84	2,12	<0,01
3.	Blood pressure (diastolic), mmHg	85,34±1,95	76,83±2,01	3,04	<0,001
4.	VC, L	2,89±0,37	3,28±0,19	0,97	>0,05
5.	Sample Stange, s	47,63±0,86	54,15±1,63	3,54	<0,001
6.	Sample Genchi, s	40,51±2,35	48,91±1,47	3,03	<0,001
7.	Respiratory rate at rest (per minute.)	16,98±1,37	12,05±1,74	2,23	<0,01

tive changes have also occurred in respiration rate. So, in group I, the respiratory rate decreased from 15,34±0,96 times per minute to 12,92±1,18. But the differences between the beginning and end of the study turned out to be unreliable (P(t)>0,05), while in group II the respiratory rate decreased from 16,98±1,37 times per minute to 12,05±1,74 – the differences are significant (P(t)<0,01).

### Conclusions / Discussion

Based on the analysis of special scientific and methodological literature, practical experience, and the result of our own research, we revealed a high need for women to engage in physical-health-improving types of physical culture. An analysis of literary sources indicates that physical education programs do not fully provide the motivation for a healthy lifestyle, do not involve mental and physical activity, and do not take into account the peculiarities of the change in the bio-rhythms of the female body.

In this regard, one of the promising directions in the innovation of physical education of women may be the development and implementation of recreational swimming programs with adjustable physical activity.

The study found that the functional state of women significantly changes during training in the health swimming groups (P(t)<0,01; P(t)<0,001). It can be stated that recreational swimming classes had a positive effect on the anthropometric indicators of women aged 30–40. The targeted use of innova-

tive recreational swimming programs contributes to a significant reduction in body weight, which can significantly improve motor, functional fitness and health, increase the emotional state and motivation for regular physical exercises in water, and form a sustainable need for them.

During the year of swimming, significant improvements were made in the indicators of the functional state of the cardiovascular and respiratory systems of women. It was revealed that anthropometric indicators and indicators of the functional state of the cardiovascular and respiratory system compared with the initial data are significantly high (P(t)<0,01; P(t)<0,001).

Dissemination of the experience of such work meets the needs of practice, and the proposed information will help teachers, instructors, physical education practitioners, doctors, as well as those who are engaged in their own activities, to use recreational swimming aids more effectively to improve health and increase physical preparedness.

**Prospects for further research** include research in the direction of studying the physiological mechanisms of adaptation processes to physical activity during recreational swimming classes and the development of swimming programs for adults, which will take into account not only physiological and functional indicators, but also the characteristics of work. It is necessary to further introduce innovative programs in the educational and tertiary process of groups for improving swimming pools and sports clubs.

**Conflict of interests.** The author declares that no conflict of interest.

**Financing sources.** This article didn't get the financial support from the state, public or commercial organization.

### References

1. Amosov, I.V. & Zemskov, Ye.A. (2000), "Peculiarities of the influence of complex exercises in gymnastics and swimming with a health-improving focus on the main components of physical fitness of women aged 21–35", *Teoriya i praktika fiz. kultury*, No. 6, pp. 23–26. (in Russ.)
2. Balamutova, N.M., Kozhukh, N.F., Sheyko, L.V. & Oleynikov, I.P. (2006), "Changes in the physical development and physical fitness of women aged 35–50 years who are engaged in recreational swimming groups", *Fizicheskoe vospitanie studentov tvorcheskih spezialnostej*, No. 1, pp. 57–61. (in Russ.)
3. Kardamonov, N.N. (2001), *Plavanie: lechenie i sport* [Swimming: treatment and sport], Fizkultura i sport. (in Russ.)

4. Laffin, T. (2012), *Like a fish in water. Effective swimming techniques available to everyone*, Mann, Ivanov i Ferber. (in Russ.)
5. Ponomareva, V.V. (2001), *Fizicheskaya kultura i zdorove* [Physical Culture and Health], SGIFK, Smolensk. (in Russ.)
6. Romanchuk, O.P. (2010), *Medical and pedagogical control in the physical fitness: navch.-metod. pos.*, Odesa. (in Ukr.)
7. Houli, T.E. (2000), *Improving fitness*, Kiev. (in Russ.)
8. Sheyko, L.V. (2012), "The choice of a method for mastering the optimal distance of recreational swimming for men 51-60 years old", *Slobozans'kij naukovno-sportivnij visnik*, No. 1, pp. 18-21. (in Russ.)
9. Sheyko, L.V. (2014), "The relationship and differences of sports, recreational and recreational swimming", *Visnik Chernigivskogo nazionalnogo pedagogicheskogo universitetu*, Vol. 3, No 118, pp. 314-317. (in Russ.)
10. Sheyko, L.V. (2016), "Estimation of the influence of recreational swimming on the level of the physical state of women", *Fizichna utabilitsiya ta rekreatsivno-ozdorovchi tekhnologii*, No 3, pp. 263-269. (in Russ.)
11. Sheyko, L.V. (2017), "Dynamics of the physical and psychoemotional state of women under the influence of swimming", *Slobozans'kij naukovno-sportivnij visnik*, No. 1(57), pp. 121-126, doi: 10.15391/snsv.2017-1.021. (in Russ.)
12. Sheyko, L.V. (2018), "Dynamics of indicators of the functional state of the cardiovascular and respiratory systems of women under the influence of swimming", *Slobozans'kij naukovno-sportivnij visnik*, No. 1(63), pp. 121-125, doi: 10.15391/snsv.2018-1.022. (in Russ.)
13. Shulga, L.M. (2008), *Wellness swimming*, Olinpijska literatura. (in Ukr.)
14. Brian J. Sharkey & Steven E. Gaskill (2006), "Fitness & Health", *Human Kinetics*, No. 6, p. 429.
15. Le Corre, E (2014), *The History is Phesical Fitness*, available at: <http://www.artofmanliness.com/2014/09/24/the-history-of-hysical-fitness/>.
16. Sifferman, J. (2009), *Physical Culture: it's more than just bodybuilding, muscles, and oid-time strongmen training culture*, available at: <http://physicalliving.com/physical-culture-its-more-than-just-bodybuilding-muscles-and-oid-time-strongmen-training-culture/>.
17. Wilmore, J.H., Costill, AD.L. (1994), *Physiology of sport and Exercise – Champaign: Human Kinetics*.
18. Encyclopedia BRITANNICA (2018), Darwinian fitness, available at: <https://www.britannica.com/science/Darwinian-fitness>.

Received: 04.07.2019.

Published: 31.08.2019.

## Information about the Authors

---

**Liliya Sheyko:** *Kharkiv State Academy of Physical Culture: Klochkivska Street 99, Kharkiv, 61058, Ukraine.*

**ORCID.ORG/0000-0002-0020-1959**

**E-mail:** [sheiko.liliya@gmail.com](mailto:sheiko.liliya@gmail.com)



**SLOBOZHANSKIY  
HERALD OF SCIENCE AND SPORT**

The reliability of the presented results correspond to authors

Publication of Kharkiv State Academy of Physical Culture  
Kharkiv State Academy of Physical Culture  
Klochivska Str. 99, Kharkiv, 61058, Ukraine  
+38 (0572) 705-21-02  
hdafk.edu@gmail.com