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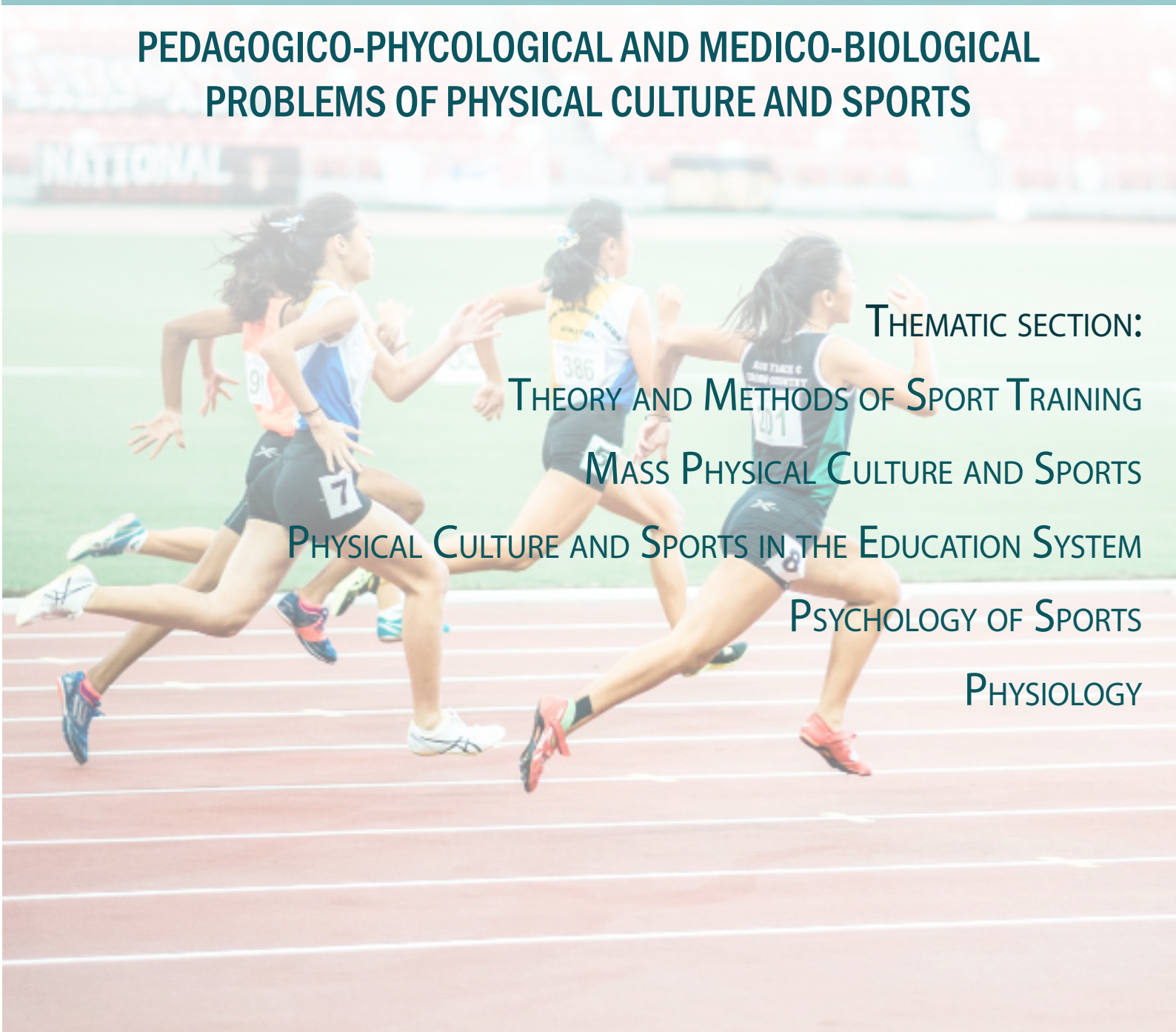
THEORY AND METHODS OF SPORT TRAINING

MASS PHYSICAL CULTURE AND SPORTS

PHYSICAL CULTURE AND SPORTS IN THE EDUCATION SYSTEM

PSYCHOLOGY OF SPORTS

PHYSIOLOGY



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**RUSSIAN JOURNAL OF PHYSICAL  
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Pedagogico-Phycological and Medico-Biological Problems of  
Physical Culture and Sports

Volume 15 no 1 2020

## RUSSIAN JOURNAL OF PHYSICAL EDUCATION AND SPORT

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### Pedagogico-Phycological and Medico-Biological Problems of Physical Culture and Sports

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## Relationships between anthropometric, spirometric, cardio-respiratory and endurance performance values among male Kenyan runners

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**Abstract:** Anthropometric measures such as height and age are used in equations for estimating spirometric values for various populations, while some studies have reported significant relationships between some spirometric, cardio-respiratory and endurance performance. Equations for evaluating spirometric values are usually based on data derived from samples of certain groups of people which may not be representative of the world's diverse population. This study therefore sought to determine the relationships between anthropometric, spirometric and cardio-respiratory values of Kenyan elite endurance runners. **Methods.** Ten (10) male purposively selected elite Kenyan runners volunteered to take part in the study. They were instrumented in anthropometric assessments, spirometry assessments, and an incremental treadmill test to exhaustion coupled with cardio-respiratory assessments. **Results.** Pearson correlation analyses show Pearson correlation analyses from in the current study shows significant relationships between subjects' body height and peak expiratory flow (PEF) ( $r=.741$ ;  $p=.002$ ), forced vital capacity (FVC) ( $r=.640$ ;  $p=.010$ ) and forced expiratory volume in one second ( $FEV_1$ ) ( $r=.587$ ;  $p=.021$ ). The runners' FVC and minute ventilation (VE) had significant correlation with volume of oxygen consumption ( $VO_2$ ) both at submaximal ( $p<.01$ ) and maximal levels ( $p<.05$ ). Sitting height recorded a stronger positive association with  $VO_2$  ( $r=.667$ ;  $p=.009$ ) than body height ( $r=.564$ ;  $p=.029$ ), while the latter has a stronger positive association with submaximal endurance speed ( $r=.668$ ;  $p=.009$ ) than the former ( $r=.617$ ;  $p=.019$ ). Dependent sample t test showed that spirometric values are not significantly different from predicted values ( $p>.05$ ), but maximum heart rate was significantly lower than predicted ( $p=.001$ ). **Conclusion.** Current spirometric prediction equations that use anthropometric variables are fairly accurate. However, more studies are needed to improve prediction and reference values for cardio-respiratory parameters.

**Keywords:** Endurance exercise variables, Predicted values, Somatotype.

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### INTRODUCTION

Anthropometric measures such as height and age are used in equations for estimating/predicting spirometric values for various populations (Hankinson, Odencrantz & Fedan, 1999; Stanojevic et al., 2008). Most of these equations have been derived from measurements data collected from people outside Africa. On the other hand, some studies have reported positive relationships between some spirometric variables and endurance performance (Adegoke & Arogundade, 2002; Fatemi, Shakerian, Ghanbarzade, Habibi & Moghaddam, 2012; Pringle, Latin & Berg, 2005). Use of equations derived from other population may

lead to development of research instruments which have not been validated for the particular population, and may underrate or overrate test parameters. This can have adverse implications in health and fitness appraisal, training, as well as in performance. According to Sood, Dawson, Henkle, Hopkins-Price and Qualls (2007), ancestral background, altitude, and area of residence are some of the factors that may contribute to biological variation which may cause lack of agreement with reference values from different population.

In the last several decades (since 1968) athletes from East Africa have dominated international distance running events (International

Association of Athletics Federation [IAAF], 2012; Larsen, 2003; Onywera, Scott, Boit & Pitsiladis, 2006; Scott & Pitsiladis, 2007). This is especially the case for runners from Kenya. Noakes (2001) noted that no international sport has ever been dominated by athletes from one country to the extent the Kenyans have done in international competitions from 800 m to the marathon, winning between 40 and 50% of all medals.

Favourable anthropometric characteristics have been touted as contributing to success of East African runners. Lucia et al. (2008), and Saunders, Pyne, Telford, and Hawley (2004) observe that reduced muscle mass below the centre of gravity (i.e. thin calves compared with Caucasians) can increase efficiency of running, and seems to be the main determinants of efficiency of human locomotion. However, the extent to which various factors contribute to Kenyan runners dominating the field remains as yet to be determined (Scott and Pitsiladis, 2007; Onywera et al., 2006; Scott et al., 2005; Pitsiladis, Onywera, Geogiades, O'Connell, W. & Boit, 2004). This study therefore sought to determine the relationships between anthropometric, spirometric and respiratory values, and endurance performance indicators (sub-maximal and maximal oxygen consumption and speed) among Kenyan distance runners.

## **MATERIALS AND METHODS**

Ten (10) purposively selected elite Kenyan runners were instrumented in anthropometric assessments, baseline spirometry and an incremental treadmill running test to exhaustion with respiratory assessments. Prior to instrumentation and baseline testing sessions, each participant signed an informed consent form and completed a physical activity readiness screening questionnaire (PAR-Q). After the inclusion criteria were met, the participants underwent basic anthropometry measurements, resting physiological measurements (ventilation [tidal volume and frequency], respiratory gases, blood pressure and heart rate), baseline spirometric tests, and a treadmill test to exhaustion with respiratory measurements regularly taken.

Anthropometric measures (heights, segments, skinfolds, girths and breaths) were taken

and used to establish the general body type and composition of the participants using procedures recommended by ISAK (Marfell-Jones, Olds, Stewart & Carter, 2006). Digital scale (Seca aura 807, Leicester) was used for weight measurements, stadiometer (Height Measure SE001, Leicester) for height, skin fold calliper (Slimguide Body Care, England) for skin fold measurements, sliding calliper (Rosscraft Cambell 10, USA) for breaths, segmometer (Rosscraft Segmometer 4, Canada) for segments, and tape (Rosscraft Anthrotape ORC, USA) for girths.

Spirometric variables measured included forced vital capacity (FVC), forced expiratory volume in one second ( $FEV_1$ ), forced expiratory volume in one second as a proportion of forced vital capacity ( $FEV_1/FVC$ ) and maximum inspiratory pressure (MIP). Respiratory measures obtained during treadmill test included tidal volume (VT), breathing frequency (Fb), minute ventilation (VE), oxygen consumption ( $VO_2$ ), carbon dioxide production ( $VCO_2$ ) and respiratory exchange ratio (RER).

Participants performed 3-6 forced vital capacity maneuvers. This test involved breathing on a turbine Pneumotachograph (HR800L, HansRudolph, USA) from a portable spirometer system (ML 311, ADInstruments, Australia), taking several normal breaths followed by a large inspiration to total lung capacity and a full forceful expiration to residual volume. From this maneuver, researcher recorded values for the forced vital capacity (FVC), the forced expiratory volume in 1 second ( $FEV_1$ ) and peak expiratory flow rates (PEF). Maximal Inspiratory (MIP) was also taken to measure the strength of the respiratory muscles using a pressure manometer (Raytech Instruments, Vancouver, BC). The measurements required the subject to breathe in as hard as possible for at least 1 second at functional residual volume.

The participants began the running test on a treadmill at a starting speed of  $14 \text{ Km h}^{-1}$  with no elevation (after a 5 minute warm-up at a speed of  $5-8 \text{ Km h}^{-1}$ ). Every three minutes the treadmill speed was increase by  $1 \text{ Km h}^{-1}$  until exhaustion. The participants were made to breathe through a mouthpiece of spirometer system with nose clip fixed, allowing the measurement of ventilation

to be made. In addition, the respired gases were analyzed using respiratory gasses analyzers (17625 and 17630, Vacumed, Ventura, California, USA) such that the amount of carbon dioxide produced and oxygen consumed was determined. Heart rate was measured and monitored using Polar heart rate monitor (S610i, Polar Electro, Kempele, Finland). The last five stages leading to maximal exercise were considered in the data analyses. Average speed for these five exercise stages leading to termination of exercise were 14.72±1.35, 15.60±1.51, 16.70±1.34, 17.70±1.34, 18.70±1.34 (mean±sd) [km/h]. At the time of termination of the incremental exercise, the participants reached average speed of 18.7±.34 Km/hr, the highest being 21 Km/hr.

**Participants' Characteristics**

The average age of the participants was 26.90±4.175 (mean±sd) and is within the range at which endurance athletes at which endurance athletes are in their prime (Schulz & Curnow, 1988), while the BMI average was 18.376±1.624, typical of values reported for Kenyan distance runners (Kong & Heer, 2008). The participants' training attributes include running training frequency of 5.10±.316 per week, training distance 12.70±5.10 km, weekly training mileage of 111.60±44.06 [km], and duration of competitive running of 5.10±2.02485 (mean ± sd) years.

**RESULTS AND DISCUSSION**

**Anthropometric Values**

The participants' anthropometric values were summarised as calculated using Heath-Carter formula as adopted in ISAK Manual (Marfell-Jones et al., 2006). The somatotype values indicate that the participants had moderate ectomorphy and

mesomorphy components, with low endomorphic values (Endomorphy; 0.91±0.34, Mesomorphy; 3.31±0.98, Ectomorphy; 4.80±1.32). The values are similar to those reported by Abraham (2010) showing low endomorphic characteristics and with ectomorphic component highly marked among middle and long distance runners. Percent body fat by six skin folds (5.25±0.59%) rated the participants as athletic according to established norms used in evaluating trained persons (Netfit, 2012). It showed that the runners have low levels of fat, bordering what is referred to as essential fat necessary for vital body functions. Rating of BMI (18.38±1.62) and Waist to Hip Ratio (0.80±0.03) shows similar trend for the athletes. The values are close to those observed by Kong and Heer (2008) who reported low body mass index (20.1±1.8 [kg\*m-2]) and low percentage body fat (5.1±1.6) among elite Kenyan distance runners.

**Baseline Spirometry values**

The spirometry values are summarised in descriptive measures in Table 1. Dependent sample t test was used to compare the baseline spirometric values against their corresponding predicted values. Prediction equations from the National Health and Nutrition Examination Survey (NHANES III) for African American were used as presented by Hankinson et al., (1999). These reference standards are based on measurements of normal subjects of similar age, height, and race. The results indicate that spirometric values are not significantly different (p>.05) from predicted values, Prediction equations from local study by Orié (1999) yielded significantly higher values than those recorded by the current study.

Table 1 - Subjects' recorded and predicted spirometry values (n=10)

Spirometric Variable	Mean±Std. Deviation
Peak inspiratory flow (PIF) [L/s]	4.45±1.84
Peak expiratory flow (PEF) [L/s]	8.57±2.34
Predicted PEF [L/s]	9.29±.58
Percentage of predicted PEF [%]	91.88±22.05
Forced vital capacity (FVC) [L]	4.02±.56
Predicted FVC [L]	4.33±.35

Percentage of predicted FVC [%]	93.11±12.62
Forced expiratory volume in one second (FEV <sub>1</sub> ) [L]	3.39±.56
Predicted FEV <sub>1</sub> [L]	3.66±.28
Percentage of predicted FEV <sub>1</sub> [%]	92.91±15.61
FEV <sub>1</sub> as a proportion of FVC ((FEV <sub>1</sub> /FVC)%) [%]	86.69±6.48
Predicted value for FEV <sub>1</sub> as a proportion of FVC [%]	84.32±.76
Percentage of predicted value for FEV <sub>1</sub> /FVC [%]	102.82±7.77

### **Cardio-Respiratory Variables**

Cardio-Respiratory values recorded at rest and during treadmill incremental exercise tests for Heart rate (HR), Percent of age-predicted maximum heart rate (%MHR<sub>pred</sub>), Tidal Volume (VT), Breathing Frequency (Fb), Minute Ventilation (VE), Oxygen Consumption (VO<sub>2</sub>), Carbon dioxide production VCO<sub>2</sub>, and Respiratory Exchange Ratio (RER) are summarized in Table 2. The variables values are known to increase with exercise intensity at varying rates, with sub-maximal and maximal values used to estimate fitness and metabolic statuses of the individual (Carey, Schwarz, Pliego & Raymond, 2005; Haff & Dumke, 2012; Plowman & Smith, 1997). Peak values can be differentiated from maximal values in that the latter are the values recorded at the termination of exercise with or without a plateau, while the former are the highest recorded values during the exercise test duration. Robergs (2001) observes that the term VO<sub>2</sub> max should not be applied to the peak VO<sub>2</sub> attained without a VO<sub>2</sub> plateau. This can apply to the other tested variables.

Most of the resting values for the respiratory variables are within values cited by several authors. According to Elert (2001), the average values for VT is 500 mL for Male and 390 mL for Female. Mackenzie (2004) cites values of 600 and 500 mL for (Caucasians) male and female respectively. The author says that for a given standing height, thoraxes of people of African origin are shorter than of Caucasians of similar age, sex and height, and therefore have lower lung capacity. As for the heart rate values, one sample *t* test comparing the recorded and age-predicted values indicate that the participants had significantly lower HR and %HRM (*p*=.001) at rest and during maximal endurance running. Oxygen Consumption peak values (3.50±.26) [L/min] were significantly higher than predicted values (*p*=.001), for people of similar age and height in general population. Relative VO<sub>2</sub> max values (64.4±4.9) [ml/kg/min] rated superior judged on cardio-respiratory fitness classification from Physical Fitness Specialist Manual as presented in Heyward, (2006).

**Table 2 - Cardio-Respiratory values for athletes at rest, at sub-maximal exercise, maximal exercise, and peak values recorded (mean ± sd), (n =10).**

<b>Respiratory Variable</b>	<b>At Rest</b>	<b>At sub-maximal exercise</b>	<b>At maximal exercise</b>	<b>Peak</b>
HR	57.60±10.74	176.60±9.76	180.40±10.28	180.40±10.28
% MHR <sub>pred</sub>	30.01±2.09	91.50±5.62	93.46±5.82	93.46±5.82
VT [L/br]	.55±.14	1.84±.31	1.87±.29	1.90±.29
Fb [br/min]	21.64±4.40	59.28±12.27	60.51±10.88	61.77±11.37
VE [L/min]	8.57±1.61	79.45±10.90	83.07±11.98	84.24±10.14
Absolute VO <sub>2</sub> [L/min]	.29±.07	3.40±.29	3.44±.35	3.50±.26
VCO <sub>2</sub> [L/min]	.25±.06	3.41±.44	3.51±.46	3.57±.41
RER	.86±.08	1.00±.07	1.02±.07	1.02±.07
Relative VO <sub>2</sub> (ml/kg/min)	5.30±1.10	62.32±4.13	63.22±6.76	64.36±4.88



### Correlation Analyses

Pearson correlation analyses from in the current study shows significant relationships between subjects' body height and PEF ( $r=.741$ ;  $p=.002$ ), FVC ( $r=.640$ ;  $p=.010$ ) and FEV<sub>1</sub> ( $r=.587$ ;  $p=.021$ ). The runners' FVC and VE had significant correlation with relative VO<sub>2</sub> both at sub-maximal ( $p<.01$ ) and maximal levels ( $p<.05$ ). PEF, FVC, FEV<sub>1</sub>, VE and speed had higher correlation ( $p<.05$ ) with VO<sub>2</sub> at sub-maximal than at maximal levels. Other spirometric variables (PIF, FEV<sub>1</sub>/ FVC, MIP)

recorded no significant relationship with subjects' body height ( $p>.05$ ). Subjects' body height recorded high correlation with speed at maximal exercise level ( $r=.668$ ;  $p=.009$ ) and with maximal oxygen consumption relative to body weight (VO<sub>2</sub> max) ( $r=.564$ ;  $p=.029$ ) (Table 3). Other anthropometric variables which recorded significant correlation (inversely) with velocity/speed at maximal exercise level at  $p<.01$  are waist to hip ratio (WHR) and percentage body fat.

Table 3 - Correlation analyses for subjects anthropometric variables vs speed at maximal exercise level and rVO<sub>2</sub> max ( $n = 10$ )

Anthropometric variables	Correlation $r$ with speed	Correlation $r$ with VO <sub>2</sub> max
Body height (stretch stature)	.668**	.564*
Body weight/mass	.519	.384
Body mass index (BMI)	-.044	-.145
Waist girth	.575*	.313
Arm girth	.183	.093
Gluteal girth (max.)	-.356	-.515
Calf girth (max.)	.162	.019
Waist to hip ratio (WHR)	.739**	.624*
%Body fat	-.713**	-.839**
Sum of 6 skinfolds	-.645*	-.763**
Sum of 8 skinfolds	-.630*	-.760**
Sitting height	.617*	.667**
Troncherterion ht	.452	.295
Troncherterion-tibiale laterale	.568*	.156
Tibiale laterale ht	.405	.321
Tibiale mediale-sphyrion tibiale [cm]	.345	.167
Endomorphy	-.649*	-.726**
Mesomorphy	-.029	-.008
Ectomorphy	.093	.386

\* Correlation is significant at the 0.05 level (2-tailed).  
\*\* Correlation is significant at the 0.01 level (2-tailed).



Waist girth, sitting height and Troncherterion-tibiale laterale recorded significant positive correlation with velocity/speed at maximal exercise level at  $p < .01$ , while sum of skinfolds, and endomorphic component recorded significant inverse correlation at same confident interval. These anthropometric variables also registered significant relationship with maximal oxygen consumption relative to body weight ( $VO_2$  max), with sitting height recording a stronger association than body height (Table 3). Calf girth did not register significant correlation ( $r = .346$ ;  $p = .226$ ) with running economy ( $VO_2$  at 16 Km/hr as a percentage of  $VO_2$  max).

Anthropometric measures have been used to establish somatotype and body composition for different purposes. These aspects in turn have been used to characterize and estimate the suitability of individuals to particular sports. The process whereby the physical demands of a sport lead to selection of body types best suited to that sport have been referred to as morphological optimization (Abraham, 2010). Spirometric measures have been used to evaluate the status of lung capacity and the concomitant effects on external and internal respiration in human (O'Donnell, Lam & Webb, 1999; Stanojevic et al., 2008). In exercise, some studies have shown high correlation of some spirometric measures and performance in endurance events (Adegoke & Arogundade, 2002; Fatemi et al., 2012; Pringle et al., 2005), while some have shown weak or no significant relationships (Amonette & Dupler, 2002; Knechtle & Kohler, 2008). Anthropometric attributes on the other hand are used in spirometric prediction equations. With most of these regression equations having been developed using data mostly from populations from outside Africa, it is important to establish the accuracy of the same not only among local populations, but also among athletes/sports participants.

Some anthropometric values of Kenyan runners have captured the interest of researchers with some of them concluding that they could be behind their dominance in endurance running. Kong and Heer (2008) reported small calf circumference ( $34.5 \pm 2.3$  cm) among Kenyan distance runners and suggested that the slim limbs may positively contribute to performance by having a low moment

of inertia and thus requiring less muscular effort in leg swing. The current study similarly observed small calf girth values ( $33.17 \pm 1.78$  cm). However, the values showed no correlation with either maximal endurance speed at maximal exercise level ( $r = .162$ ;  $p = .580$ ), maximal oxygen consumption ( $r = .019$ ;  $p = .948$ ) (Table 3), or running economy ( $r = .346$ ;  $p = .226$ ).

Sitting height recorded a stronger association with  $VO_2$  than body height at maximal exercise level (Table 3). This may be related to larger lungs, which makes it correlate highly with  $VO_2$  ( $r = .667$ ;  $p = .009$ ) and running speed ( $r = .617$ ;  $p = .019$ ) (higher than troncherterion height) (Table 3). This is supported by the correspondingly high correlation between FVC and  $VO_2$  at same exercise stage ( $p = .021$ ), and higher correlation at sub-maximal level ( $p = .002$ ). Mackenzie (2004) observes that the values of  $FEV_1$  and FVC, for people of African origin are 10 to 15% lower than for Caucasians of similar age, sex and height because for a given standing height their thorax is shorter. This implies that a person with more sitting height has a taller thorax, and hence larger lungs indicated by high FVC values. Waist to hip ratio (WHR) and percentage body fat variables which recorded significant correlation (inverse) with speed at maximal exercise level at  $p < .01$ . This is expected because any increment in body fat and weight causes oxygen consumption to increase due to the greater energy demand required to initiate and sustain movement of a larger weight (Abraham, 2010). In addition, endurance training utilizes fat metabolism more than other forms of training (Heyward, 2006).

As for the heart rate values, one sample *t* test comparing the recorded and age-predicted values indicate that the participants had significantly lower HR and %HRM ( $p = .001$ ) at rest and during maximal endurance running. Heart rate increases proportionately with exercise intensity (linearly with  $VO_2$ ) (Haff & Dumke, 2012; Plowman & Smith, 1997). The variable values are influenced by an individual's age and level of cardio-respiratory fitness. Percent of maximum heart rate (%MHR) at rest and during exercise have been used to predict cardio-respiratory fitness, with the maximum heart rate (MHR) measured directly, or estimated from

age-based formulae. In the current study, MHR was estimated from 220 – age formula. The subjects' average age-predicted maximum heart rate in the current study was  $193.10 \pm 4.18$  (mean $\pm$ sd) [bts/min]. Lower heart rate is a hallmark of adaptation to endurance training (Haff & Dumke, 2012; Plowman & Smith, 1997). According to the authors, the reduction of HR following training results from increased stroke volume rather than reduction in  $VO_2$  or cardiac output. It is therefore logical to say that the subjects in the current study had high stroke volume.

The minute ventilation (VE) variable is normally expected to increase linearly/proportionally with increasing exercise intensity up to about 60% of maximum effort, then more sharply (after ventilation threshold) (Haff & Dumke, 2012). Values of  $145.7 \pm 27.5$  L/min have been reported at maximal endurance treadmill tests (Carey, Pliego & Raymond, 2008) and  $162.0 \pm 6.4$  L/min during competition (Kippelen, et al., 2005). McArdle, Katch, and Katch (2010) observe that during strenuous exercise, elite endurance athletes may increase exercise minute ventilation to 100 L or more (about 17 to 20 times the resting value). But it is expected that persons with superior gaseous exchange capacity will need relatively less VE at rest and during a given exercise intensity (Hallstrand, Bates & Schoene, 2000). Values recorded during the current study are lower and may indicate favourable gas exchange status. Breathing frequency (Fb) variable is normally expected to increase with increasing exercise intensity. Together with increased tidal volume, the variables account for the increased VE. Synchronisation of breathing action with running rhythm is important at high intensity endurance exercise for efficiency (Harriman, 2011), while Fb and VE have been shown to significantly correlate to  $VO_2$  max (Carey et al., 2008). Values of  $48.3 \pm 5.7$  breaths per min have been reported for endurance runners during treadmill tests and  $51.7 \pm 6.7$  during cycle ergometry (Carey et al., 2008). McArdle et al., (2010) observe that during strenuous exercise, elite endurance athletes breathe as rapidly as 60 to 70 times each minute during maximal exercise. With tidal volume of 2.0 L and above occurring during exercise, such increases in

breathing rate and  $V_t$  may increase exercise minute ventilation to 100 L or more (about 17 to 20 times the resting value). Values recorded during maximal exercise in the current study are therefore typical, and indicates similar trend, with VE registering significant association with  $VO_2$  at maximal exercise stage.

The Respiratory exchange ratio (RER) is normally expected to increase with increasing exercise intensity. Values of over 1.2 have been reported in maximal endurance exercise, with values higher than 1.0 used as criterion for accepting test trial as maximal (Haff & Dumke, 2012). Values recorded during the current study indicate that the participants exerted themselves to reach maximal effort at the termination of the exercise.

Absolute Oxygen Consumption ( $VO_2$ ) peak values ( $3.50 \pm .26$ ) [L/min] were significantly higher than predicted values ( $p=.001$ ), for people of similar age and height in general population. Relative  $VO_2$  max values ( $64.4 \pm 4.9$ ) [ml/kg/min] rated superior judged on cardio-respiratory fitness classification from the Physical Fitness Specialist Manual as presented in Heyward, (2006). There is relatively high rate of oxygen consumption which can be sustained, given that sub-maximal value of relative  $VO_2$  do not differ significantly from maximal value ( $p=.739$ ).

## **CONCLUSION**

From the findings of the study the researcher concludes that some anthropometric measures (stature, sitting height, BMI) have significant relationship with some spirometric variables (FVC, PEF,  $FEV_1$ ) and endurance exercise performance variables (speed and  $VO_2$ ) among Kenyan distance runners. Sitting height has a stronger positive association with  $VO_2$  than body height, while the latter has a stronger positive association with speed than former among these athletes. The runners' somatotype mainly consists of moderate ectomorph and mesomorph with low endomorph components.

Kenyan distance runners' spirometric values can be approximated by commonly used equations. However, there is need to establish local norms for more accurate interpretations of these data. Significant correlation exists between some

anthropometric, spirometric and sub-maximal endurance running performance variables. These variables can be used to predict endurance running performance, but in cohort with other factor/s which may be yet to be determined. Ventilatory responses of Kenyan runners can be able to support relatively high intensity endurance performance through both increased breathing rate and tidal volume. Breathing frequency however indicates some potential which may be tapped for better performance in endurance exercise through training.

Kenyan endurance runners have excellent and superior oxygen consumption (aerobic capacity) when rated against commonly used norms. They utilise relatively low percentage of their maximum heart rate during sub-maximal and maximal endurance exercise. This must have been accompanied by large stroke volume (and thus a strong and/or versatile heart. With their pulmonary function being able to support delivery demands of superior oxygen consumption at sub-maximal and maximal endurance exercise despite being comparable to values from other population, it is possible that they could be having enhanced gaseous exchange capacity such as more pulmonary capillarisation and / or less shunts.

Given the high significant correlation between some spirometric variables (FVC, VE) and endurance performance indicators (sub-maximal velocity and  $VO_2$ ), the study recommends using these parameters in cohort with other factor/s such as velocity at  $VO_2$  max to tell apart athletes' potential in endurance performance in middle and long distance races. More studies need to be done in this area to determine the extent anthropometric and cardio-respiratory parameters of Kenyan distance runners compares to those of runners from other regions, the source of the differences and their overall contribution to endurance running performance. While the existing spirometric prediction equations that use anthropometric variables are fairly accurate, more studies are needed to improve prediction equations for cardio-respiratory parameters as well as develop locally generated norms.

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## **Comparative analysis of technical actions in students-badminton players taking into account temperament and heart rate indices monitoring**

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**Abstract:** Students' sports life is characterized by participation in physical culture and sport events of different orientation and level. First of all it is going in for different sports sections. Badminton as a kind of physical culture and sport activity has become the part of students' life. Modern level of students' badminton development is characterized by badminton players' sufficient technical-tactical readiness and high level of physical qualities. At the same time, there is lack of psychic state self-regulation and psychic readiness control in competitive activity of students-badminton players. In this terms the problem of planning training in students-badminton players, taking into account temperament characteristics is reasonable enough. The aim of the research is to realize comparative analysis of badminton players' technical actions taking into account temperament characteristics and heart rate indices monitoring. **Materials and research methods.** Students-badminton players from Yelabuga Institute (branch) of the Kazan (Volga Region) Federal University (Yelabuga, Russia) took part in the research. The research was held since 2015 till 2019. In order to define the characteristics of students' temperament (among those, who go in for badminton) we used the methodology of professor H.J. Eysenck EPQ (Eysenck Personality Questionnaire). **Results.** We studied the characteristics of temperament in students, who go in or badminton. We revealed the demonstration of all types of temperament, but most of all there are students-badminton players who belong to the groups of choleric (46,9%) and sanguine persons(34,4%). In students' badminton team the number of choleric persons prevails, then go sanguine persons. Melancholic and phlegmatic persons are not often revealed. Studying the range of the players temperament characteristics together with their individual style of playing would help to model the process of psychological training, where the inclination for the attacking actions, for the arsenal of technical and tactical actions use, courage, inclination for risk, quickness of reactions and accuracy are taken into account. It was mentioned that "choleric" badminton players fulfill more technical actions during the game – 193 striking movements. Choleric persons mainly use below strikes and straight strikes. They demand quickness of reaction. "Sanguine" type people have 161 striking actions during the game, which is 32 times less than among choleric persons. Sanguine persons have lower tempo of movements, than choleric persons. Melancholic persons have 120 striking movements during the game, phlegmatic persons- 90. HR indices among badminton players differ depending on the type of temperament. Choleric persons had high degree of tension during the control period of HR monitoring. Maximum HR index in choleric persons also was high. In order to define fatiguability of badminton players it is necessary to take into consideration the period of HR renewal till maximum values. In sanguine persons HR reaction to the loads in the studied game period is less than in choleric persons. In melancholic and phlegmatic persons HR reaction was less, than in choleric and sanguine persons. **Conclusion.** The presented results of the held research help to choose the most effective techniques for badminton players taking in to account the types of temperament. They help to change the characteristics of motor activity depending on the type of badminton players' temperament, to carry out physical, functional and psychological training individualization taking into account the type of temperament, increase playing activity of badminton players, select the means of psychic state regulation for fatiguability control during the game, estimate game situations, the volume and intensity of physical loads taking into consideration the type of players' temperament, define the ratio of HR increase time and decrease in different game periods for individual competitive activity tolerance determination by each badminton player, estimate the state of psychic readiness for competitive activity.

**Keywords:** sports training, students-badminton players, type of temperament, technical actions, strikes, heart rate.

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## **INTRODUCTION**

Badminton is one of the most ancient kinds of physical culture and sport activity. It originated from Indian games. Modern badminton is a unique kind of motor activity. In Russia it became popular among students.

Since badminton was included into the program of the Olympic Games it developed in this country. We can mention high level of technical-tactical actions among badminton players at the International level, success is underlined by confidence of highly-qualified athletes competitive activity. Among students-badminton players there are successful physically and technically players, but it doesn't give them effectiveness in competitive activity. Modern badminton demands quickness of reaction, accurate movements, noise immunity and technical-tactical mastery steadiness of an athlete-badminton player [2,3]. All mentioned above factors define the effectiveness of competitive activity among athletes-badminton players.

In this connection modern student's badminton demands not only physical, technical and tactical readiness level increase, but also functional and psychological readiness improvement.

In the sources of recent years specialists pay special attention to psychological readiness in sports games [6,7,8]. It is connected with the effectiveness increase of control over psychic state of team members. It provides success of a player's activity in competitive activity [7, p. 96-101].

Scientific-methodical and special literature analysis concerning the problem of training athletes in sports games of different level showed that in order to increase the effectiveness of training it is necessary to consider thoroughly psychological training of players [4,5,6].

First of all, effectiveness of training is connected with students' motivation increase to systematic sport. Students may have initial desire, but the absence of motivation can lead to training lessons attendance. Secondly, badminton demands the team of like-minded people, who correspond

with each other according to psychological status.

Many scientists are interested in different sides of sports training. For example, V.A. Alatortsev (2009) studies the state of psychic readiness as the basis of competitive activity effectiveness increase in athletes [1].

O.V. Zhabanov (1994, 1995) pays attention to training process control on the basis of comparative analysis of technical mastery among athletes and influences the tempo of game and the effectiveness if functional abilities of badminton players increase [2,3].

In the works of D.R. Zakirov (2012, 2013) in order to increase the effectiveness of sports training the psychic readiness state of wrestlers was examined at different stages of training. The methodology of training athletes was created on the basis of taking into account individual characteristics of psych. The importance of the methodology was in the fact that it was demanded in all kinds of sport [5,6].

G.A. Kamaliev (2010) offered the system of difficulties overcoming in training volleyball players using specially created objectives [6].

A.V. Pushkarev (2019) describes the necessity to organize sports training in basketball taking into account functional state and the typology of players according to psychological status as the base for effective team community. These points of view are supported by other authors [7, p.95-101, 9].

Nowadays it is especially important that in student's sport there is teams creation for competitive activity effectiveness increase, taking into account individual peculiarities of the organism.

The aim of the research work was comparative analysis of badminton players' technical actions taking into account their temperament and heart rate indices monitoring.

## **MATERIALS AND METHODS**

Students-badminton players from Yelabuga Institute (branch) of the Kazan (Volga Region) Federal University (Yelabuga, Russia) took part in the research. The research was held since 2015



till 2019. In order to define the characteristics of students' temperament (among those, who go in for badminton) we used the methodology of professor H.J. Eysenck EPQ (Eysenck Personality Questionnaire). The last variant of H. J. Eysenck Personality Questionnaire (1970-1980) EPQ is demanded nowadays in order to define the characteristics of athletes' temperament. This method is considered valid and convenient.

Specialists think that the presented variant of H.J. Eysenck questionnaire is suitable for the athletes. The following characteristics of the personality are taken into consideration: confidence, risk level, independence, determination and aggressiveness. Technical actions of badminton players were studied with the help of the game video (CANON MV700), shots handling was realized on

the computer using Media Player Classic program. We realized the analysis of the games videos in order to reveal the number of the fulfilled by students technical actions. We realized expert estimation of technical actions among students-badminton players with the help of competent experts (3 people). In order to analyze the striking actions of badminton players in terms of 9 elements we realized the analysis of general number of their striking actions.

### RESULTS AND DISCUSSION

Table 1 presents the results of studying the characteristics of temperament in students-badminton players during five years according to H.J. Eysenck methodology.

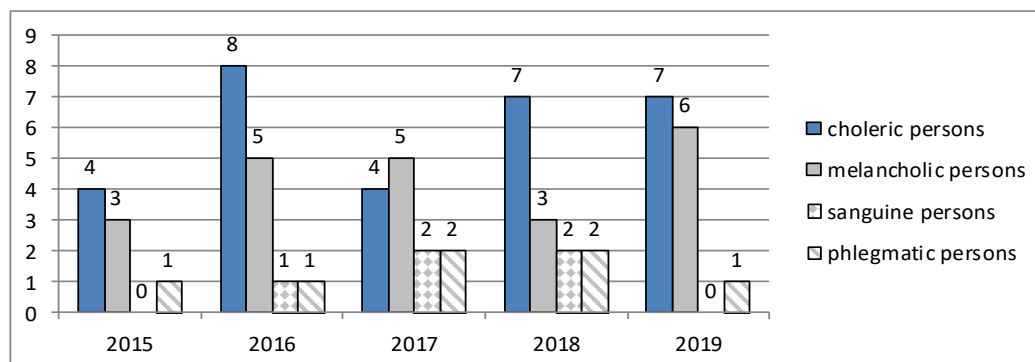
Table 1 – The indices of studying the features of temperament in students-badminton players during the following period 2015-2019

Stages of the research	Types of temperament of badminton players			
	Choleric	Sanguine	Melancholic	Phlegmatic
2015 (n=8)	4	3	0	1
2016 (n=15)	8	4	2	1
2017 (n=13)	4	5	2	2
2018 (n=14)	7	3	2	2
2019 (n=14)	7	6	0	1
Total	30	21	6	7

Table 1 presents the results of studying the characteristics of temperament among students-badminton players during 5 years according to H.J. Eysenck methodology. We define all types of temperament among the groups of students-badminton players, but most of all they belong to the group of choleric (46,9%) and sanguine

persons(34,4%).

Picture 1 shows the team content within 5 years taking into account different types of temperament. In student's badminton team choleric persons prevail. The second place take sanguine persons and finally melancholic and phlegmatic persons are not often met.



Picture 1 – Dynamics of students-badminton players team content taking into account their types of temperament (number of people)

Considering and revealing the factors, which influence the success of competitive activity in badminton players, we can't but say about an individual style of game organization. It is characterized by perfect technical means mastering, the ability to use different actions in extreme game situations, high level of flexibility, stability and efficiency.

Owing to an individual style of the type of temperament a badminton player is able to find unexpected variants of solving situational problems, quickness of reaction demonstration. National badminton teams training taking into consideration the characteristics of players' temperament in competitive activity will help to achieve high sports results.

Studying the characteristics of players' temperament in combination with their individual style of game organization would help to model the process of psychological training. There we take into account the tendency to realize the attacking actions, a wide arsenal of technical and tactical actions, courage, desire to take risks, quickness of reactions, accuracy and quickness.

In our research work we decided to reveal the demonstration of the technical actions range (by the example of the striking actions) in students-badminton players taking into account the characteristics of their temperament. Such kind of an approach in planning the training means during the lessons helps to organize psychological training individualization and helps to choose the means of psychic state psychological regulation in badminton players taking into account their characteristics of temperament. For this purpose we studied the number of correct technical actions, fulfilled during the game by students-badminton players taking into consideration the characteristics of their temperament.

Table 2 presents the results of video analysis during the game of students-badminton players using CANON MV700 camera. Shots handling was realized with the help of computer using Media Player Classic program, where shots were stopped and estimated and the players' technical actions were counted. The results were written into an individual protocol of each player.

**Table 2 – The number of technical actions in students-badminton players during the game (season 2017-2018)**

Technical actions of a badminton player	Choleric		Sanguine		Melancholic		Phlegmatic	
	Amount during the game	Relative density, %	Amount during the game	Relative density, %	Amount during the game	Relative density, %	Amount during the game	Relative density, %
Right strikes	25	12,95	15	9,31	13	10,83	10	11,11
Left strikes	27	13,98	16	9,93	13	10,83	8	6,66
Above strikes	29	15,02	23	14,28	23	19,16	15	12,5
Below strikes	30	15,54	17	10,55	14	11,66	8	6,66
Flat strikes	8	4,14	9	5,59	7	5,83	13	14,44

Flat-far strikes	8	4,14	6	3,72	9	7,5	3	3,33
High-far strikes	20	10,36	29	18,01	23	19,16	14	11,66
Straight strikes	27	14,00	26	16,14	23	19,16	17	18,9
Short strikes	19	9,84	20	12,46	18	15	15	12,5
General amount of strikes	193	100	161	100	120	100	90	100

Table 2 shows that badminton players use great number of technical actions. The main motional actions, which are fulfilled by badminton players, are the strikes from different positions. Apart from the main actions there are situational actions. They depend on the opponent's actions and game situations. It is noted that "choleric" type badminton players fulfilled 193 striking movements during the game (the greatest index). Relative density of each strike is presented in table 2.

Among choleric persons below and straight strikes prevail. They demand quickness of reaction. It is mentioned that the representatives of the first type are more active (with prevalence of 50 sets). "Sanguine" type representatives fulfill 161 striking actions during the game. It is 32 times less than in choleric persons. The tempo of movement in sanguine persons is less, than in choleric persons, but is higher, than in the representatives of other psychological types. In melancholic persons the amount of striking movements was 120 strikes and in phlegmatic persons- 90 striking movements.

Striking movements of badminton players are different and change from game to game. The main tendency of striking movements relative density change in badminton players is technical mastery improvement. The number of striking movements in badminton players is connected with the state of psychic readiness in terms of competitive activity depending on the type of temperament.

Important components of badminton players' activity are also ball serves, the tempo of the

game.

The competitive game analysis among badminton players showed that the game load has an alternating character. It is difficult to define badminton players' active and passive time of game. Motor activity of badminton players during the game can be different. Motor movements registration among students-badminton players was held visually during the pedagogical observation, marking the trajectory of movements. For this purpose different computer programs can be used, but the most effective way for this purpose we consider hear rate indices monitoring. On the basis of summary HR indices we can define game activity and the intensity of the fulfilled by badminton players physical load.

The effectiveness of technical movements use in badminton players depending on their type of temperament helps to form their necessary psychic state before the competitions. The number of the leading strikes decrease can be the index of activity and game effectiveness. Trademark blows and their timely use during the game are the indices of high level of an individual style. Psychic readiness of any athlete is formed during psychological training. In this connection psychological status study taking into account the characteristics of badminton players' temperament helps to form effective thinking activity, accuracy and speed of thinking increase.

An important component of competitive activity effectiveness improvement, in our opinion,

is the control over competitive load realization. Pedagogical observations showed that depending on the characteristics of temperament we can define the

degree of game tension for the definite badminton player.

Table 3 – HR indices in students-badminton players during the game period of control

Indices	Choleric	Sanguine	Melancholic	Phlegmatic
HR at rest	68	64	72	72
HR min	118	109	100	100
HR max	189	178	164	145
HR av.	164	158	147	143
V, %	7,68	8,67	5,67	8,91

Notes: HR at rest– heart rate; HR min – minimal heart rate; HR max – maximum heart rate; HR av. – the average heart rate; V – variation coefficient

Table 3 presents that HR indices in badminton players differ depending on the type of temperament. Choleric persons had a high level of tension within the control part of HR monitoring. Minimal HR index shows till which index the rehabilitation period lasts at rest. Maximum HR index in choleric persons is also high. In order to define fatiguability among badminton players it is necessary to take into account the period of HR renewal till minimal values.

Among sanguine persons HR reaction to the loads in the studied game period is less, than among choleric persons. Among melancholic and phlegmatic persons HR reactions were less than among choleric and sanguine persons.

The characteristic of HR increase and decrease in different game parts characterizes individual tolerance of competitive load by each badminton player. The analysis of the studied indices depending on the characteristics of badminton players' temperament helps to create an individual regimen of an effective motor activity during the game.

Express-estimation of competitive activity organization in badminton players taking into account their type of temperament helps to control the state of psychic readiness and correct psychic state.

More correct badminton players' actions estimation helps to see individual characteristics of effective technical-tactical actions depending on the types of their temperament.

The studied indices analysis depending on characteristics of temperament in badminton players showed that valid differences between

typical choleric, sanguine persons according to psychic characteristics, typical to each type.

### CONCLUSION

Thus, the presented results of the held research works help to do the following:

- select the most effective technical actions for badminton players taking into account types of temperament;
- change the characteristics of motor activity depending on the type of badminton player's temperament;
- to realize the process of physical, functional and psychological training individualization taking into account the type of temperament;
- to increase game activity of badminton players;
- to select the means of psychic state regulation in badminton players for the control over tiredness during game activity;
- to estimate game situations, the volume and intensity of physical loads taking into account the type of players' temperament;
- to define the ratio of the time of HR increase and decrease in different game parts for an individual tolerance of competitive load determination by each badminton player;
- to reveal the state of psychic readiness for competitive activity in badminton players.

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## Motives change, which stimulate 9-11 year-old children to attend training lessons, during platform diving

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**Abstract.** The article presents the results of yearly observations over young athletes. They go in for diving at a sports school for children and teen-agers. The received results show that among most children motivation increases during the training lessons. Children receive more information about the kind of sport. The strongest athletes want to improve their level of achievements. **Materials.** The article is about the motives change among young divers within the year of training period. **Research materials.** Information sources analysis and summarizing, questionnaire survey, methods of statistical data handling. **Results.** It was revealed that 20% of children stopped going to diving as they couldn't master the jumps because of fear. The level of their motivation, received during the first research, was considerably lower, than among children, who continued their training lessons. Most young athletes, who continued their lessons, want to be like well-known divers, are satisfied with their coach, want to achieve high results and like to take part in competitions. **Conclusion.** This article is about the peculiarities of the motives change. They stimulate 9-11 year-old children to go in for diving. It was revealed that the main motives, which stimulate young athletes to overcome great training loads, are the following: "The desire to achieve high results", "To be like a famous athlete".

**Keywords:** motives, diving, 9-11 year-old children, competitions, sport.

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### INTRODUCTION

In sports activity the main motives have social meaning and importance and are considered through the definite interests of each personality [1]. This concept is called the theory of a gradual stage-by-stage motives formation. According to this theory it is necessary to look for the definite ways of psychological influence on a person and gradually form his consciousness [2,3,4].

The work of the coaches in diving is connected with motives upbringing and formation for further sportsmanship improvement in athletes. Interests absence leads to the fact that people stop going in for this kind of sport and choose another kind of sport [5]. For children, who don't have inclination for diving, it can be a positive moment [6]. Such children can realize themselves in other kind of activity or sport. At the age of 9-11 children, who went through the initial selection and have the definite combination of qualities for further

development, go in for sports schools for children and teen-agers. As the practice shows, the main selection of young athletes happens at the stages of mastering backward jump with repeated rotations. The main reason of selection is fear of losing orientation during the flight and water impact. In order to overcome the sense of fear a coach should use all his pedagogical mastery, in order to make a young athlete fulfill the jump. We considered the changes of motives. They stimulate 9-11 year-old children to continue diving lessons.

The aim of the research was to study the dynamics of motives during training lessons during the age period: 9-11 years old.

The following objective was set – to reveal motives change. They stimulate 9-11 year-old



children to go in for diving.

### **MATERIALS AND METHODS**

Information sources analysis and summarizing, questionnaire survey among young athletes. They go in for diving to sports school for children and teen-agers in Moscow, in order to reveal the motives, which stimulate to go in for diving; methods of mathematical statistics.

At the first stage of experiment we realized a questionnaire survey among 9-11 year-old students of sports school for children and teen-agers of the Olympic reserve in diving in Moscow in order to reveal the motives, which stimulate them to go in for diving. The experience of going in for diving among the respondents was 3-4 years, sports qualification – from the 1<sup>st</sup> youth till the 2<sup>nd</sup> category.

100 girls and boys at the age of 9-11 took part in the research. They went in for diving at sports school for children and teen-agers in Moscow since 2005 till 2015. The questionnaire was held every year during the competitions of sports school for children and teen-agers.

At the second stage of experiment we realized a questionnaire survey among 9-11 year-old students of sports school for children and teen-agers of the Olympic reserve in diving in Moscow. The experience of going in for diving among the respondents was 3-4 years, sports qualification – from the 1<sup>st</sup> youth till the 3<sup>rd</sup> adult category.

In a year we held additional questionnaire survey among children, who took part in the first

research, in order to reveal changes in motives. They stimulate children continue their training diving lessons. Within a year most children improved their qualification at least for one category.

As a result of the first questionnaire survey we defined the main motives. They stimulate children go in for diving at sports school for children and teen-agers of the Olympic reserve (Table 1).

During the questionnaire survey we offered to range the motives according to the degree of importance. Many respondents mentioned more than one motive as important ones. As a result of the questionnaire survey it was revealed that the most important motives for the lessons beginning were the following: “Desire to achieve high sports results”, “Health improvement”, “It is fashionable to go in for sports”. These answers gave 80% of children, 50% of children “want to be like famous athletes”.

The received answers mean that the main motive for diving training lessons beginning at a sports school for children and teen-agers of the Olympic reserve is the desire to improve fitness, become like the leading athlete, as in modern society it is modern to go in for sports.

40% and 43% of the respondents mentioned that they liked to spend free time at the training lessons and swim after the training and paly. Almost 30% of children go in for diving as they like their coach or parents make them or they think training lessons are the place of meeting new friends.

**Table 1 – The results of the first questionnaire survey for the motives revelation, which stimulate 9-11 year-old children to go in for diving (60 people)**

Nº	Motive	% of children, who mentioned this motive as important one
1.	To achieve high results.	80%
2.	Health improvement.	80%
3.	It is fashionable to go in for sports.	80%
4.	Want to be like a famous athlete.	50%
5.	Like to swim after the training.	43%
6.	Like to spend my free time this way.	40%
7.	I like the coach.	26%
8.	To find friends.	26%
9.	Parent make me.	30%

The questionnaire survey was held every year. We tried to include new 9 year-old students into the questionnaire survey and students, who answered the questions last year. It should be noted that almost 20% of children, who were asked during the first survey, finished their diving lessons within a year because of different reasons. After the talk with the coaches it was clear that these children didn't correspond with the demands of sports readiness of this age group, were afraid to fulfill difficult for their age jumps. Some children stopped going in for the training lessons because of social reasons (moving to another place of living, no person to go to the training lessons with a child and others).

The results of the additional questionnaire survey among young athletes with the results, received at the beginning of the experiment, prove the change of motives, which stimulate children to

go in for the training lessons (Table 2). Answering the question "Would you like to become a famous athlete or be like some famous athlete?" most respondents mentioned that they want to be like famous divers. At the same time, young athletes, who had a positive answer, didn't change their minds and the athletes, who didn't want to be like famous divers, changed their minds. It shows that during the year of training lessons children gained the desire to achieve higher results.

Answering the question "Would you like to find friends?" most athletes gave negative answer. However, they mentioned that at a sports school for children and teen-agers of the Olympic reserve they have a lot of friends. Thus, a negative answer can be considered as the absence of the necessity to find new friends, as they have a lot of friends at a sports school.

Table 2 – motives changes, which stimulate to go in for diving lessons among athletes, who continue lessons at a sports school for children and teen-agers of the Olympic reserve (40 people)

QUESTIONS	The answer changed and became positive	The answer didn't change
Would you like to become a famous athlete or be like some famous athlete?	29,8%	69,2%
Would you like to find new friends?	No – 57,7%	42,3%
Do you like to play after the training lesson?	No – 65,4%	Yes – 34,6%
Do you like your coach?	Yes – 30,8%	Yes – 61,5%
Do you like to take part in the competitions?	Yes – 61,5%	38,5%

Answering the question "Do you like to play after the training lesson?" most respondents changed their answers from positive (Yes, I like) to negative one (No). Initially they liked to play and swim after the training lesson and now it was not an important motive for them. Great loads during the training lesson didn't leave strength for games.

Answering the question "Do you like your coach?" 92,3% of respondents gave a positive answer, although answering the question "Does your coach screams at you?" 84,4% of respondents gave a positive answer "Yes".

It is true, very often coaches scream at their students in order to increase the emotional level of the lesson, which as a result has a positive influence on the attitude of athletes to lessons. Emotional atmosphere proves the interest of a coach in students and the desire to make them achieve the

definite results. Most students understand it.

Answering the question "Do you like to take part in the competitions?" 100% of athletes, who continue going in for diving, in a year gave a positive answer, although before it positive answer was given only by 42,3% of the respondents. We can suppose that young athletes, who continue going in for sports, gained the desire to achieve high results and the sense of rivalry.

### CONCLUSION

The held research work showed that when children are 9-11 years-old their sports character is formed, they gain the desire to train and desire to compete. Young athletes start to understand the role of a coach in their training. The age period of 9-11 is the key period when selecting athletes for further improved training.

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## Sexual dimorphism in young 11-12 year-old divers and swimmers

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**Abstract:** Morphofunctional characteristics of athletes, who specialize in different kinds of sport are interesting for many scientists and it is reflected in their works. Special interest cause the characteristics of gender differences in the tempos of physical and biological development of athletes. They specialize in water kinds of sport. However, there were no works about sexual dimorphism comparison in 11-12 year-old children, who go in for diving and swimming. **Materials.** The article is about yearly growth of physical development indices in boys and girls. They go in for diving and swimming (sports schools of the Olympic reserve in Moscow). **Research methods.** Scientific literature analysis and summarizing, anthropometry, fractionation of body weight, methods of statistical data handling. **Results.** We revealed sexual differences in physical development, in proportions and body mass content in 11-12 year-old divers and swimmers. More distinct sexual dimorphism was revealed in the group of young 11-12 year-old swimmers according to the main indices of physical development, according to the index of body mass and body length ratio and fat component. **Conclusion.** The held research showed different degree of sexual dimorphism both in swimmers and divers at the age of 11-12.

**Keywords:** divers, swimmers, sexual dimorphism, physical development, body mass content, body proportions.

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### INTRODUCTION

Studying the peculiarities of male and female organism development in athletes of different specializations is one of the most important aspects of sports science [1,2]. Many well-known scientists studied the peculiarities of physical development of athletes in terms of age-related aspect [3,4 and others].

Nowadays there is no definite information concerning the methodology of training men and women. There are two different opinions concerning the problem of sexual dimorphism. One group of scientists offers to organize training women taking into account their biological characteristics and the other group of scientists insists that the training process should be organized in the same way as men [2].

In the theory of physical culture and sport the problem of sexual dimorphism is studied. This problem is based on gender differences of male and female sport. The main disadvantage of most modern research works in theory of physical

culture is in the problem that the estimation of the received scientific results is held without taking into consideration sexual dimorphism. Only such kind of an approach would help to reveal objective reasons for the existing problems of female sport and reject out-of gender study of physical culture problems in general [2, 9-14].

In water kinds of sport, in our opinion, not enough attention is paid to this problem. The works by Timakova T.S. [5] reveal considerable differences between the type of constitution and puberty of boys and girls. Some works were dedicated to studying the influence of biological maturation tempos on the dynamics of sports achievements in swimmers and divers [3,5,6,7,8]. However, there were no works about sexual dimorphism study in these kinds of sport.

In this connection the aim of this research work was to reveal the peculiarities of sexual dimorphism demonstration in the tempos of physical development among 11-12 year-old divers

and swimmers.

The objectives of the research:

1. To study sexual dimorphism in young 11-12 year-old swimmers and divers.
2. To reveal the main differences of sexual dimorphism in 11-12 year-old swimmers and divers.

### MATERIALS AND METHODS

Physical development and constitution peculiarities study in young swimmers and divers was held by means of anthropometry method. The results were handled by means of mathematical statistics methods. We calculated the average indices -  $\bar{X}$ , standard deviations -  $\sigma$ , and the validity of differences of the average indices according to Student t-test. The research was held on the basis of sports school of the Olympic reserve in Moscow in 2016-17. Young 11-13 year-old swimmers and divers took part in the research (20 people in each group).

### RESULTS AND DISCUSSION

Sexual dimorphism study in young divers and swimmers showed that among 11 year-old girls, who go in for diving, body length indices are 2,3 cm higher, than among boys. The differences were not

valid (table 1).

The indices of boys of the same age were higher than among girls, and the difference between them was 1,7 cm.

At the age of 12 girls (divers and swimmers) have higher indices of body length than boys, among divers the difference is insignificant (0,1 cm), among swimmers- 6,1 cm.

Yearly growth of body length in boys-divers was higher, than in girls for 2,2 cm (table 1) in swimmers yearly increases of body length among girls were higher than in boys (for 7,8 cm) (table 2).

According to body weight in divers and swimmers at the age of 11 the difference between boys and girls was the same and is 0,7 kg. By the age of 12 the differences between the athletes of both genders increase. Divers boys surpass girls in weight for 3,2 kg, in swimmers this index is higher in girls (8,7 kg). At the same time we revealed considerable differences of yearly weight increase in divers and swimmers. So yearly increases in boys-divers are 2,5 kg higher, than in girls and in swimmers yearly increases of girls were higher, than in boys for 9,4 kg.

Table 1 – Comparative results of the main indices yearly increases in 11-12 year-old divers physical development

Indices	Age (years)	Boys	Girls	$\Delta$	P
		$\bar{X} \pm \sigma$	$\bar{X} \pm \sigma$		
Length of body (cm)	11	136,2 $\pm$ 4,0	138,5 $\pm$ 4,9	- 2,3	>0,05
	12	141,7 $\pm$ 4,7	141,8 $\pm$ 4,7	- 0,1	> 0,05
Yearly increase	$\Delta$	5,5	3,3	2,2	
Weight (kg)	11	31,5 $\pm$ 2,6	30,8 $\pm$ 3,3	0,7	>0,05
	12	35,5 $\pm$ 4,3	32,3 $\pm$ 8,4	3,2	>0,05
Yearly increase	$\Delta$	4,0	1,5	2,5	
Chest volume (cm)	11	68,7 $\pm$ 2,9	67,1 $\pm$ 3,7	1,6	>0,05
	12	71,7 $\pm$ 3,7	69,9 $\pm$ 3,1	1,8	>0,05
Yearly increase	$\Delta$	3	2,8	0,2	
Broca Index (body length – weight – 100)	11	4,7	7,8	-3,1	
	12	6,2	9,5	-3,3	
Yearly increase	$\Delta$	1,5	1,7	-0,2	



Divers-boys surpass girls in chest volume for 1,6 cm, and girls-swimmers surpass boys for 0,4 cm (differences are invalid in both cases in case  $p > 0,05$ ).

By the age of 12 the differences according to this index in boys-divers increase insignificantly (1,8 cm), in swimmers there is considerable chest volume increase in girls for 10,8 cm, at the same

time the difference of chest volume in girls and boys is 9,9 cm.

We revealed gender differences in yearly increases of chest volume index in the representatives of divers and swimmers. In divers the differences are insignificant. But swimmers-girls surpass boys in yearly increase for 9,5 cm ( $p < 0,05$ ).

Table 2 – Comparative results of yearly increases of the main physical development indices in 11-12 year-old swimmers

Indices	Age (years)	Boys	Girls	$\Delta$	P
		$X \pm \sigma$	$X \pm \sigma$		
Body length (cm)	11	146,6 $\pm$ 4,2	144,9 $\pm$ 1,6	1,7	<0,05
	12	152,7 $\pm$ 4,9	158,8 $\pm$ 4,8	- 6,1	<0,01
Yearly increase	$\Delta$	6,1	13,9	-7,8	
Weight (kg)	11	35,3 $\pm$ 1,9	34,6 $\pm$ 0,7	0,7	>0,05
	12	37,5 $\pm$ 4,1	46,2 $\pm$ 1,3	- 8,7	<0,05
Yearly increase	$\Delta$	2,2	11,6	-9,4	
Chest volume (cm)	11	70,9 $\pm$ 2,9	71,3 $\pm$ 1,2	- 0,4	>0,05
	12	72,2 $\pm$ 7,2	82,1 $\pm$ 4,8	- 9,9	<0,05
Yearly increase	$\Delta$	1,3	10,8	-9,5	
Broca Index (body length – weight – 100)	11	11,3	10,3	1,0	
	12	15,2	12,6	2,6	
Yearly increase	$\Delta$	3,9	2,3	1,6	

Broca Index in female divers is higher both at 11 and at 12 years-old, than in boys. In swimmers this index was higher than in boys. The difference

of yearly increase of Broca Index was insignificantly higher (0,2%) in female divers, and in swimmers it is higher in boys (1,6%).

Table 3 – Comparative results of body proportions yearly changes in young 11-12 year-old divers, (in %)

Indices	Age (years)	Boys	Girls	$\Delta$	P
		$X \pm \sigma$	$X \pm \sigma$		
Weight / body length	11	23,1 $\pm$ 0,3	22,2 $\pm$ 0,3	0,9	< 0,05
	12	25,0 $\pm$ 0,3	22,7 $\pm$ 0,3	2,3	< 0,01
Yearly increase	$\Delta$	1,9	0,5	1,4	
Chest volume / body length	11	50,4 $\pm$ 0,5	48,4 $\pm$ 0,4	2,0	< 0,05
	12	50,6 $\pm$ 0,4	49,3 $\pm$ 0,3	1,3	< 0,05
Yearly increase	$\Delta$	0,2	0,9	-0,7	
Shoulders width / body length	11	21,0 $\pm$ 0,3	20,4 $\pm$ 0,3	0,6	< 0,01
	12	22,1 $\pm$ 0,5	22,1 $\pm$ 0,2	0	> 0,05
Yearly increase	$\Delta$	1,1	1,7	-0,6	



Body proportions were studied according to the ratio of body weight, chest volume, shoulders width and body length of young 11-12 year-old divers and swimmers. The received results analysis show (tables 3 and 4) that at the age of 11 and 12 the ratio of body weight to body length in divers is higher in boys, than in girls. At the same time in boys yearly increase of this index is higher and the difference between boys and girls increases by the age of 12. Among swimmers gender differences at the age of 11 are insignificant and by the age of 12 there is considerable increase of this index among girls, which leads to valid differences at the age of 12.

The ratio of chest volume to body length in divers is higher in boys, than in girls. The situation in swimmers is different: at the age of 11 and 12 higher results have girls.

According to the ratio of shoulders width to body length there were differences at the age of 11. Among divers higher indices have boys

among swimmers girls. But by the age of 12 these differences disappear.

Weight content analysis in divers and swimmers showed that girls have advantage in muscle component of body weight both at the age of 11 and 12 (tables 5 and 6). Yearly increases of muscle mass are higher in female divers (3,9%), and in female swimmers they are lower (1,9%). In boys-swimmers there is percentage of muscle mass decrease by the age of 12 (for 2,2%), in divers there is positive dynamics. It is probably connected with the peculiarities of the divers training process, directed toward speed-power qualities development.

Speaking about bone component of body mass, it should be noted that swimmers have relatively lower indices, than divers. It is conditioned by the specificity of sports swimming. There light skeleton provides better hydrostatic and hydrodynamic qualities of an athlete.

Table 4 – Comparative results of body proportions yearly changes in 11-13 year-old swimmers (in %)

Indices	Age (years)	Boys	Gils	Δ	P
		X ± σ	X ± σ		
Weight / body length	11	24,1± 0,3	23,9± 1,3	0,2	> 0,05
	12	24,5± 0,2	29,1± 1,2	- 4,6	< 0,05
Yearly increase	Δ	0,4	5,2	- 4,8	
Chest volume / body length	11	48,4±0,4	49,2±0,5	- 0,8	< 0,05
	12	47,3±0,5	51,7±1,5	-4,4	< 0,05
Yearly increase	Δ	- 1,1	2,5	-1,4	
Shoulders width/ body length	11	21,9±0,4	22,6±1,4	- 0,7	< 0,05
	12	22,3±0,3	22,3±1,3	0	>0,05
Yearly increase	Δ	0,4	- 0,3	0,1	

Studying percentage of fat component content in body weight showed that swimmers have the advantage over divers both at the age of 11 and

12. It is connected with the necessity to accumulate fat in order to have the opportunity to spend more time in water.

Table 5 – Comparative results of weight content yearly changes in 11-13 year-old divers (%)

Indices	Age (years)	Boys	Girls	Δ	P
		X ± σ	X ± σ		
Muscle mass %	11	45,6 ± 3,9	46,4 ± 3,0	- 0,8	>0,05
	12	47,1 ± 3,2	50,3 ± 6,6	- 3,2	>0,05
Yearly increase	Δ	1,5	3,9	-2,4	
Bone mass %	11	21,2 ± 1,5	20,9 ± 1,1	0,3	<0,05
	12	21,1 ± 0,4	21,2 ± 3,6	- 0,1	<0,05
Yearly increase	Δ	- 0,1	0,3	0,2	
Fat mass %	11	4,3 ± 1,9	5,9 ± 1,7	- 1,6	< 0,05
	12	10,6 ± 0,5	6,2 ± 2,1	4,4	< 0,05
Yearly increase	Δ	6,3	0,3	6,0	

Table 6 – Comparative results of weight content yearly changes in 11-12 year-old divers (%)

Indices	Age (years)	Boys	Girls	Δ	P
		X ± σ	X ± σ		
Muscle mass %	11	46,1 ± 3,7	48,0 ± 3,7	- 1,9	>0,05
	12	43,9 ± 3,5	49,9 ± 3,5	- 6,0	>0,05
Yearly increase	Δ	- 2,2	1,9	- 0,3	
Bone mass %	11	19,2 ± 1,6	17,8 ± 1,6	1,4	>0,05
	12	19,8 ± 1,6	17,9 ± 1,6	1,9	>0,05
Yearly increase	Δ	0,6	0,1	0,5	
Fat mass %	11	17,4 ± 5,6	18,0 ± 5,6	- 0,6	< 0,05
	12	17,7 ± 6,0	21,8 ± 6,0	- 4,1	< 0,05
Yearly increase	Δ	0,3	3,8	-3,5	

### CONCLUSION

1. We revealed considerable gender differences of the main physical development indices yearly increases in divers and swimmers during the age period 11-12 years-old. In swimmers the difference of yearly body length indices increase in boys and girls was 7,8 cm, in divers - 2,2 cm., according to body weight in swimmers - 9,4 kg, in divers- 2,5kg, according to chest volume - 9,5 cm in swimmers and 0,2 cm in divers and according to Broca Index- 1,6 and 0,2. Thus, sexual dimorphism at the age of 11-12 is vividly demonstrated in the group

of swimmers.

2. Body proportions study (the ratio of weight, chest volume and shoulders width to body length) in young divers and swimmers showed that yearly changes during the age period: 11-12 years old are insignificant in terms of chest volume and shoulders width to body length. According to the ratio of mass to body length gender differences are more vivid in swimmers.

3. It was stated that according to muscle component of weight at the age of 11 and 12 girls have the advantage (both divers and swimmers). However, sexual dimorphism is more distinct in

divers. According to fat component more distinct gender differences are in swimmers.

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## Innovative sports and technology device for use in power lifting

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**Abstract:** Modern sport is an entire industry that is rapidly developing. The efforts of numerous scientists and researchers are aimed at improving the training methods of athletes and improving their sports results. Every day more and more new technical solutions come to the aid of coaches and athletes, and entire training complexes and systems are being developed that focus on more thorough training and improvement of key movements of athletes. In this sense, powerlifting is no exception. **Materials.** The article is devoted to the description of an innovative sports and technical device designed for winding bandages in powerlifting. The sports and technical device is high-performance and provides high-quality winding of the bandage in a tight roll, optimizing the activity of athletes-powerlifters. **Research methods.** Analysis and generalization of scientific literature, analysis of the effectiveness of sports and technical devices used in powerlifting. **Results.** The developed sports and technical device is designed for fast and high-quality winding in a tight roll of a special bandage used for performing the "Squat" and "Pull" exercises. The technical task that the claimed utility model – an innovative sports and technical device (utility model patent No. 180528) is aimed at solving is to increase productivity and reduce energy costs when winding the bandage in a tight roll. **Conclusion.** The developed model is high-performance and provides high-quality winding of the bandage in a tight roll, optimizing the activity of athletes-powerlifters.

**Keywords:** sports and technical device, powerlifting, bandage winding, athlete.

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### INTRODUCTION

Modern sport is a whole industry that is developing by leaps and bounds, day by day. The efforts of numerous scientists and researchers are aimed at improving the methods of training athletes and improving their athletic performance. No wonder that every day new and new technical solutions come to the aid of coaches and athletes, and even entire training complexes and systems aimed at more thorough preparation and polishing of the key movements of athletes. In this sense, power lifting is no exception [1, 3, 4, 5].

### MATERIALS AND METHODS

In the course of the research various sports and technical devices used in powerlifting were analyzed. In this sport, as in many others, an important condition for effective sports training is equipment. It is selected in accordance with the specifics of the exercise (Squat, Bench Press, and Thrust). It changes from year to year. It is connected

with the improvement of quality, convenience, growth of sports results, as well as permission for use in individual federations. The team "serving" the athlete is of great importance: in power lifting it is impossible to put on equipment yourself. Sports equipment comes to the rescue of the athlete.

Sports and technical devices are products, mechanisms, technical complexes, special equipment that are used for training effects on various organs and systems of the body, for training and improving motor skills, as well as for obtaining information in the process of training sessions to improve their efficiency [6,7,8,9,10].

In power lifting, one of an athlete's outfit components is a "knee bandage for a squat." Some athletes use it in the exercise "Traction." The main function of bandages is to protect the knee joints from injuries and increase efficiency. Bandages are made by several companies - the main manufacturers of equipment for power lifting. The power lifting squat band is elastic; it needs to be rolled up into a tight

roll for subsequent winding on the knee joint. An athlete performs three attempts at competitions, not counting warm-up exercises, winding turns into a labor-intensive process, therefore the use of special sports-technical devices is highly relevant at present.

An innovative sports and technical device designed and developed for fast and high-quality winding into a tight roll of a special bandage used to perform the exercises "Squat" and "Thrust" in power lifting.

A device for winding bandages, consisting of a metal body, a handle, a cylindrical cone with a kerf, clamp, is known. This device for winding bandages allows to reel knee bandages into a roll already in a tense state. Tightly wound bandage more tightly "falls" on the protected joint and allows to save time and effort at competitions. The small size and weight of the device make it possible to carry it to the training camp and competitions. However, the disadvantage of this device, in our view, is the "manual" tension of the bandage. It entails a low winding speed and requires a large amount of energy costs.

The closest in technical essence and the achieved result is a device for winding bandages roller unit for pre-tensioning an elastic bandage. It is then wound on its knees to provide support and reduce the risk of injury (US Patent for utility model No. 20030218090 A1, publ. 27.11.2003). The disadvantage of this device, in our opinion, is its "cumbersome" inability to transport to various competitions, as well as the presence of large components and assemblies.

## RESULTS

The technical task, which is addressed by the claimed utility model - an innovative sports and technical device (patent for utility model No. 180528), is to increase productivity and reduce energy costs when winding a bandage into a tight roll.

Figure 1 shows the main view of the device, figure 2 shows the left view, and figure 3 shows the top view.

A permanent technical problem is solved in such a way that a device for winding a bandage in power lifting, comprising a metal case (1), a handle (2), a cylindrical cone with a kerf (3), a clip (4). In addition to the body of the machine, a tensioning mechanism (6) consisting of four knitting needles (5) with a thread cut at the ends is attached by welding.

Device for winding bandage in power lifting works as follows. The device is fixed on a solid stationary support. The end of the bandage is brought upwards between the second and third needles. Then the bandage is pulled up by 15–20 cm and stretched from top to bottom between the first and second needle. The bandage is passed in front of the first needle is stretched from top to bottom. And the fourth needle, then pull the bandage up in front of the fourth needle, fill the bandage into the slot of the tapered shaft and wind it into a tight roll. The bandage in the process of winding itself is stretched due to the uneven arrangement of the inclination of the spokes to the body of the machine.

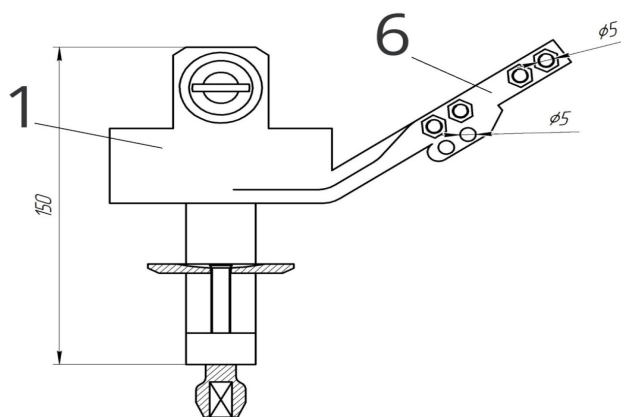


Fig. 1. Main view of the device for winding the bandage in power lifting



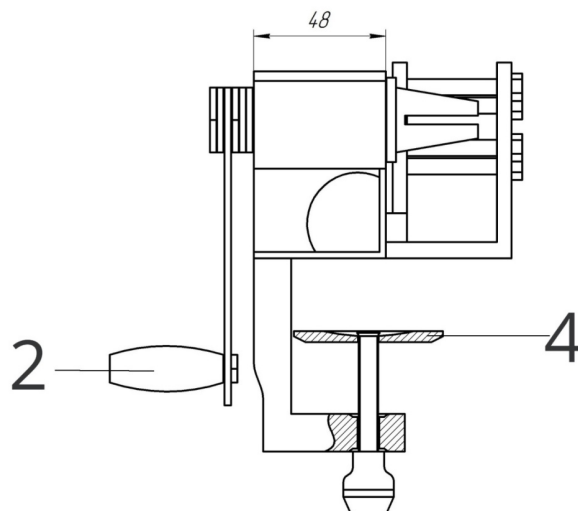


Fig. 2. Device for winding a bandage in powerlifting (left view)

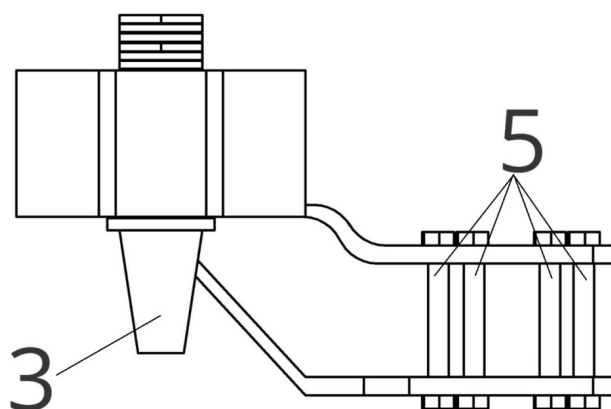


Fig. 3. Device for winding a bandage in powerlifting (top view)

### CONCLUSION

Thus, the developed utility model is highly productive and provides high-quality winding of the bandage into a tight roll, optimizing the activities of power lifters.

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## Sequence and duration of physical qualities development in cyclic kinds of sport with endurance demonstration

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**Abstract:** The article is about the problem of taking into account the sequence and duration of physical qualities development in cyclic kinds of sport with endurance demonstration. This problem was urgent for the specialists as the base for an effective training time distribution in terms of general and special physical training of athletes. Sometimes the planned means of subordinate physical qualities development is realized in terms of training athletes and racing skiers as additional physical loads without orientation determination. **Materials.** We organized expert estimation of specialists' opinions concerning the sequence and duration of the main physical qualities development and support in training average distance runners and racing skiers. **Research methods.** Information sources analysis, method of expert estimation, methods of mathematical statistics. **Results.** By the example of cyclic kinds of sport we defined the sequence, duration of physical qualities development and improvement taking into account the opinions of the specialists. We defined the amount of time, given for physical qualities development, by the example of a weekly micro cycle. We also defined the necessary and effective time for physical qualities development among the average distance runners and racing skiers. The specialists think that the effectiveness of muscle activity energy supply sources formation and development depends on the conditions and time of the means realization, directed toward physical qualities development. We underline the necessity to pay attention to three and more physical qualities development at each lesson. It should be noted that most time among the average distance runners and racing skiers is paid to general endurance and special endurance development – approximately five months, speed-power oriented training-2,5 months, quickness, coordination and flexibility development- 1,5 months. The important component of the training process in athletes and racing skiers is the sequence of physical qualities development and their support during the whole sports training period. **Conclusion.** It was defined that the duration and sequence of the main physical qualities development in cyclic kinds of sport has the same character. Both among the average distance runner and racing skier the main place in the training process takes general and special endurance development. Such physical qualities, as quickness, flexibility, coordination, strength, speed-power qualities are also important, as they are the base of an effective rational athletes' technique demonstration. There are two variants of the training lessons organization: complex orientation and a gradual physical qualities development in all kinds of training. The example of a gradual solution of physical qualities development problem is the following: speed work (25-30%); power work (30-35%); endurance development (35-40%).

**Keywords:** physical qualities, runners, racing skiers, stages of training.

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### INTRODUCTION

The main question of athletes' training improvement in cyclic kinds of sport is the effectiveness of control improvement. For this purpose it is necessary to plan the main physical qualities development and improvement taking into account their realization sequence and duration.

Scientific-methodical sources analysis

showed that physical training takes the first place, especially with the orientation toward the main physical qualities development [1,2,6,10].

The authors consider functional training in terms of athletes physical training as the base for physical qualities development depending on individual ones. [1,3,4,5,7,9].

In recent years great attention is paid to

the functional side of sports training in the kinds of sport as the base for reserve and adaptive capacities of an organism development [1,2,5, 6,10].

In the works of the authors the questions, connected with studying the sequence and duration of time, directed toward physical qualities development, separately and in general in cyclic kinds of sport, are not discussed enough and it makes hard to control the training process.

In the theory and practice of sports training in cyclic kinds of sport the duration of stages and periods of training are mainly considered (divided into micro cycles, meso cycles and macro cycles). In the works of the authors we find the duration of the training cycles, stages, their approximate orientation [1,3,6,9]. Other authors also consider the sequence and duration of the training cycles concerning the kinds of training development [1,3, 11-14].

In this article we define the sequence, duration of the main physical qualities development and improvement, by the example of cyclic kinds of sport, among the athletes in the micro cycle of the special-preparatory stage training during 6 month macro cycle of training, taking into account the opinions of competent respondents.

## MATERIALS AND METHODS

We used mathematical methods of the research for qualitative indices calculation. We analyzed the experts' opinions concerning the sequence and duration of the main physical qualities development and support during athletes training. We held a questionnaire survey among the specialists in cyclic kinds of sport (23 people – athletics coaches and racing skiing coaches).

## RESULTS AND DISCUSSION

We held a questionnaire survey among the specialists and asked about the duration and sequence of the main physical qualities development among athletes in average distance running and racing skiers during the first 6-month cycle of training.

The results of the questionnaire survey, concerning the time, spent for the main physical qualities development among the average distance runners and racing skiers, by the example of two micro cycles of general-preparatory and special-preparatory stages of the first yearly cycle of training, are presented in table 1.

Table 1 – Results of the questionnaire survey among the specialists concerning the questions of time, spent for the main physical qualities development among the average distance runners and racing skiers

Physical qualities of an athlete	Timespentforqualitiesdevelopment, min(by the example of two-weeks micro cycle of training)				
	According to the plan	Necessary plan	Effective time	Average value	Total value
Average distance runners					
1.Strength and power qualities	4,4/5,0	12,6/15,0	8,0/10,0	8,3 /10	25/30
2.Flexibility	3,4/5,0	5,8/6,0	6,0/10,0	5,1/7,0	15,2/21,0
3.Quickness	2,0/4,0	5,0/8,0	7,0/8,0	4,7/6,7	14/20
4.Coordination	5,6/3,5	8,0/8,0	6,0/8,0	6,5/6,5	19,6/19,5
5.General endurance	10/8,0	10,0/15,0	20,0/15,0	13,3/12,6	40/38
6.Special endurance	6,0/10,0	6,0/10,0	12,0/15,0	8/11,7	24/35
Racing skiers					
1.Coordination	5,0/6,0	8,0/8,0	8,0/8,0	7/8	21/22
2.Speed-power oriented	6,0/8,0	8,0/10,0	10,0/12,0	8/10	24/30
3.Strength	8,0/10,0	10,0/12,0	12,0/13,0	10/11,6	30/35
4.Speed	6,0/6,0	8,0/8,0	10,0/10,0	8/8	24/24
5.General endurance	10/13,0	10/15	15/15,0	11,6/14,3	35/43
6.Special endurance	8,0/10,0	12,0/15,0	15,0/15,0	11,6/13,3	35/40

Table 1 presents physical qualities, which in the opinion of the specialists, should be paid attention to in the training process of the average distance runners and racing skiers.

Table 1 shows that an effective time for physical qualities development, planned and necessary one, differ. Total time according to physical qualities differs greatly from the time according to the plan, within a weekly micro cycle. Thus, the specialists meant trainings of the runners and racing skiers twice a week. It was mentioned that it was one of the episodes of time planning for physical qualities development. The received average values can be used as optimal amount of an effective time for physical qualities development in a weekly micro cycle. The specialists saw real problem of physical training. The difference of duration according to the plan, directed toward physical qualities development, and the necessary time shows that this direction should be considered by the specialists and athletes. It is necessary to control how athletes realize the training means of each lesson.

The specialists consider that each physical quality should be paid attention to even in terms of one lesson. It conditions the effectiveness of the energy supply formation and development sources in muscle activity of athletes. Among the average distance runners general and special endurance are the leading physical qualities. More time is given for their development according to the plan and it corresponds with the opinion of the specialists. Information sources say that the time, which is necessary for the main physical qualities development, exceeds the time devoted to other qualities development. According to the questionnaire survey we revealed the effective time duration for physical qualities development. We define the necessity to pay attention to three or more qualities development at each lesson. The specialists underline mainly the complex character of the training lessons planning as the base for the several objectives solution.

It is necessary to mention, that the examined specialists placed general and special endurance after other physical qualities considering their importance. Such kind of the approach they

explained by the fact that other qualities are the base for the main athletes' physical qualities formation and development.

In the opinion of the specialists, the duration of physical qualities development at all stages of training is an important component of effective sports training. It should be noted that most time both among the runners and racing skiers is paid to general and special endurance – almost 5 months, speed-power oriented training- 2,5 months, quickness and flexibility development- from 1,5 months.

An important component of the training among athletes and skiers is the sequence of physical qualities development and improvement and their support during the whole period of training in a macro cycle.

One more important thing is to support all physical qualities development. For this purpose it is necessary to plan the used means in the macro cycle of training. For the average distance runners and racing skiers it is important to plan the means, directed toward general and special endurance development. These qualities develop gradually within the whole cycle with some transient stage during 2,2 weeks.

Picture 1 presents the diagram of the means volume change, directed toward general and special endurance development and speed-power oriented training, in the average values for cyclic kinds of sport.

Together with general and special endurance development other physical qualities, necessary for the athletes, are developed, improved and supported. Speed-power oriented training in our example is realized together with special endurance development and support. The qualities such as quickness, coordination and flexibility are included depending on the content of the training lesson as an addition. The change of the training means orientation was mentioned at special-preparatory stage.



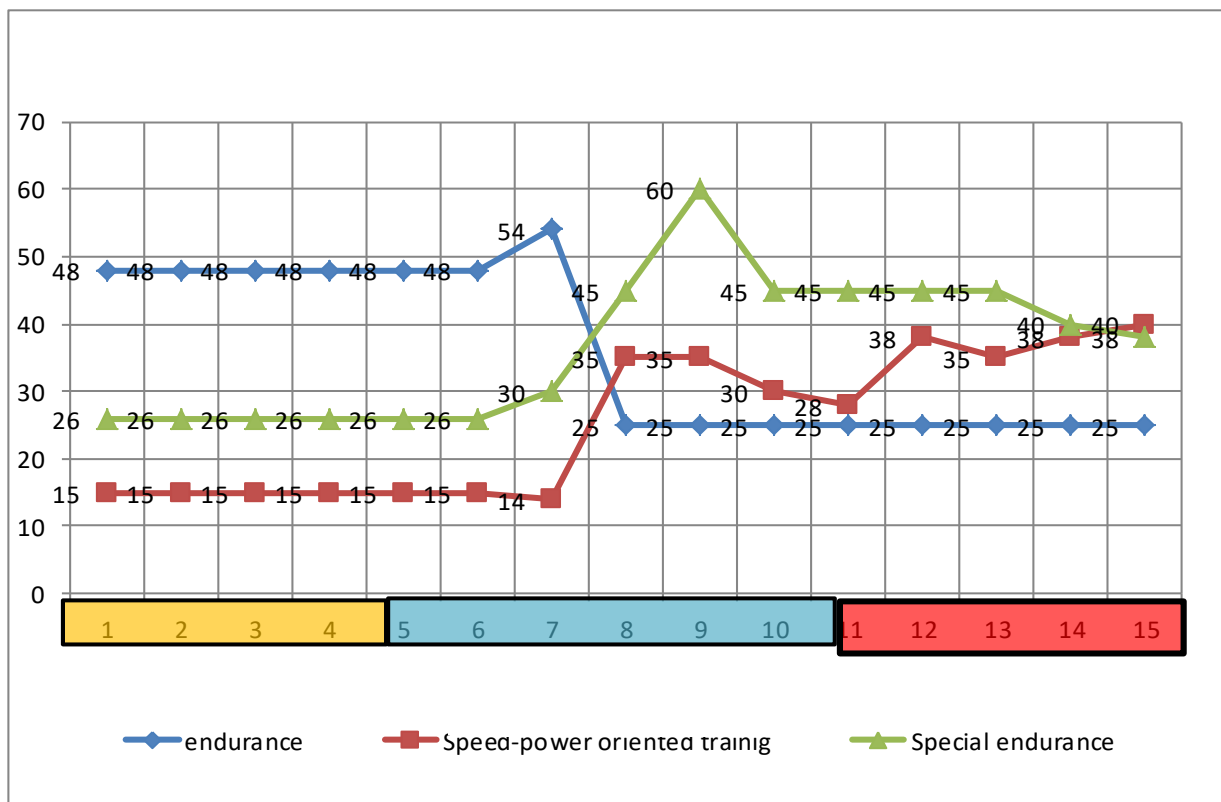


Fig. 1. The diagram of the means volume change, directed toward main and physical qualities development and their duration in the cyclic kinds of sport

Technical training improvement among the average distance runners and racing skiers lasts till the 10<sup>th</sup> week, then during the whole cycle the technique develops while physical qualities development. The achieved level of physical qualities preservation is realized approximately since the 15<sup>th</sup> week and till the end of the early competitive stage. High level of physical qualities development among the average distance runners and racing skiers is demonstrated at the level of their technical readiness.

The approximate periods of start and finish of physical qualities development in the macro cycle of training among the average distance runners and racing skiers coincide. We underline that general endurance development, its support and special endurance development among athletes are realized during the whole yearly cycle. The same situation is among racing skiers. In the opinion of the specialists in athletics and cross country ski race, power oriented training should last forever and gradually transfer into speed-power oriented training. It is important to create the variants of the training means combination in complex lessons.

### CONCLUSION

An important component of sports training in cyclic kinds of sport is physical qualities development. They are necessary for the average distance runners and racing skiers. It was defined that the duration and sequence of the main physical qualities development in cyclic kinds of sport has equal character. Both among the average distance runner and racing skiers the main place in the training process takes general and special endurance development. Such physical qualities, as quickness, flexibility, coordination, strength, speed-power qualities are also important. They are the base of an effective rational athletes' technique demonstration. There are two variants of the training lessons organization: complex orientation and a gradual physical qualities development in all kinds of training. The example of physical qualities development problem gradual solution is the following: speed work (25-30%); power work (30-35%); endurance development (35-40%).

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## **Competitive load influence on athletes' organism in striking kinds of the Olympic combat sports**

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**Abstract:** The process of training highly-qualified athletes is the subject of the research works of many scientists. It is necessary to have correct notion of the differences in periodization of training athletes from the national teams, reserve teams, including sports schools. These differences should be reflected during the training process, while choosing means and methods of training. Otherwise using different means and methods during the training process, before the main start, can lead to a negative result. **Materials.** Competitive load influence study on athletes' organism in striking kinds of combat sports during training for the main competitions of the yearly cycle. **Research methods.** Information sources analysis and summarizing, oxygen consumption and carbon dioxide excess determination with the help of gas analyzer Metamax 3B (Cortex, Germany), heart rate with the help of PolarV800 system, capillary blood analysis with the help of LactateScout; methods of mathematical statistics. **Results.** Competitive combat use at different stages of the yearly cycle as the training means showed that its realization claims high demands on athletes' organism. During the second round the athletes achieve aerobic maximum and during the third round there is tiredness increase as the reaction to the fulfilled main technical-tactical actions. As a result of it athletes have power and speed-power oriented muscles abilities decrease. It can influence the quality and effectiveness of the fulfilled technical-tactical actions. **Conclusion.** Maximum intensity training load fulfillment at different stages of the yearly cycle is connected with high demands, which the load claims. There is slow rehabilitation and lactate concentration increase within 3 minutes. The next effort of this exercise should be held no less than in 5 minutes of rest.

**Keywords:** competitive load, striking combat sports, sports training, tiredness, working capacity, micro cycle.

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### **INTRODUCTION**

The process of training highly-qualified athletes is the subject of many scientists research works [1-7]. It is necessary to have correct notion of the differences in periodization of training athletes from the national teams, reserve teams, including sports schools [6]. The training process periodization has considerable differences. It means that the differences should influence the training process, training means and methods choice. Otherwise using different means and methods during the training process, before the main start, can lead to a negative result. In spite of different points of view and approaches to the training process all specialists want to solve this problem – the highest sport result achievement by

an athlete, qualitative and effective training. As a rule, highly-qualified athletes training is realized in terms of the training camps (duration 10-14 days) [6,8,9,10]. Usually the means and methods are used, which would model the participation of an athlete in competitions [1,4,11,12,13]. If we graphically present the participation of athletes in the International competitions during a yearly cycle of training, we can state that the athletes of striking kinds of combat sports have the following kinds of competitions: boxing – Championship of Europe (CE) and World Championship (WCh), taekwondo WTF (World Taekwondo Federation) – WCh, World Cup (WC), CE (picture 1). Before each competition athletes should take part in the training events and fulfill the training volume of the different orientation loads. The presented periodization characterizes the

yearly cycle of training planning and differs from the same planning of the nearest reserve athletes long-term training. In this connection the main aim of this research work is to study the influence

of competitive load on the organism of athletes in striking kinds of combat sports in terms of direct training for the main competitions of the yearly cycle.

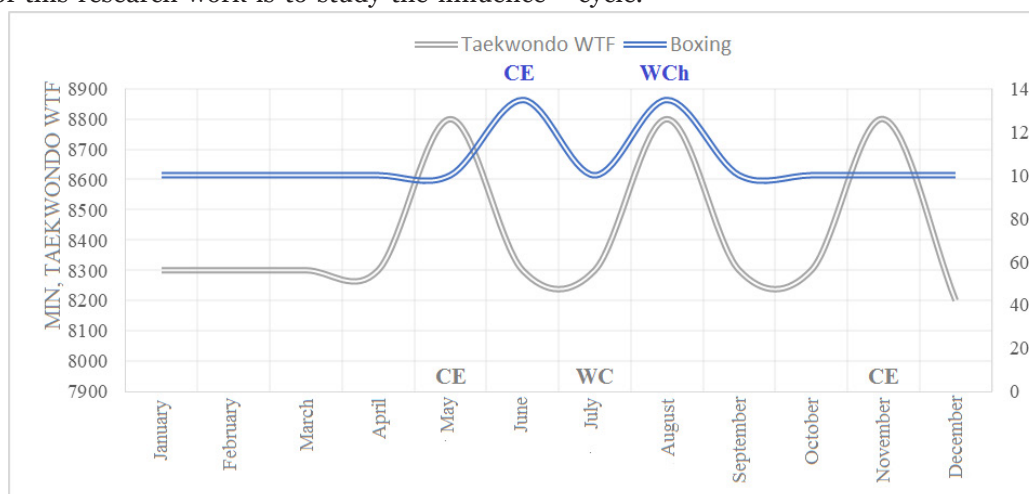


Fig. 1. Periodization of the yearly cycle of training among highly-qualified athletes in boxing and taekwondo WTF

### RESEARCH METHODS

In order to achieve the set aim we held out the research work of athletes' organism urgent reaction to competitive load (combat) fulfillment. For this purpose the group of striking kinds of combat sports athletes (10 athletes) was divided into pairs - 5x2. The main aim was in competitive combat imitation. The average age of athletes - 27,5±5,96 years old, weight - 68,4±8,95 kg. A portable gas analyzer was attached to an athlete in order to define oxygen consumption and carbon dioxide excess (gas analyzer Metamax 3B, Cortex, Germany). Heart rate (HR) registration was held with the help of HR estimation system PolarV800. The athletes had the task to have three rounds (60 seconds each), the interval of rest was 120 seconds. At the beginning of the exercise and at the end of the exercise (sparring) during the 5<sup>th</sup> minute of rehabilitation we analyzed capillary blood in order to state lactate concentration. For this purpose we used portable device Lactate Scout. Picture 2 and tables 1,2 present research results.

### RESEARCH RESULTS

According to the results of the research we stated that the competitive combat claims great demands on athletes' organism. During the second round athletes achieved their aerobic maximum and

then during the third round there was only the increasing tiredness as the reaction to the fulfilled main technical-tactical actions. Since the beginning of the exercise fulfillment till the interval of rest there is a linear pulse, oxygen consumption and minute pulmonary ventilation increase. After the end of the exercise during rehabilitation since the first till the second round athletes had the tendency of pulse, minute pulmonary ventilation, lactate concentration increase and oxygen consumption coefficient decrease. It should be noted that during the second round athletes achieved their maximal oxygen consumption. It is seen in the volume of respiratory coefficient, plateau of oxygen consumption, carbonic acid release, minute pulmonary ventilation. During the third round and after it athletes didn't have changes if the studied indices and it is connected with tiredness increase and the ability to support intensity decrease (picture 2).

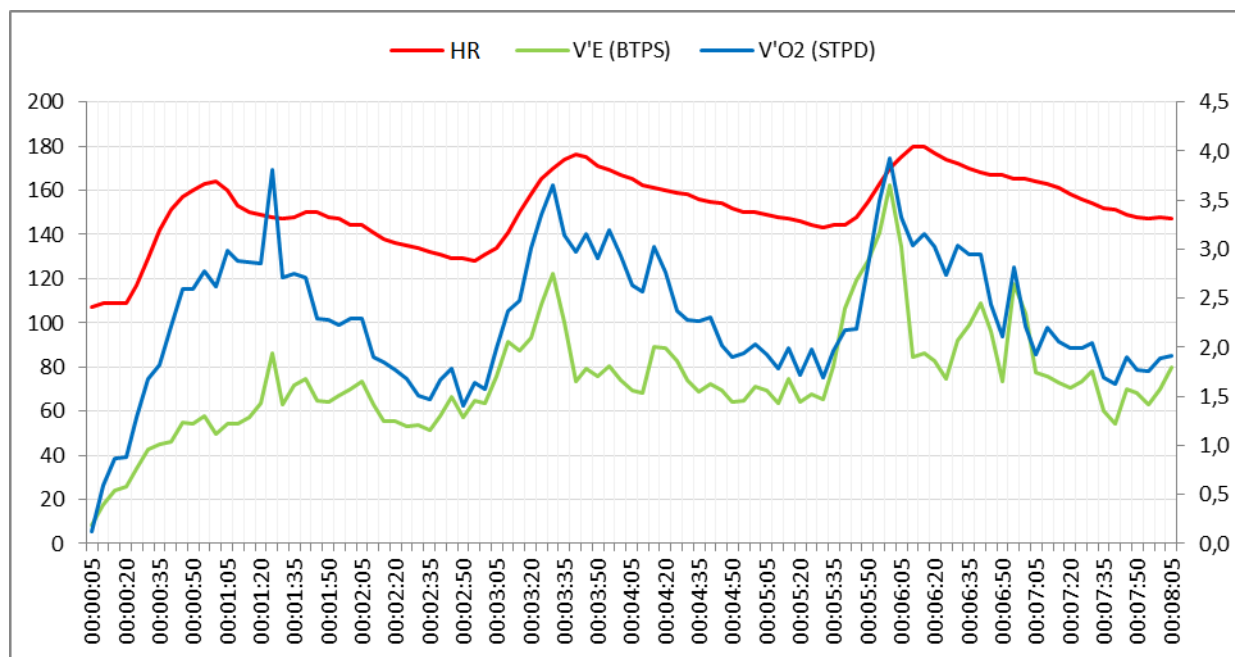


Fig. 2. Urgent reaction of physiological indices to competitive combat by athletes of striking kinds of combat sports

Table 1 – Morphofunctional peculiarities of an organism urgent reaction in the athletes of striking kinds of combat sports. It models competitive combat of the load

Load	The 1 <sup>st</sup> round		The 2 <sup>nd</sup> round		The 3 <sup>rd</sup> round	
	x	s	x	s	x	s
HR, b/min	159	5,2	170	5,9	173	4,8
VE, l/min	51	5,2	92	17,5	99	27,1
VO <sub>2</sub> l/min	2,4	0,4	3,2	0,2	3,0	0,5
VCO <sub>2</sub> l/min	2,0	0,4	3,8	0,3	3,8	0,5
RER	0,82	0,09	1,19	0,06	1,28	0,16
CUO <sub>2</sub>	7,7	0,37	5,8	0,7	5,1	0,7

HR – heart rate, VE – minute pulmonary ventilation, VO<sub>2</sub> – oxygen consumption, VCO<sub>2</sub> – carbon dioxide emission, RER – respiratory metabolism coefficient, CUO<sub>2</sub> – coefficient of the used oxygen

Table 2 – Morphofunctional peculiarities of an organism urgent reaction in athletes of striking kinds of combat sports in the interval of rest after the modeling competitive combat load fulfillment

Rest	After the 1 <sup>st</sup> round		After the 2 <sup>nd</sup> round		After the 3 <sup>rd</sup> round	
	x	s	x	s	x	s
HR, b/min	132	2,8	145	1,9	147	0,84
VE, l/min	56	5,0	70	6,8	71	6,04
VO <sub>2</sub> l/min	1,6	0,2	2,0	0,2	1,9	0,08
VCO <sub>2</sub> l/min	2,5	0,2	3,0	0,4	2,6	0,16
RER	1,53	0,02	1,54	0,08	1,41	0,05
CUO <sub>2</sub>	5,0	0,3	4,3	0,5	4,4	0,28
Lactate mM/l	1,52	0,33			14,2	1,7



Thus, this means of training use should be strictly regulated concerning the duration and intensity of rest in a weekly competitive micro cycle while using it as the main training means, especially for the athletes. They have a low level of training. Before and after the modeling competitive load fulfillment we estimated power and speed-power oriented abilities of the front and back part of the hip muscles in order to estimate the influence of motor abilities tiredness, realized with maximum effort. For this purpose the group of athletes (10 people) fulfilled two efforts of knee joint extension with maximum isometric tension sitting at power-estimating complex

BIODEX. The time of the exercise fulfillment was 5 seconds, the interval of rest between the exercises – 30 seconds. The indices of maximum moment of power on repeat, power moment gradient and maximum power on repeat were registered. The enumerated indices characterize speed and power oriented abilities of legs muscles. Table 3 shows that athletes had power moment gradient and maximum power decrease before and after the load fulfillment. It models competitive combat. It finally led to time period increase of maximum motor actions demonstration.

Table 3 – Dynamics of power moment gradient change among athletes of striking kinds of combat sports before and after the modeling competitive combat load fulfillment

Indices	Weight, kg	Power moment gradient (H*m/s)	Fmax (H)
Before the load	68,4±8,95	122,9 ± 53,2	678,3 ± 32,5
After the load	68,1±8,2	89,0 ± 38,5	535,6 ± 42,9
p	> 0,5	< 0,05	< 0,05

### CONCLUSION

1. Competitive combat use at different stages of the yearly cycle as the training means showed that its realization claims high demands on athletes' organism. During the second round the athletes achieve aerobic maximum and during the third round there is tiredness increase as the reaction to the fulfilled main technical-tactical actions.

2. As a result of tiredness athletes have power and speed-power oriented muscles abilities decrease. It can influence the quality and effectiveness of the fulfilled technical-tactical actions.

3. Maximum intensity training load fulfillment at different stages of the yearly cycle is connected with high demands, which the load claims. There is slow rehabilitation and lactate concentration increase within 3 minutes. The next effort of this exercise should be held no less than in 5 minutes of rest.

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## Jiu Jitsu and asceticism: a spiritual approach grounded on the tradition of action

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**Abstract:** Connected to the traditional domains of martial arts and sport, Jiu Jitsu is endowed with a dual spiritual nature. The present work had for objective to investigate the ascetic potential of Jiu Jitsu and its possible connections with the sacred. The method used for this study was the literature review. The Jiu Jitsu Academy is a kind of sacred space, since its structure descends from the temples and religious monasteries. Belt promotions are rite of passage from one plane of understanding of the art and state of athletic preparedness to another. The belt whipping corridor is the traditional initiation ritual that prepares the practitioner to enter the new belt's phase. The sacred time can be found in both these rituals as well as in the athletic performance itself. As images-motion, the techniques are saturated with contemplable symbols in different spheres of life. Jiu Jitsu constitutes a way of asceticism and catharsis. Given the symbolism provided by its dual spiritual nature, Jiu Jitsu encounters can be identified as a modality of holy war. The Jiu Jitsu Academy is unlike an ordinary gym where one goes only in order to work out. It can be verified that Jiu Jitsu is endowed with a transcendent dimension from which it is possible to ascend into super-sensible realities through the symbolical experience provided by the combat. It has been found that the ascetic potential of Jiu Jitsu made possible by the spiritual experience can reach different levels according to the practitioner's degree of readiness and proficiency.

**Keywords:** Jiu Jitsu, martial arts, sport, asceticism, sacred

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### 1 INTRODUCTION

As Jiu Jitsu has been resulted from the influx of many martial arts, nowadays it comprises both a self-defence art and a sport modality [1,2]<sup>1</sup>. Since it operates in a sporting atmosphere with an emphasis on its martial roots, it can also be understood as a martial sport [3,4,5]. Despite the desacralization process that has been verified in sports domain in post-modernity, sport is a religious ritualistic phenomenon that provides the practitioner with the possibility of ascending to super-sensible realities through symbolic experience, as well as of purifying oneself through its mechanisms of active catharsis [6,7,8,9]. Likewise, Jiu Jitsu is connected to the martial tradition, which, in its turn, is connected to the initiatic tradition [1,10,11,12]. Therefore, this work will investigate the ascetic potential of Jiu Jitsu and its possible connections with the sacred, considering its incidence in both traditional domains of sport and martial arts.

### 2 MATERIALS AND METHODS

This research is characterized as qualitative. The method used for this study was the literature review. A search was made through the databases of Google, Scielo, and Research Gate. The bibliographic survey consists of articles from electronic journals, digital and printed works, interviews and dissertations related to the subject under consideration. To carry out this procedure, the following keywords was entered. Jiu Jitsu, martial arts, sport, asceticism, sacred. At first, the spiritual nature of Jiu Jitsu was investigated. Then, the possible presence of sacred time and space as well as the possible rites present in Jiu Jitsu in the light of traditional teachings and the eliadean approach on the sacred were researched. Finally, the ascetic potential of Jiu Jitsu was investigated.

<sup>1</sup> According to Gracie [2], the martial arts and combat sports known as Judo, Wrestling and Sambo were integrated into Jiu Jitsu by Master Rolls Gracie. Indeed, the current Jiu Jitsu, that has been building by many schools around the world, is a recovery of the traditional one that was divided into many branches by budo doctrine, notably by the end of Edo period when Japan started losing its true identity.

### **3 RESULTS AND DISCUSSIONS**

#### **3.1 Sacred time and space in jiu jitsu**

The Jiu Jitsu Academy is a kind of a sacred space, since its structure descends from the religious temples and monasteries [12], besides being separated from the profane space, that is, in a place where the sacred time of ontological nature can be recovered, since it's the time of "being" of a cyclical nature, albeit sometimes it can be manifested in chronological way, whose linear characteristics go beyond the ordinary temporal duration of profane time as it can be verified bellow [6,13].

From an eliadean approach, the profane time could mainly be found in the control mechanisms of training volume, speed measurements and as a component of time-motion control protocol, since it tends to result in an ordinary temporal duration devoid of any kind of spiritual experience for the martial athletes [13,14,15]. The sacred time, in its turn, is manifested through the belt promotion ceremonies, which usually occur according to a cyclical time and operate as a rite of passage from one plane of understanding of the art and state of athletic preparedness to another [13,16]. However, its occurrence depends on the belt of the practitioner, as from the black belt on, the time of belt and degrees promotions tend to change, according to general system of graduation of International Brazilian Jiu Jitsu Federation [17]. The belt whipping corridor - or just corredor in Portuguese - is the traditional initiation ritual that prepares the practitioner to enter the new belt's phase. Once the corridor is formed by the students positioned on each side of mat, the promoted Jiu Jitsu practitioner goes through the corridor while his comrades whip him with their own belts [18,19]. According to Evola [6] (p. 62) "initiation in its highest form is an intensively real operation to changing the ontological status of the individual and grafting onto him certain forces of the world of being". Initiation rituals correspond to cosmogony, by which the initiate comes to be qualified [11,20].

Thus, in each promotion the practitioner is initiated into the mysteries corresponding to the technical competencies of the belt achieved,

which is verified in both the increasing difficulty in competitions and the ascetic potential it tends to imply [10,12,21]. Once ascending in the hierarchy, some techniques become gradually allowed to the practitioner. For instance, toe hold, knee bar, calf slicer, biceps slicer are martial techniques restricted to brown belts and black belts only, according to the rule book of International Brazilian Jiu Jitsu Federation [21]. On the one hand, the way white and black belts practitioners escape a stranglehold can lead to the same result in terms of technical effectiveness, that is, in terms of having performed successful defensive actions despite differing in the mastery resulting from the level of their skills. On the other hand, beyond the motor gesture, it is possible to identify a variability in using such ascetic potential made possible by this symbolic experience, understood as the ability to carry this experience to other life situations in face of adverse events that one has to deal with [22,23]<sup>2</sup>. In this regard, according to Gracie [24] "... a grip in the kimono or a choke has an extrasensory power...". Given the existence of a symbolic dimension found in sports technical gestures, such as that above-mentioned escape from stranglehold, techniques constitute images-motion in this sense, since they are saturated with contemplable symbols in different spheres of existence [22,24].

Although the time of athletic performance reveals itself as a linear time, considering its chronological characteristics, it is consecrated by the symbolic dimension of sports combat itself, thus differing from the profane duration [6,13]. According to Eliade [25] (p. 33) "anything that is not directly consecrated by a hierophany becomes sacred thanks to its participation in some symbol". In this regard, becoming a Jiu Jitsu champion can correspond to a cosmogonic process, given that a new factual situation is brought into existence with a new ontological status achieved from a kind of inner combat [6,20].

Moreover, sport is constituted by a radically religious impulse toward the sacred [6,7,9]. In this sense, in each match, the athlete connects to his own eschatology, exhausting himself through the effort in order to achieve not only new physiological

<sup>1</sup> Evola [23] had already pointed out such possibility of taking some situations as symbols of austerity.

adaptations, but also to change his own ontological status. This, in turn, implies a spiritual death for all limits of his past athletic form of existence, which can be manifested through his new personnel record achieved [7,13,20]. From an initiatic perspective, the sports combat itself can be understood as the descent into hell, i.e., into the own ascetic's labyrinth, whereas the new athletic form achieved as his new spiritual birth [6,9,11].

### 3.2 Jiu jitsu as a way of ascesis and catharsis

For Gracie [24] "Jiu Jitsu is a spiritual art". Therefore, despite the opposition established by some modern masters between sport and martial arts [10,26], both dimensions, that constitute essentially religious ways, are found in Jiu Jitsu [1,7,9,12]. Studies evidence the cathartic and sanctifying potential of sport [7]. Catharsis, or purification, extends from the moral and ritual field to the intellectual one, in order to achieve higher knowledge [23]. In light of this, given the inherent ritualistic character of combat sports and martial arts, Jiu Jitsu consists a transcendental way to get purified [7,9,24]. In Tsunetomo's words [27] (p. 11) "purity is something that cannot be attained except by piling effort under effort".

Nevertheless, for some modern masters, the combative atmosphere of sports cannot express the true spirit of budo. The martial arts practitioner shouldn't have for purpose to win sports tournaments in which brute force prevails and victory at any cost tends to be the main objective. Instead of this, the martial artist should seek the harmonization of individual ki with universal ki [26]. However, such comprehension results from a superficial and partial view of sport. In this regard, Evola [6] identifies that the symbolism of victory found in sport is endowed with a twofold aspect, since the triumph over the external opponent depends previously on the triumph over oneself.

Given its martial nature, Jiu Jitsu techniques are composed of a visible face, known in Japanese as *omote*, and a hidden face, known as *ura*. These martial techniques more often called as *jutsu* or *jitsu* are considered a vehicle for achieving the spiritual discernment [28,29,30]. For Scupoli [31] the spiritual discernment is achieved through

the training of the will and intelligence of the ascetic through the practice of prayer itself. However, in addition to such contemplative way, it is possible to identify another modality of inner combat that is directly linked to the domains of the tradition of action, to which combat sports, in their turn, are deeply connected [6,32]. According to Gracie [33] "men are born to be warriors". Therefore, with the confrontation of an external adversary, understood as the little war, one arrives at the great war that, in turn, is of an internal order, in which the symbolisms of the sacrificial act and heroic drunkenness are found from the competitive victory [6]. For Severino [12] (p. 17) "...in these mystical wars, it's not about winning or being defeated by the simple glory or detriment that it can mean". To defeat the adversary, it is first needed to defeat oneself, which consequently leads to the ontological transfiguration of the fighter. However, what is really pursued is not consummated with the mere victory over the opponent himself, but with the triumphal peace, that is, with the victory over oneself [34]. In short, the peace through war [6,32].

### CONCLUSION

This study presented as main limitation the scarcity of previous studies on Jiu Jitsu from spiritual approaches. However, by identifying the converging points between the traditional teachings and some analytical precepts of the science of religion, it was possible to identify the presence of the sacred in Jiu Jitsu as well as its ascetic potential. Whether as a self-defence art or a martial sport, Jiu Jitsu is an essentially spiritual practice that enables access to the deepest domains of the sacred, as its atmosphere is saturated with sacrality. The Jiu Jitsu Academy is unlike an ordinary gym where one goes only in order to work out, but it constitutes a kind of sacred space, since its structure descends from the religious temples and monasteries where practices of spiritual nature are still carried out; besides it is separated from the profane space. It has been verified that sacred time can occur on the ceremonial rites of belt promotion that can be repeated and recovered cyclically, depending on the practitioner's belt. The sacred time can also be identified in the performance itself, manifested in a linear and eschatological way



from which it is possible to engage in a modality of holy war. It's been also verified that Jiu Jitsu is endowed with a transcendent dimension from which it is possible to ascend into super-sensible realities through the symbolical experience provided by the combat. Finally, the ascetic potential of Jiu Jitsu made possible by such spiritual experience can reach different levels according to the practitioner's degree of readiness and proficiency.

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## **Psychological characteristics of students' personality different specialties**

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**Abstract:** Compliance with individual typological characteristics of the student to the chosen direction contributes to successful adaptation to higher education and readiness for future professional activities. The goal is to identify the psychological characteristics of students-doctors, engineers, and lawyers. **Materials.** Future doctors (n=80), lawyers (n=50), and engineers (n=50) studied psychological characteristics of the individual in 180 students of 1-3 courses (17-25 years). The program «Mini-mult» of the medical diagnostic hardware and software complex «Biomysht-research» («Nerolab», Russia) was used. **Results.** Students of different specialties have intergroup and individual differences in neurodynamic and cognitive functions. The most significant difference was found on the scales 1, 2, 6, 7 (P 0,05-0,01). The character of the students-future doctors and lawyers personality pattern, has a «peak-like», three-phase pattern and there are no significant differences between contrasting «peaks». The average psychological profile of the students personality and future engineers is «linear» – all its indicators are in the range between 45T and 55T. Such a profile is found in people who belong to the concordant norm. **Conclusion.** According to the indicators of the three evaluation scales (L, F, K), students of all the study groups are characterized by high openness and a desire to present themselves in a more favorable light. Psychological profiles of students, doctors and lawyers are similar in nature. Engineering students are confident, happy with themselves and their surroundings, sociable, optimistic and cheerful. However, their level of anxiety is higher than that of a group of law students. It is recommended to create a system of organizational and pedagogical conditions for the formation and development of «sinking components of professional mobility» for students of various specialties.

**Keywords:** psychological characteristics of the individual, students, doctors, lawyers, engineers.

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### **INTRODUCTION**

One of the leading tendencies of modern educational situation development, which is realized on the basis of global changes in social-economic sphere of our society, is attention to new level staff potential formation [1,2].

For a successful crises escape and the tempo of economics development government takes the measures, which include the objectives, directed towards the level of all productive relations intensification [3]. It is possible in terms of the working staff professional training quality and in terms of the highly-productive working places increase (HPWP) number [4].

During vacancies for HPWP announcement

many organizations and industrial productions have the demands for the potential workers' professionally important psychophysiological qualities (PIPQ) [5]. At the same time special attention is paid to physical, functional and psychological parameters of the future workers [6]. It is supposed that professional working capacity of a person, which is based on special knowledge, skills and abilities and a range of professionally significant physical and psychic qualities, influences labor productivity [7]. We revealed feedback, when the profession influences a person, forming different "psychophysiological portraits" [6,7]. For example, medical, juridical or economic influence on a person is multidimensional, for some subjects

harmoniously controlled, empathic, for others-impulsive, emotionally unsteady, frustratoire. Depending on the peculiarities of professional activity there is varied frequency of different influence kinds [4].

It becomes obvious that the problems of professional selection in terms of severe modern demands gain not only great urgency, but also can have great value both for employer and for the specialist. The problem of specialists with the definite HPWP selection appears not only before the establishments and organizations, which offer HPWP, but before higher educational establishments, which realize the future specialists training [5].

M.S. Emmert and other authors [8] and our own earlier research works [4] show that professionally important qualities of doctors, lawyers and engineers include general endurance (as for many professions, as it determines the level of specialist's working capacity and his fatigability) [10], static and dynamic power of "pose" muscles (of spine, abdomen, shoulder girdle) [10], dexterity of muscle apparatus of hands [11]; communicative and organizational abilities, attention switch, logical thinking, operative memory and the ability of self-control (stress resistance) [12] (picture 1). However, for complete characteristic of psychophysiological status of students of different specialties it is necessary to study psychological characteristics of a personality.

The aim of the research is to reveal psychological characteristics of students- doctors, engineers and lawyers personality.

### **MATERIALS AND METHODS**

Psychological characteristics of the personality were studied among 180 students of the 1st -3rd courses (17-25 year-old), the future lawyers (n=50) and engineers (n=50). The program «Mini-mult» of the medical diagnostic hardware and software complex «Biomouse-research» (Biomysh-issledovatelskaya) («Nerolab», Russia) was used. «Mini-mult» questionnaire was created by Swedish psychologist James C. Kincannon (1968) [13] and was adapted in Russian variant by V.P. Zaytsev (1981) [14]. It is a short variant of Minnesotan multiaspect

personality test MMPI – methodology of personality many-sided study, for express-estimation of psychic adaptation of big amount of respondents in terms of dynamic self-control. This test is used not only in the clinic for the personality structure and psychic states estimation, but also is used for healthy people study (students, athletes and other people) in order to get additional information about the characteristics of a personality and possible deviations (for example, psychopathic traits of character revelation) [15].

The test among students was held in auditoriums before the lessons. At a preliminary stage all respondents were registered in a computer database. Then each student fulfilled the test, which included 71 questions (statements). After the program start there appeared the dialogue box on the screen. The dialogue box had the question and it was offered to choose the answer. Questions were in sequence. Each respondent was tested no more than 15 minutes. Results interpretation was held according to 11 scales. Three evaluation scales (L, F, K) reflect the respondent's sincerity, the degree of results validity and the volume of correction. It is introduced by excessive caution. The rest 8 scales estimate the features of a personality. Results handling was held using the set of special tables. They transform the received points into T-points. The indices higher than 70T and lower than 40T were considered as a deviance [14]. The results of the studies were statistically handled, using «STATISTICA 10.0». Parametric methods were used, the validity of the received results differences was determined with the help of Student t-test in terms  $p < 0,05$ . As the measure of the central tendency arithmetical mean (M) was used, as the measure of dispersion standard error of the arithmetical mean (m) was used.

### **RESULTS AND DISCUSSION**

During the held research we received the results. They characterize psychological characteristics of students' personality –doctors, lawyers and engineers. It is known that T-points value of the main profile scales, which are within the range of 40T-70T, are considered a norm and are called "corridor of norm". Among the sampling of students-doctors all scales of the main profile are

within the range of  $47,60 \pm 1,20T$  till  $77,13 \pm 2,00T$ , with peaks. They correspond with the scales F, 3, 6, 8 (table 1). Such kind of profile can be considered “peak-like” or “three-phase”. The leading typical traits of this profile are the traits. They are typical for the scales, corresponding with the “peaks”. The greatest T-points value of the main profile scales corresponds with F scale -  $77,13 \pm 2,00T$  (picture 1). Such a high value of F scale profile can prove uncertain answers. Sometimes it proves the need for self-expression among young people with not high thinking sensitivity, the inkling for conflict behavior [18]. The value of the rest T-points of the main profile scales are within the range of the upper limit of norm. The contrasting “peaks” are seen according to the scales of hysteria (Hy), paranoia state (Pa), schizophrenia state (Se).

As the values of T-points according to these

scales are within the limits of the norm, we can say that a student-doctor is characterized by some difficulty in social adaptation, the desire to attract attention, be special, not having clear grounds for it, an artistic demonstration of own “Self”. For such students it is typical to have nonstandard approaches and ideas. They are sometimes far from their realization, not always practical.

The received results of the lawyers’ study are presented in table 1 and are graphically interpreted in picture 1. The averaged psychological profile of students-lawyers analysis showed the same “three-phase” personality picture, as in case of students-doctors. In one case “peaks” correspond with the scales of students- doctors and don’t have valid differences. The values of almost all basic scales are within the norm, but are closer to “the average corridor”.

Table 1 –T-points value of the students- doctors (n=80), students-lawyers (n=50), students-engineers (n=50) main scales

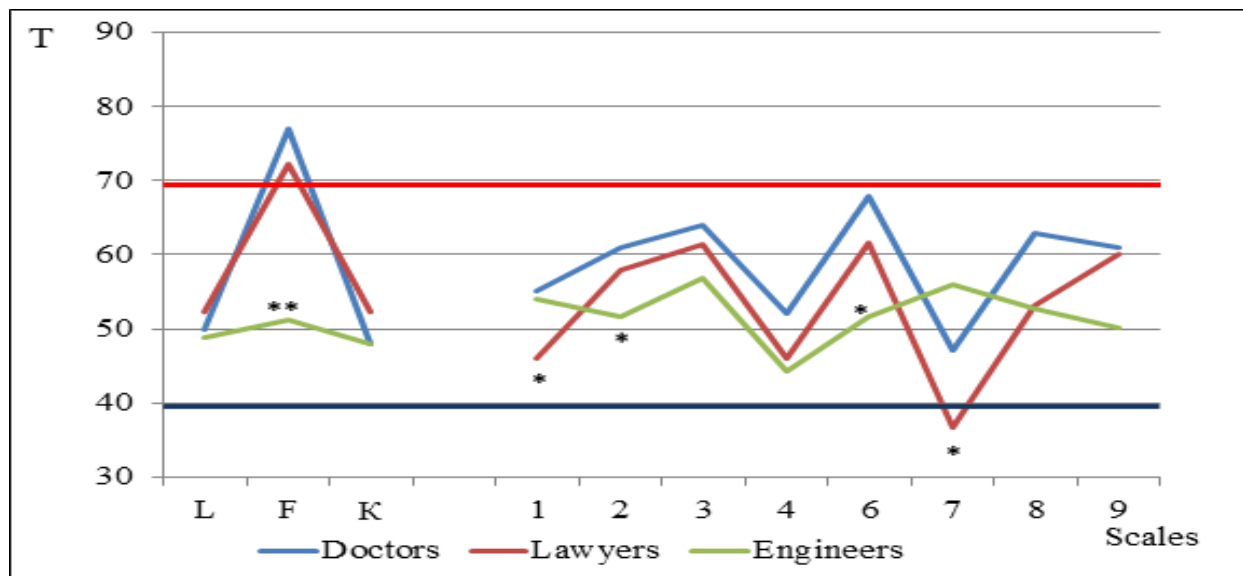
№	SCALES	Indices		
		Doctors	Lawyers	Engineers
L	Lie	50,62±1,40	52,25±1,30	48,92±1,50
F	Validity	77,13±2,00	72,33±3,90	51,31±1,50
K	Correction	48,56±7,60	52,38±7,00	48,02±1,30
1(Hs)	Hypochondria	55,03±1,70	46,00±3,30	54,00±1,60
2 (D)	Depression	61,00±2,00	58,00±2,70	51,68±2,10
3 (Hy)	Hysteria	64,05±2,00	61,35±1,60	56,78±2,00
4 (Pd)	Psychopathy	52,35±2,00	46,17±2,00	44,26±1,90
6 (Pa)	Paranoia state	68,98±1,10	61,79±1,40	51,65±2,00
7 (Pt)	Psychasthenia	47,60±1,20	36,66±1,80	55,92±2,00
8 (Se)	Schizophrenia state	63,36±2,10	53,23±2,20	52,71±1,60
9 (Ma)	Hypomania	61,52±1,20	60,14±1,60	50,18±1,70

The exception is the scale of psychasthenia (Pt). T-points value of this scale are extremely low  $36,66 \pm 1,80T$ . The value of psychasthenia scale is 23% lower than among students- doctors. It proves the absence of caution in deeds and scrupulosity in the questions of morality, egocentrism, decreased ability to empathy, non-conformity of mindsets, severe manner of behavior, cynicism. Such decrease according to the 7<sup>th</sup> scale proves uncritical attitude to own “Self”, to own abilities reevaluation. It can be the reason for adaptation violation.

In students-lawyers, the same as in

students-doctors the greatest value of T-points of the main profile scales corresponds with F scale-  $72,33 \pm 3,90T$ . Absolute values of this scale are 7% lower, than in students-doctors. Such moderate F scale indices increase can be connected with the inner tension and dissatisfaction in first-year students with the adaptation to changed situation in communication and the specificity of education [19].





Notes. L – lie scale, F – validity scale, K – correction scale, 1 – hypochondria scale, 2 – depression scale, 3 – hysteria scale, 4 – psychopathy scale, 6 – paranoia state scale, 7 – psychasthenia scale, 8 – schizophrenia state scale, 9 – hypomania scale. \* –  $p < 0,05$  – significance level; \*\* –  $p < 0,01$  – significance level Student t-test

Fig. 1. Averages psychological profile of students -doctors (n=80), students-lawyers (n=50), students-engineers (n=50)

Psychological profile of students-engineers differs considerably from the profile of students-doctors and students-lawyers. According to the scales of validity there was the difference in F scale - among students- engineers it was 48,69% lower ( $p < 0,01$ ), than among other respondents. The scales of lie and correction were within the limits of norm and didn't differ considerably. In general the averaged profile of students-engineers can be included into "linear" one, as its all indices are within the limits between 45T and 55T. Picture 1 shows that students-engineers had the inversion according to the indices of D and Pt scales. The level of anxiety (according to the scale of psychasthenia) among them was  $55,92 \pm 2,00T$ , which is 52,53% ( $p < 0,05$ ) higher than the level of the students-lawyers group and corresponds with the norm.

Comparative analysis of results, received in all three defined groups, showed considerable difference according to scales 1, 2, 6, 7. According to the basic scale of hypochondria (Hs) students-lawyers have the lowest value of T-points, which is  $46,00 \pm 3,30T$ . In the future lawyers the value of this scale is 16% ( $p < 0,05$ ), lower, than in students-engineers. It can be explained by the specificity of medical education in doctors and by the inclination for own accuracy, steadiness and working capacity demonstration in engineers. According to the basic

depression scale (D) students- engineers have the lowest values -  $51,68 \pm 2,10T$ . In students-doctors and students-lawyers the volume of T-points according to this scale is 12,2% and 18,0% higher. Such tendency can prove great resistance of the future lawyers to depressive-anxious states. In students-engineers such results prove a low level of anxiety, activity, communicativeness, the sense of own importance, power, energy and cheerfulness. At the same time the indices of all three groups are within the limits of "norm corridor". According to the basic paranoia state (Pa) scale the lowest values, which correspond with the norm, were in students-engineers. In students- doctors and students-lawyers T-points values according to paranoia state (Pa) scale were 33,6% ( $p < 0,05$ ) and 19,6% higher and were close to the upper limit of the norm. According to the basic scale of psychasthenia (Pt) students-engineers also didn't have any deviations from the norm. Students-doctors and students-lawyers have negative "peaks" of T-points value according to psychasthenia (Pt) scale. In doctors the results are 14,9% lower. In lawyers the results is 34,4% lower and is beyond the lower limit of "norm corridor". Higher values according to scale 8 were in students-doctors, than in the future lawyers and engineers, 15,5% and 24% higher (table 1, picture 1). In general the values according to all basic scales in

students-engineers and students-lawyers are lower and are closer to the norm in comparison to the same results in students-doctors.

### **Discussion**

The research works, devoted to psychological characteristics of students' personality study in students of different specialties, are still very urgent. In the opinion of some authors [9], students' age is the final stage of socialization. The main aim of this age is profession and the type of educational establishment choice. It leads to differentiation of students' way of life at different educational establishments, interests and responsibility range broadening. Psychological characteristics influence the character of the individual, his success and failures in the definite professional activity, the interaction with other people in professional and personal spheres [19]. Many authors study differences in psychological characteristics of students' personality of technical, artistic specialties, programmers [8,19,20]. At the same time, most native authors consider, that the main factor in personal characteristics development is a person's way of life and his professional activity. "It determines personal characteristics of the subjects, their professional motivation" [20]. Our research work studied psychological characteristics of a personality in students-doctors and the future lawyers and engineers. According to the results of testing using multiaspect MMPI questionnaire we studied the personality features of different specialties students. In accordance with T-points of L and K scales students of all three groups have sufficiently high sincerity and the tendency to present oneself in a favorable light, demonstrating social norms observance. According to F scale students-doctors and students-lawyers have high results. They prove low validity of answers and high level of anxiety concerning the test. Psychological profiles of students-doctors and students-lawyers have much in common. Students-doctors and students-lawyers can show themselves better in the situations. In these situations it is necessary to change own role, where there are short-term contacts, the ability to adapt to different people. Decisiveness, flexibility of behavior with low level of anxiety, confidence during decisions making are

the characteristics typical for the future doctors and lawyers. These characteristics would help to realize professional activity in the future [14]. Probably straightforwardness, sense of competition, desire to estimate own achievements high, some neglect of behavior rules are typical for them.

Psychological profile of students-engineers is different. For them low level of anxiety, activity, communicativeness, sense of own significance, power, energy is typical. One of the psychological characteristics of engineers is the tendency to preserve constant interests, mindsets, determination, flexibility of behavior with low level of anxiety, confidence during decisions making. Such psychological picture corresponds with the profile of technical specialties students. In professional activity of engineers such qualities are extremely important. The received results correspond with the results of our previous research works and with the opinion of several authors [4,21,22,23]. A. Baurina thinks that for the future engineers it is typical to have the following characteristics: low anxiety level, emotional comfort, self-acceptance, adaptability, low level of emotionality, rational behavior during stress. [21]. Thus, the held research works prove the presence of peculiarities in psychological profile of students-doctors, students-lawyers and students-engineers. The success and failure in the definite professional activity, the style of interpersonal communication, interaction with other people in professional and personal spheres depend on these characteristics [19].

### **CONCLUSION**

According to the indicators of three evaluation scales (L, F, K), students from all studies groups have high level of sincerity and a desire to present themselves in a favorable light.

Psychological profiles of students-doctors and lawyers are similar. The stating "peaks" are defined according to the scales of hysteria, paranoia state schizophrenia state. It shows constant dissatisfaction and steady desire to achieve the aim. Decisiveness, flexibility of behavior with low level of anxiety, confidence during decisions making are the characteristics typical for the future doctors and lawyers. Students-engineers are confident, are

satisfied with themselves and their surroundings, sociable, optimistic and cheerful. However, their level of anxiety is higher than that one in a group of students-lawyers. It is recommended to create a system of organizational and pedagogical conditions for the “stay-put components of professional mobility” formation and development in students of different specialties.

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## The effectiveness of physical culture elective courses realization using Nordic walking in terms of higher education

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**Abstract:** In modern society the research works are constantly held using innovative approaches to physical activity organization among different groups of population. It is especially popular among students. Modern educational establishments are characterized by constant increase of students' intellectual activity. The amount of mental loads, tasks, projects increases. In this case students' physical activity decrease has negative influence on their organism. Hypodinamia is a chronic process. It is characterized by gradual decrease of muscles tonus, first of all the disorders in the work of cardiorespiratory system. A person's neuromuscular and locomotor apparatus are damaged. The aim of the research is to study the influence of systematic Nordic walking lessons on students' health indices. **Research methods.** In order to estimate the level of students physical health we held the test of functional indices, such as heart rate (HR), lung capacity (LC), physical working capacity, Skibinskaya index, birth-death ratio, health level according to Apanasenko. 44 students of the 2<sup>nd</sup> course of the State University of Land use Planning and Control took part in the research work. After defining the initial level of the indices we formed one control and one experimental group. In the control group lessons were held taking into account the demands of the physical culture and sport elective course working program. In the experimental group we used the methodology, directed toward Nordic walking use in three directions: therapeutic, health improving and sports. **Results.** In order to estimate the initial level students' physical health in the experimental and control groups we used the diagnostics, offered by G.L. Apanasenko (2000). 35% of students have a low level of physical health (LPH), 15%- below the average, 45%- the average level, 10%- above the average and 5%- a high level of physical health. A low level of LPH among the students of the 2<sup>nd</sup> course is mostly connected with motor activity decrease, especially during exams. In the EG after the methodology realization there was the amount of students increase, who have the average, above the average and high level of physical health. The safe level of students' health is the average and above the average level, where there are no adaptation disorders. Adaptive potential of students from CG and EG was defined with the help of functional indices study with transfer into points. Adaptive potential of students as the index of cardiovascular system functional abilities characterizes the range between health and disease. Before and after the experiment there were no cases of adaptation violation zones in CG and EG. The cases of students with unsatisfactory zones of cardiovascular system adaptation in CG and EG we connect with the fact that students didn't have aerobic loads of health-improving and training character for a long time period. After the experimental methodology realization we received the results. They characterize not only students' physical health level improvement, but also improvement of cardiovascular system adaptive potential to physical loads of aerobic orientation. **Conclusion.** Functional state indices study among the 2<sup>nd</sup> course students revealed, that their physical health is at a low, below the average and the average level. Taking into consideration the studied indices we realized Nordic walking during physical culture lessons in three directions: therapeutic, health improving and sports. They differed in volume and intensity of physical loads. The volume of physical load was corrected taking into account an individual level of students' physical health according to the studied indices. In general the methodology realization demands the differentiated approach use to lessons organization, taking into account morphofunctional indices.

**Keywords:** elective course, methodology, Nordic walking, students, aerobic potential, physical health.

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## **INTRODUCTION**

In modern society the problem of students' health is widely discussed. In terms of educational establishments 90% of those, who enter higher educational establishments have health problems [7,8]. Specialists also mention that the level of chronic diseases also increases. The amount of students, who can be included into the main groups for physical culture lessons decreases. Global decrease of functional state and the necessity to change the negative tendency of adaptive potential and physical health level among different groups of population demands great attention from the research workers in the sphere of physical culture and sport [3,4,5,6,9,10,11]. In this connection it is important to find the way out, directed toward the conditions creation for innovative methods realization for students' and athletes' health improvement. Students try to master new approaches to their motor activity increase. Nordic walking is the means, which helps to solve the problems of therapeutic, health improving and sports orientation.

Nordic walking very quickly became the part of Russian people life. Politics, directed toward Nordic walking introduction into the life of population, was successful owing to the work fulfilled by the participants of the project and mass media in towns and regions of the Russian Federation. Nordic walking introduction into educational process of students as an effective aerobic exercise helps to realize the idea of Kuper. It says that the effectiveness of each person breathing depends on systematic physical exercises of aerobic orientation. He underlined the role of aerobic exercises in effective breathing formation with sufficient amount of oxygen. It is achieved owing to continuous, moderate and constant physical loads. In this case cardiovascular system development with the help of walking is very important.

Defining students' physical state we take into account the indices, which help to estimate the level of students' physical health.

Important indices, which characterize health state, can be considered morphofunctional indices. It is also important to take into account individual characteristics of students' organism. In

order to define the effectiveness of Nordic walking influence it is important to take into consideration adaptive potential of a person [7].

The aim of the research is to study the influence of systematic Nordic walking lessons on students' physical health indices.

## **MATERIALS AND METHODS**

Before and after the experiment the following indices of students were studied: heart rate (HR), arterial pressure (AP), weight-height index (WHI), vital capacity (VC); life index (LI), Skibinskiy index (SI), physical working capacity according to Ruffier index, adaptive potential (AP) and health level [1,2]. The received results handling was held by means of MS Excel. 44 students of the 2<sup>nd</sup> course State University of Land use Planning and Control took part in the research work. After defining the initial level of the indices we formed one control and one experimental group. In the control group lessons were held taking into account the demands of the physical culture and sport elective course working program. In the experimental group we used the methodology, directed toward Nordic walking use in three directions: therapeutic, health improving and sports. The research was held during the academic year. Taking into consideration the initial level of students' physical health we created the methodology of Nordic walking lessons.

Nordic walking lessons were realized in three interconnected directions. The first direction-therapeutic, was used for students with a low level of physical health (5 students); health-improving- was used for students with the average level of physical health (12 students); sports- was used for students with high level of physical health (5 students).

Therapeutic direction of lessons included Nordic walking realization during the experimental period with the duration 10, 20, 25, 30, 90 min; heart load in percentage from maximum - 70, 50, 40, 30%. Heart rate was defined for one lesson in proportion with the duration of the lesson. For example, 10 minutes lessons, HR-till 140 beats/min., if the lesson duration is 20 minutes, then HR indices are till 120 beats/min.

Thus, the duration of the therapeutic orientation lesson is controlled taking into

account students' HR indices. The main aim of therapeutic orientation Nordic walking realization is cardiorespiratory system effectiveness increase owing to constant physical load increase. The main principle of means realization is gradual and regular character. Methodical recommendation for therapeutic orientation lessons was the rules observation during the speed of movement decrease, duration of the distance increase.

Health-improving orientation realization included the following: generally developing exercises fulfillment for all parts of the body; exercises directed toward physical qualities development:

1) endurance: the average tempo walking in accordance with individual HR indices; a long term walking in a slow tempo or weak intensity;

2) power: exercises with external resistance; exercises with own body weight overcoming; exercises for passive or active muscles tension;

3) quickness: running with maximum possible speed (duration 20-30 seconds); walking with above the average speed.

Sports orientation of Nordic walking

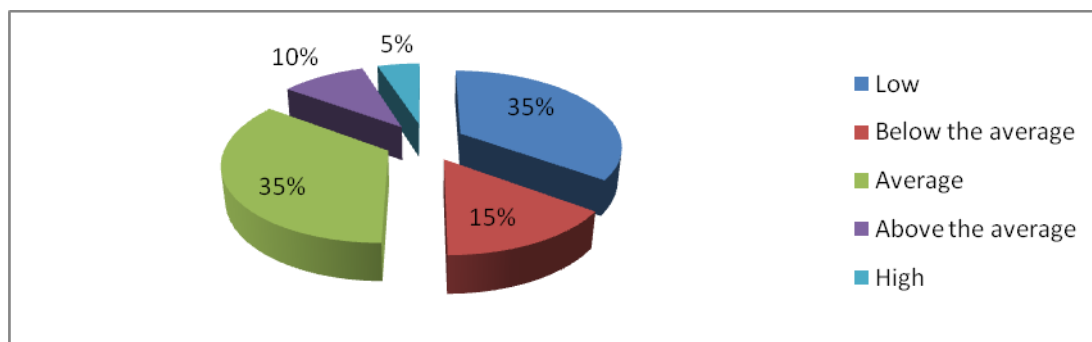
realization among the students from the experimental group included the following: walking fulfillment according to the following scheme: the first week- 15 minutes with the repetition twice after 10 minutes rest; the 2<sup>nd</sup> week-20-25 minutes with the repetition 2-4 times after an active rest; the 3<sup>rd</sup> week – till 30 minutes. During further lessons there was duration of the lessons increase (1 minute). During physical load in a form of Nordic walking students should pay attention to breathing. Forced respiration or dyspnea during walking should be the signal for the tempo of walking decrease.

For all students, independent of the program, which they fulfill, the objective is set in a way that to prevent unpleasant feelings in an organism.

## RESULTS AND DISCUSSION

In order to estimate the level of students physical health from the control and experimental group we used the diagnostics, offered by G.L. Apanasenko (2000).

Picture 1 presents the results of students' physical health level (PHL).



Picture1 – The initial level of physical health in the 2<sup>nd</sup> course students

Picture 1 shows that 35% of students have a low level of physical health, 15%- have below the average level, 35% – have the average level, 10% have above the average level and 5% have a high level of physical health. Low LPH in the 2<sup>nd</sup> course students is mostly connected with motor activity

decrease, especially during examinations.

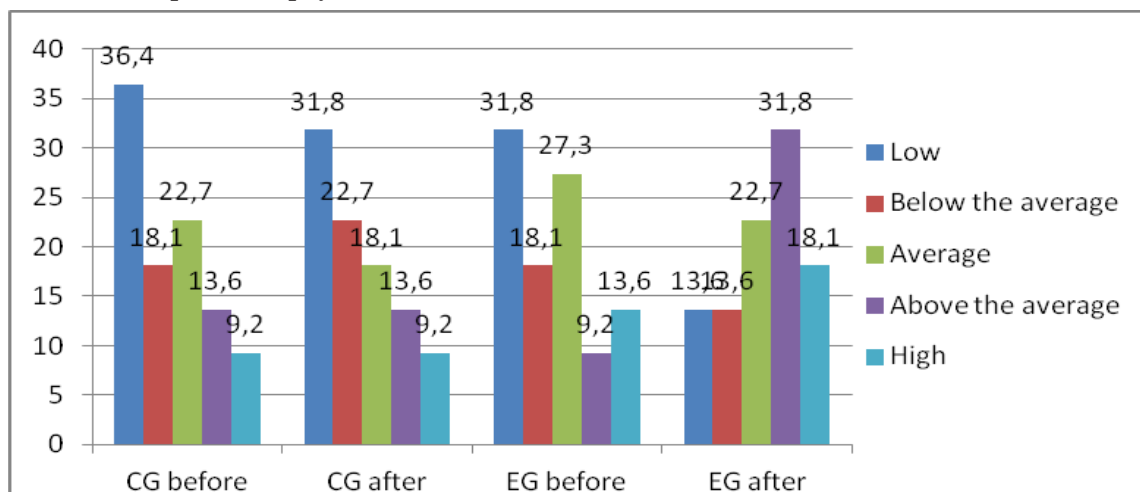
Table 1 presents the level of physical health in students according to G.L. Apanasenko methodology before the experiment and after their distribution according to the groups.

**Table 1 – The level of physical health in students according to G.L. Apanasenko methodology before the experiment**

Group	n	Level of physical health among students									
		Low		Below the average		Average		Above the average		High	
		Number of people	% from general	Number of people	% from general	Number of people	% from general	Number of people	% from general	Number of people	% from general
CG	22	8	36,4	4	18,1	5	22,7	3	13,6	2	9,2
EG	22	7	31,8	4	18,1	6	27,3	2	9,2	3	13,6

Table 1 shows that in CG and EG all kinds of students' physical health level are revealed.

Picture 2 presents physical health level



**Picture2 – The level of physical health in students after the experiment**

Picture 2 shows that students from EG and CG have all levels of physical health. In EG after the methodology realization taking into account three directions (therapeutic, health improving and sports) there was the amount of students increase, who have the average, above the average and high level of physical health. Safe level of students' health is the average and above the average level, where there is no adaptation disorder.

Adaptive potential of students from CG and EG was defined with the help of functional indices study and their transfer into points. According to the received results we estimated the adaptive potential of students as the index of cardiovascular system functional abilities. It characterizes the range between health and illness.

The results of adaptive potential determination in students are presented in table 2.

Table 2 shows that in the studied groups of students there are three variants of adaptive potential

of their cardiovascular system demonstration.

Adaptive potential of students from CG and EG before the experiment didn't have validly significant differences. After the experiment the situation with physical health level among experimental group students changed. Before and after the experiment in CG and EG there were no zone of adaptation break-down. Unsatisfactory zone of cardiovascular system adaptation in students from CG and EG we connect with the fact that they didn't have aerobic loads of health-improving, training character for a long time period.

After the experimental methodology realization we received the results. They characterize not only physical health improvement, but also adaptive potential of cardiovascular system improvement to aerobic orientation physical loads.

Table 2 – Adaptive potential of students according to R.M. Baevskiy methodology

Group	n	Adaptive potential of cardiovascular system.							
		Adaptation disorder		Unsatisfactory		Tense		Satisfactory	
		n	% from generaln	n	% from generaln	n	% from generaln	n	% from generaln
CG	22	0	0	7	31,8	4	18,1	11	50
CG after	22	0	0	8	36,6	5	22,7	9	40,9
EGbefore	22	0	0	7	31,8	3	13,6	12	54,5
EGafter	22	0	0	0	0	1	4,5	21	95,5

It should be noted that the effectiveness criterion of the experimental methodology estimates chosen by us tactics of students' health improvement and training. If we get a positive effect from the achieved level of students' physical health, we can say that the methodology is realized correctly. Individual talks with students after the experiment helped to define the level of changes in a functional state. The main criteria for this are chosen the following: health state in general, health state improvement partially, without changes, only worsening.

The level of physical state in general and its main indices improved in 77,8% of students. They trained according to the experimental methodology; health state improvement partially was in 20,9% of students, characterizing changes in cardiovascular, respiratory or muscular systems indices, but at the same time without considerable decrease of other indices; only one student had some indices decrease ( $p < 0,05$ ).

In the control group during the experiment the level of health decreased in 45,9% of cases, some morpho-functional indices - in 54,1% of students ( $p < 0,05$ ).

The received results help to come to the conclusion, that therapeutic, health-improving and sports effects from Nordic walking methodology in 98,7% of students from the experimental group was provided owing to an optimal planning of physical loads and their correct realization during the lessons.

PHL indices analysis in students from EG revealed that functional abilities of the organism improved in students, who went in for Nordic walking of therapeutic orientation (59%), health-

improving orientation (27%) and sports orientation (14%). In all groups the differences between the initial and final indices of physical health level were valid ( $p < 0,05$ ).

Thus, cyclic exercises by the example of Nordic walking, directed toward general endurance and aerobic mechanism of muscle activity energy supply development helps not only to increase physical health level, but also the quality of students' life.

Presented by us methodology of Nordic walking lessons with the 2<sup>nd</sup> course students provides necessary conditions for individual influence lessons organization and help to solve educational, developing and health-improving objectives and achieve the initial aims of its creation and introduction.

All mentioned above helps to create students' profile of physical health for the training effects estimation. Below we present health profile of students from EG before and after the experiment.

Picture 3 presents the example of the physical health level profile creation diagram. It is characterized by gained points.

Picture 3 shows that any diagnostic index can be introduced into the given profile and get an individual profile of physical health of each student. It can make diagnostic indices perception easier.

The main pedagogical conditions of the experimental methodology realization are the following: conditions organization for students' physical health monitoring in a macro cycle of training; a data bank creation of the studied indices; regular analysis of results monitoring; practical recommendations creation.

**Estimation in points**

Bad (1 point)									
Unsatisfactory ( 2 points)									
Satisfactory (3 points)									
Good (4 points)									
Excellent (5 points)									
	BMI	LI	PI	RI	PW	AP	HR	AP	IIH

Notes: BMI – body mass index, LI – life index, PI – power index, RI – Robinson index, PW – physical working capacity, AP – adaptive potential, IIH – integral index of health

Pic. 3. Students’ health profile creation before and after the experiment

**CONCLUSION**

Thus, functional state indices study in the 2<sup>nd</sup> course students helped to state that their physical health is at a low level, below the average and the average level. Taking into consideration the studied indices we realized Nordic walking during physical culture lessons in three directions: therapeutic, health improving and sports. The volume of physical load was corrected taking into account an individual level of students’ physical health according to the studied indices. In general the methodology realization demands the differentiated approach use to lessons organization, taking into account functional indices. In terms of the students training level increase we see their functional abilities, adaptive potential and an integral health index increase.

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## **Psychophysical readiness to physical activity. From external requirement to personality need**

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**Abstract:** The article deals with the issues of the students preparation for physical activity and sport mainly through the transformation of motives to be engaged in P.E. from the university's requirement to the personality need. **Introduction.** Also it is revealed that formation of physical qualities, psychic abilities and skills for health promotion are necessary to support healthy way of life and to prevent some professionally dangerous diseases. **Materials and methods.** In this project we showed how students learn to determine abilities and capabilities, advantages and disadvantages on the basis of assessment and self-assessment of their organism functional state and professionally important traits of the character. At each next stage of preparation, the competence and skills for physical and physical conditions regulation were developed and the elimination methods of health deviations were searched in order to transfer ones to the professional sphere and life activity. **Results.** By the end of the study, the programs of self-development and self-improvement were defined, transfer of the valuable relation to physical activity in the process of interaction with other people was carried out, and as a result, the positive dynamics of life quality had defined.

**Keywords:** physical activity, motives, self-assessment, health, self-regulation, skills.

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### **INTRODUCTION**

Today, to identify the individual ego is a feature of social relations in the today's Russian society, as a counter to the slogan of Soviet period aimed to community ego. Therefore, choosing pedagogical methods of interaction, one should take into account certain individual characteristics: age, gender, motives, social class, profession, etc. [1-9]. In turn, the sustainability of society depends on the prudent human nature, the full realization of the potentialities, concluded in the organic intellectual, emotional and psychophysical unity. And each student must have the techniques and methods, which contribute to the formation of proper qualities, properties and conditions, manifested in intelligence, health, knowledge, quality, productive work and active life [10-15]. In this regard, the

implementation of consistent actualization of professional and personal development through various forms of human activity has become particularly important.

The purpose of the study is to develop a complex of psychophysical qualities and skills for physical activity, on the bases of the positive hereditary factors, within the educational area of physical culture.

### **MATERIALS AND METHODS**

Training sessions were conducted in the form of lectures, practical, individual and independent classes. Teachers reported to students some information about:

- psychophysical conditions, health criteria and methods for assessing its dynamics;

- nature of physical activity and its impact on human behavior;
- interaction features and methods of the acquired skills transfer in the professional communication;
- methods of maintaining motor activity, practical use of exercise systems, methods and options for self-management and self-action;
- motivation and transfer of value attitude to physical training in the practice of future professional activity.

Research included diagnostic, analytical, motivational and value, designing stages.

At the *diagnostic stage*, students measured integral component of the psychophysical state, that included cardiovascular system and respiratory function indicators, physical development and individual intellectual characteristics. Cardiovascular system was researched by means of heart rate, arterial pressure, pulse pressure, minute blood volume indicators and other simple functional tests [4]. Also, the respiratory system reserves were studied by students. In particular, they determined the reserves of oxygen in the body, vital capacity of the lungs, inspiratory breath-holding (test Shtange), holding the breath when you exhale (test Genchi). The methods by which physical development was studied include: measurement of the size and weight (somatometry), inspection and description of symptoms and physique body and appearance (somatoskopiya), method of indices (body mass index, life index, indicator of Pinie, etc.), method of standards and anthropometric profiles [4]. Psychophysical qualities, abilities and skills were diagnosed according to the tests named “black-and-red table” and “compasses”, “reaction time to the visual signal and reactions to the moving object”.

All that tests made it possible to determine attention, memory, reproductive and spatial thinking, mobility of mental processes, sensitivity thresholds of the visual analyzer, coordination of fine movements. In the pedagogical process, priority was given to samples and tests. They do not require the participation of qualified personnel, test simulators and sophisticated equipment. They identified the dynamics of functional body stability in a complex way. Thus, the measured integral

component of psychophysical state was available for every student.

At the second *analytical stage* of the study, the main goal was to form the foundations of self-knowledge (the process of determining one's abilities and capabilities, one's strengths and weaknesses). Students were trained in monitoring and self-control for physical state and development, during educational practical lessons under the guidance of teaching staff. This process formed the attitude to active, conscious and purposeful self-improvement, increased interest in physical exercises, changed the real attitude to physical culture.

Students carried out the analysis of the psycho-physical conditions development. The relationship of measured indicators showed to students some peculiarities of their functional state, physical development of the body, and intellectual personality characteristics. They could determine the latent functional lack of systems, its degree, the state of regulatory mechanisms, adaptive and compensatory reactions to a specific physical effort. Thus, the ability and skills to determine psychophysiological status contributed to the readiness for professional activities and life in general [5].

The training in creating a program of self-improvement, its realization and evaluating effectiveness was the main goal at the third *motivational and value stage*. Skills of healthy living were provided by pedagogical situations in the educational process, a purposeful statement of tasks, organization of practical activity, taking into account individual features and abilities of students. Positive advances in physical activity of students relied on methods of exerting influence, formation of skills to adequately assess themselves, the reflection of their activities and their behavior, the ability to draw objective conclusions. Replenishment of knowledge, abilities and skills for purposeful formation and management of own functional state and motor activity was carried out by means of: relaxation methods, psychotechnical games; the form of poster methods; recommendations on the use of individual physical effort and level of health.

Students explored methods to eliminate deviations from the optimal level of psychophysical

state, and as a result, a program of self-development and self-improvement was formed. Students independently created a personal project of a healthy lifestyle, during their chosen practical course and self-studies. Thus, the skills of self-control and skills to determine the effectiveness of the means, methods, organization forms, the valuable attitude to physical activity were formed.

At the fourth stage, some special relations between teacher and students were created in the process of performing physical exercises, which contributed to cooperation, mutual trust, dialogue. Attention was focused on self-control, self-correction and self-education as a result of self-improvement. The use of this experience in the process of physical self-improvement in several activities, the formation of self-regulation skills and individual psychotechnics contributed to the fact that students acted as a subject of self-educational activities. The mindset to subjective transformation of the information was carried out in the following ways: given reception (standard) – method of its execution, enriched personal meaning, on the basis of which the process of solving the problem was recognized from past experience.

Self-control of students and assessment of their own achievements in the development of motor actions was carried out as follows: 0 – a task was not completed; 1 – “anyone could do this” 2 – “majority could do this”; 3 – “some people could do this”; 4 – “only one person could do this”. This approach provided planning, control, correction and assessment of their own performance by students.

On the basis of the data obtained, the search for methods to transfer the personal value attitude to physical activity to another environment, in particular, to the process of interaction with other people during the pedagogical practice was carried out. After graduation, students rated “4 – only one person could do this”, were transferred to the group of sports improvement, and then received a certificate of additional pedagogical education in the specialty “physical culture – sports club leader”.

Participants included students 18-22 years old, who studied at different universities. Pedagogical experiment was conducted in the period from 2015 to 2018.

## **RESULTS AND DISCUSSION**

Daily educational, industrial and household activities make high demands on the human body. The effectiveness of the functional regulation system, which is carried out in different living conditions, is also determined by the level of the body compensatory capabilities. The results of the experiment showed that students could independently and quickly identify the initial signs of the homeostasis regulatory mechanisms violation due to fatigue or violation of the adaptation regime and to establish their impact on the effectiveness of educational and professional activities. Thus, students could identify the nature of the body and health adaptive reactions, the body's resistance to physical stress, adaptation to the climatic conditions of the region, to search for methods and means of recovery through their own educational and scientific research and based on the analysis of theoretical sources.

The information in the table objectively reflects psychophysical readiness to physical activity, shows which parameters are developing more intensively, and which are more difficult. This figure reflects the impact of a streamlined process of physical self-improvement to optimal preparation of students for occupation and formation of a social attitude to the physical self-education.

The students` experience of participation in the evaluation of psychophysical conditions, as a result of pedagogical influence, contributed to the expansion of the personal needs, desires, feelings awareness scope. They are coded in different physical states, prepare for a realistic resolution of internal conflicts, from the restructuring of the cognitive sphere. A meaningful analysis of their psychophysical conditions led to a deeper perception and transforming information and scientific knowledge into knowledge for decision-making. This increases the ability to understand and change the structure of motor activity: from external requirement (“I want passing my exams, that’s why I have to engage obligatory physical education classes”) to personality need and mobilization efforts (“I want to be healthy, that’s why I need knowledge, skills and abilities to improve in physical education

myself. By the way it can be helpful for other people and should find means to interact with others to transfer lessons learned”) [6,7,8].

Table 1 - Dynamics of students psychophysical condition during pedagogical experiment

Indicators	At the beginning of experiment	At the end of experiment
Physical freedom (points)	2,28±0,9	9,08±1,3
Possession method for physical actions (points)	3,29±1,9	7,91±1,5
Motor means of expression: body language, facial expressions, postures (points)	3,08±0,9	9,11±1,8
Emotional flexibility (points)	2,01±1,9	8,21±1,5
Communicative skills and self-reflection (points)	4,22±2,9	8,71±1,4
Dance and creative movement (points)	3,1±0,9	7,21±1,5
Verbal memory (word count)	7,12 ± 0,3	*8,21 ± 0,7
Numbers memory (numbers count)	4,53 ± 1,2	*5,43 ± 0,6
Attention span (quantity of looked through signs)	1602 ± 24	*1593 ± 31,6
The focus (number of errors)	2,0 ± 1,7	0,4 ± 0,7

Note: \* – no statistically significant difference

During the pedagogical practice, students carried out the transfer of experience, they created a general positive emotional attitude and focused on motor activity as a method of management of psychophysical conditions in order to improve performance and health. Following the logic of Collins, [1] the fulfillment of these conditions triggers a ritual of interaction and promotes group solidarity. A belonging to a group becomes valuable, emotionally colored and acts as a goal of group morality and ultimately contributes to the accumulation of emotional energy in the person (student). It is reflected in the ability and skill of professional activity to engage in interaction with a sense of confidence and enthusiasm [1]. Physiologically, this is described as “... the human nervous system's mood for rhythmic involvement in interaction with other people” [1].

In turn, the state of health and well-being characterizes the quality of human life, and together with the success in professional activities reduces the cost of adaptation and the risks of diseases. All this makes it possible to improve the social status and the individual ability to make a choice in the social, political and economic spheres of society that affects the welfare of the whole country [2,6,16].

### CONCLUSION

Thus, an active and positive attitude to physical activity is manifested in active measures and it serves as a value of the individual internal position in the free decision-making. It is in this context that health relevance is the need or interest or purpose in relation with benefit and greater good of the world [9,10. This position is revealed in such type of behavior, which is self-preservation, health-saving and conforms to a healthy lifestyle. It permits to identify and develop all the healthy trends, to actualize the resource potential, to design individual life programs, to ensure the growth of health potential in the unity of all its components.

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## The influence of “Isoton” system exercises on body content of female students of special medical groups

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**Abstract:** The article is about the experimental methodology of using “Isoton” system of exercises. The aim of this methodology is to cause urgent training effects in the organism of those, who train. Planning the kind and the depth of urgent training effects is conditioned by that training effects. It should be achieved for the physical state and health in general improvement.

**Research methods.** Scientific literature analysis and summarizing, experiment, methods of mathematical statistics. The experiment was held among female students of the 3<sup>rd</sup> course of a special medical group, the control group trained according to adopted program. In the experimental group “Isoton” system exercises were used. **Results.** During the experiment we revealed the effectiveness of “Isoton” system exercises influence on body content of a person. It is proved that static-dynamic exercises influence on body content. In the experimental group the indices of body mass, fat-free mass, general water and general liquid increased, the level of active cell mass and the level of intracellular fluid also increased. There was also general weight and fat mass indices decrease. General metabolism stayed almost unchanged.

**Keywords:** method of bioimpedance study, students, “Isoton” system exercises, body content.

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### INTRODUCTION

The urgency of this work is conditioned by the fact that students of technical higher educational establishments don't get necessary physical load. It leads to many diseases development, immunity and mental activity decrease.

One of the most developed units of morphology is body content studying. Nowadays body content studying is defined into a separate branch of the science. New research methods, software program, the works of scientists are introduced into this science. Bioimpedance analysis nowadays is one of the most popular research methods of studying body content of a person.

In order to study body content we used the whole available diagnostic range of medical methods, for example plethysmography, the method of infrared reflection, ultrasonic investigation, X-ray and others. However, the most effective method of body content study in the patients is considered bioimpedance analysis. The instruments for its

organization are simple and the results are easy for interpretation [2].

Bioimpedance diagnostics on the basis of water, protein and fat metabolism indices helps to estimate the risk level of many diseases and serious deviations development in the work of an organism. These diseases include hypertensive disease and its consequences, gallstone and kidney stone disease and also locomotor apparatus diseases development. With the help of bioimpedance analysis it is possible to reveal serious chronic diseases development, such as cancer, AIDS, cirrhosis) [1].

“Isoton” is a system of exercises from health improving physical culture.

Training according to “Isoton” system has the aim to improve health state, working capacity, physical health, appearance (body shape, body content), social, life and labor activity in men and women of a wide age range.

The system was named “Isoton” according

to the type of physical exercises, which take the central place – isotonic exercises, when the muscles experience constant tension during the attempt; and according to the main effect, which is achieved as a result of its use, high “life tonus” of a person, who trains according to “Isoton” system exercises.

During the main principles of “Isoton” creation and substantiation we used an imitating modeling with the help of computer graphics of physiological systems and biochemical processes in an organism and a wide spectrum of physical influence on a person analysis. Then the most effective means and methods of physical health improvement were created, selected and combined into one system by means of organism functional abilities important systems increase (endocrine, immune, digestive, cardiovascular, muscular and etc.) taking into account the effect of the lessons in terms of negative psychic states correction (depressive and etc.) [4].

In case of power exercises correct technique the speed of muscles contraction is not high, the degree of tension - 30-60% from maximum arbitrary force, amplitude is the average and full, in the cycle of movement there can be pauses or the elements of static retention. Muscles usually don't relax till the end of the attempt.

The main distinctive feature of this kind of muscles work is local blood circulation violation. It is together with considerably high degree of muscles tension quickly (during 15-30 seconds) creates hypoxic conditions inside the muscle fibers. It increases anaerobic glycolysis not only in quick muscle fibers, in which its speed is always high, but in slow ones, oxidative. As a result in all types of muscle fibers the concentration of creatine phosphate decreases, hydrogen ions, lactate, free creatine accumulate, other physiological and biochemical phenomena happen. They are typical for a traditional training with big loads.

The aim of any training lesson is to cause rational urgent training effects in an organism. At the same time, planning the kind and depth of urgent training effects is determined by those delayed training effects. It is demanded to achieve physical state and health improvement [3].

The duration of the attempt for each muscle

group leads to considerable muscles tiredness and to sufficiently intensive pain in tired muscles. A person tries to overcome it owing to psychic tension. In this situation the activation of sympathoadrenal and other parts of hormone system, together with metabolites accumulation create so called anabolic effect. They provide cells genetic apparatus activation and intensify the synthesis of the definite proteins [5-9].

In order to activate the processes, which lead to capillaries density (as the preconditions for aerobic abilities, arterial pressure normalization and others), the training process should include several attempts for one and the same muscle group. In this case alternation of a continuous hypoxic state of active muscles during the attempt and maximum blood circulation through muscle tissue after its end activates angiogenesis. It is capillary network increase.

Hypertrophy of the contracting elements of muscles, capillary network increase and anabolic atmosphere creation in an organism after the end of the training process is the main aim and effect of isotonic training. The last factor is an anabolic hormone background. It can preserve during 1-2 days after the training, is its most important effect, as it leads to an intensified synthesis of tissue-specific proteins not only in muscles, but also in all tissues. They have receptors to these hormones, in particular cardiovascular, hormonal, immune, digestive, systems and other important organs. Above we supposed that this mechanism is one of the main mechanisms. It causes health improving effect of isotonic, static-dynamic and other physical exercises [6-12]. Moreover, during static-dynamic training: there is psychic tension (at the end of the attempt) and relaxation alternation during the pauses of rest; a long time period there is a high level of partial tension of carbon dioxide in blood as a result of anaerobic reactions activation; the combination of the increased carbon dioxide concentration in blood. They stimulate respiratory center and a deep “diaphragmatic” breathing through the nose increases the amplitude (during inhalation and exhalation) of a partial oxygen tension in blood. These urgent effects provide psychic processes (psychic relaxation effect) and

vascular reactions normalization.

### MATERIALS AND METHODS

In order to study body content we used bioimpedancemetric study method. It was held on the basis of Izhevsk State Technical University, on "Aist" analyzer according to standard four-electrode scheme. This method helped to estimate the changes of the following indices: the volume of water in an organism (VWO), cellular liquid (CL), extracellular liquid (ECL), fat body mass (FBM), lean body mass (LBM), active cellular mass (ACM), skeletomuscular mass (SMM), body mass index (BMI), relative metabolism, main metabolism.

Before the beginning of the research the following parameters were written: age, gender, height, weight, the size of the wrist. The information was written for bioimpedanc analysis program. The respondent had to be isolated from outer current-conducting objects.

As the respondents we chose the female students of the 3<sup>rd</sup> course. They belong to special medical group. During physical culture lessons students fulfilled the exercises from "Isoton" system. The exercises were presented in a form of smooth squattings (not complete squat), shoulder dip from knees (the amplitude of movements is not complete), in prone position, legs apart, body lifting. At the first (introductory) lesson each attempt of the

exercise fulfillment took 30 seconds. At other lessons the time of the exercise fulfillment was 1 minute 15 seconds. The number of attempts stayed the same. The rest part of the lesson respondents trained according to the adopted program. The control group trained according to the adopted program, without using "Isoton" system of exercises.

### Results and Discussion

In order to study body content with the help of bioimpedance method during physical culture lessons in the experimental group students used the exercises of "Isoton" system. The exercises were presented in a form of smooth squattings (not complete squat), shoulder dip from knees (the amplitude of movements is not complete), in prone position, legs apart, body lifting. At the first (introductory) lesson each attempt of the exercise fulfillment took 30 seconds. At other lessons time of the exercise fulfillment was 1 minute 15 seconds, the number of attempts stayed the same. The rest part of the lesson respondents trained according to the adopted program. The control group trained according to the adopted program, without using "Isoton" system of exercises.

Before the beginning and after the experiment we held bioimpedance study in order to study body content of the respondents.

Table 1 – Comparative indices of body content among students of the experimental and control groups before and after the experiment

№	TESTS	Before the experiment		After the experiment		Increase /Decrease %	
		EG	CG	EG	CG	EG	CG
1	Body mass index	20,3	20,7	19,7	19,7	3	1
2	Weight	53,5	54	51,8	54,1	3	0,2
3	Ft mass (kg)	13,1	13,3	12,1	13,3	7,5	0,5
4	Fat mass (%)	24,4	22,7	23,4	22,8	4	0,2
5	Lean body mass (kg)	40,4	42,1	41,4	42,1	2,5	0,5
6	Active cellular mass (kg)	25,4	24,9	26,9	24,8	6	0,2
7	Active cellular mass (%)	47,4	45,2	49,1	45,1	3,5	0,1

8	General water (l)	29,5	30,8	28,8	30,7	2	0,2
9	General liquid (l)	26,7	28,1	26,1	28,2	2	0,2
10	Extracellular liquid (l)	9,6	11,1	9,5	10,9	1	1
11	Intracellular liquid (l)	17,06	17,1	16,6	17,1	3	0
12	General metabolism (kcal)	1370,1	1381	1367	1380	0,2	0,2

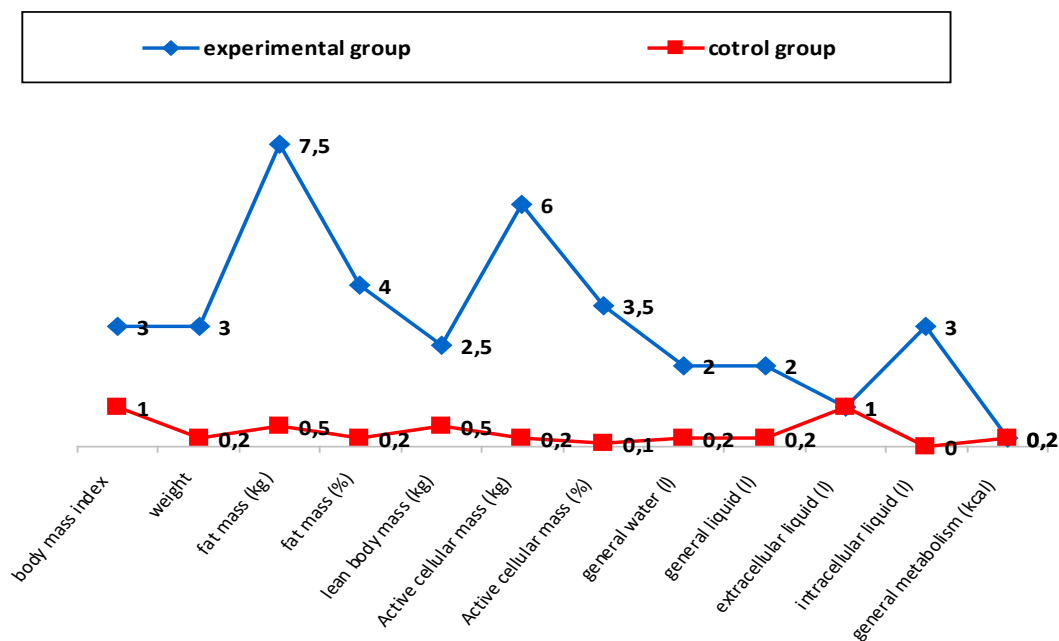
The value of the received Student t-test is more than critical one (the level of validity  $p < 0,05$ ). So the revealed differences are statistically valid.

As we see from the results, at the initial stage of the research both groups had almost the same parameters of body content. After the end of the training lessons according to "Isoton" system exercises the indices of some parameters of students from the experimental group changed. Body mass index increased in the experimental group for 3%, in the control group the results stayed unchanged. We also saw general weight decrease in the female students from the experimental group for 3%, fat mass decrease was for 7,5%, but there was lean body mass increase for 2,5%. The level of active cellular mass increased in the experimental group for 6%, and the percentage of active cellular mass increased

for 3,5%. General water and general liquid increased in an organism of the respondents for 2%, the level of extracellular liquid increased for 3%. The main metabolism stayed almost the same, it increased for 0,2%.

There were almost no changes in the indices of the control group. This situation is caused by the fact that the students from this group trained according to physical culture program. It was created for the special medical group. It should be noted that the exercises of "Isoton" system are not contraindicated for the students from the special medical group. The changes in body in the experimental group are first of all connected with the peculiarities of isotonic exercises.

The diagram shows the difference between the results of the experimental and control groups.



Picture 1 – Comparative diagram of the experimental and control groups



## CONCLUSION

During the experiment we revealed the effectiveness of "Isoton" system of exercises influence on body content of a person. It is proved that static-dynamic exercises influence on body content. BMI increased in the experimental group for 3%, in the control group the result didn't change. There was also general weight (3%) and fat mass (7,5%) indices, percentage part of fat mass in an organism (4%) decrease in the experimental group. LBM increased (2,5%). The level of active cellular mass increased in the experimental group for 6%, and percentage of ACM increased for 3,5%. General water and general liquid increased in an organism for 2%, the level of extracellular liquid increased for 3%. The main metabolism stayed almost unchanged (increased for 0,2%).

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## **Self-assessment of the University physical and non-physical education profile students physical development**

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**Abstract:** Physical culture of students is an important component of students' life activity during their studies at the University. It contributes to the student's adaptation not only to educational, but also to socio-psychological activities. In the system of physical education in higher education institutions, the proportion of people with motivation for a healthy lifestyle does not increase. There is a decrease in the motor activity of students. Under the influence of high mental and psychoemotional load, external information stress constantly increases social and psychological pressure, more often there is a strain on the compensatory and adaptive systems of the body. It leads to a violation of the daily routine, nutrition, increased risk of diseases and ultimately to a decrease in the effectiveness of the educational process and limiting professional employment prospects. **Materials and research methods.** The article is devoted to a comparative analysis of the Tuvan University physical and non-physical education faculty students lifestyle characteristics. To study the lifestyle of Tuvan students, a questionnaire was used. It included students' self-assessment of material and living conditions, health, physical development, nutrition, and socio-demographic characteristics of respondents. **Results.** Most girls and boys rate their physical development as good. Only about 15% of students regularly do morning exercises, and these are mainly students from the group of non-physical zones, young people from the field of physical education believe that they are already quite busy in the chosen sports and they do not need to do morning exercises. More and more respondents in non-physical fields receive good nutrition. Constantly malnourished more among young people in the physical field. Most respondents do not smoke, but non-physical education students have more people with irregular smoking. A rather high percentage of respondents who drink alcohol on holidays, especially in the non-physical group, in the other group they are three times less. Lack of personal interest in improving physical condition and maintaining health is especially characteristic of non-physical students. Non-physical boys and girls justify their interest in improving health with a high-response traditional response. Among respondents in the physical field, students indicate fatigue due to excessive physical activity.

**Keywords:** physical development, students, self-assessment of health, bad habits.

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### **INTRODUCTION**

The physical culture of students is an important component of the students life during their studies at the university. Physical activity and sports contribute to the student's adaptation not only to educational, but also to socio-psychological activities. In the system of physical education in universities with an obvious increase in hours of physical education and sports, the proportion of people motivated by a healthy lifestyle does not increase. This is due not only to changes in the economy, ecology, but also to the lifestyle of young

people who are becoming more and more inactive due to the widespread introduction of modern gadgets and a decrease in motor activity. Under the influence of high mental and psychoemotional stress, external informational tension, social and psychological stresses constantly increase. The tension of the compensatory-adaptive systems of the body occurs. It leads to disruption of the diet, nutrition, increased risk of diseases and, ultimately, a decrease in the effectiveness of the educational process and limiting the prospects for professional employment.

Students represent a special social group. It is characterized by a higher educational qualification, intellectual level and social activity than other peers. Youth sports and athletic activity is an indicator of personality formation, reflecting their needs, motives and interests [1,2].

From the point of view of the student period influence on a health problem, it should be emphasized that this stage of young people's life is characterized by specific working and living conditions, the need to adapt to a number of new factors. Even the first years of study at the university lead to adaptation of the stress mechanism and poor health [3,4]. Most students at the university are limited to physical education in the framework provided by the Federal State Educational Standards. They basically have a common focus on physical development. More rarely, students choose extra-curricular forms of physical activity and attend sports sections.

Significant physical activity of students is necessary to compensate for the negative impact of active mental activity during university studies, fatigue and psycho-emotional stress during class. All this, in turn, contributes to the formation, preservation and strengthening of students' health.

In the Republic of Tuva, the socio-economic standard of living is significantly lower compared to other regions of Russia. High levels of poverty, unemployment, socially determined types of diseases, combined with uncomfortable climatic

and geographical living conditions increase the risk of diseases and further reduce the body's adaptive resources [5].

The purpose of the study: to study and conduct a comparative analysis of the lifestyle characteristics of the Tuva university physical education and non-physical education students.

### **MATERIALS AND METHODS**

To study the lifestyle of Tuva students, a questionnaire was used. It included students' self-assessment of living conditions, health status, physical development, nutrition, and socio-demographic characteristics of respondents. 151 physical education students (profiles "Physical education and sport"; "Physical education with safety of life") and 218 students of the non-physical culture faculty (history; jurisprudence, biology, mathematics) were interviewed.

### **RESULTS AND DISCUSSION**

Self-assessment of one's physical condition allows to develop reflection skills. They are means of complete and effective introspection, allowing to evaluate own thoughts, actions, determine one's position in life, life priorities, analyze them and change them and directly affects lifestyle.

As a result of self-assessment of their level of physical development, students were divided as follows (Fig. 1).

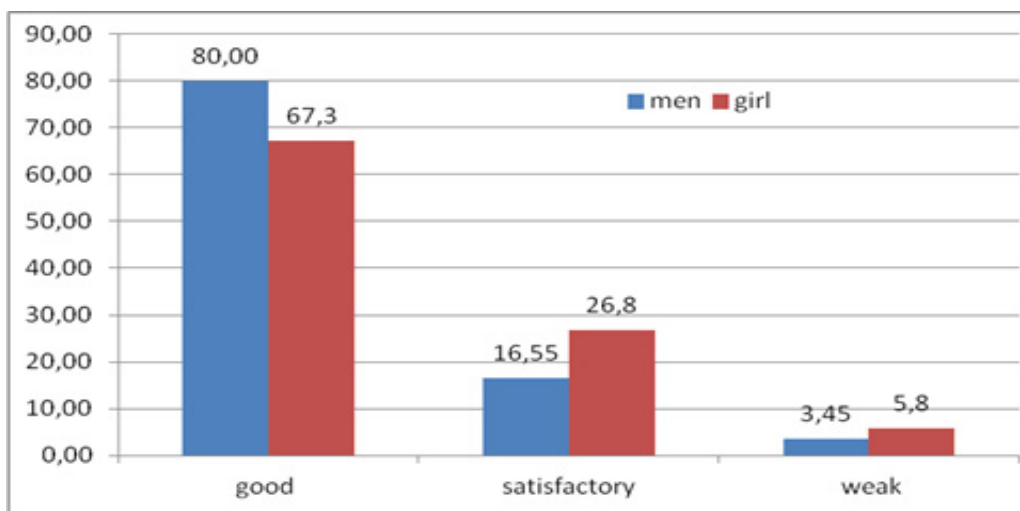


Fig. 1. Distribution of students by self-assessment of their physical development

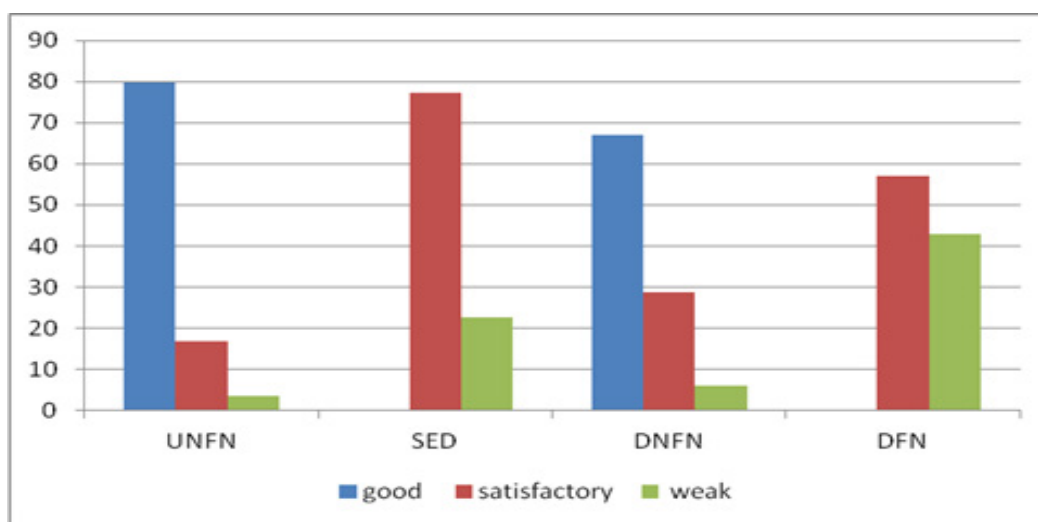
Most girls and boys rate their physical development as good, with 12.6% more among boys. Relatively more girls consider their physical development satisfactory and weak. We received the same data earlier; only the fact that the number of Tuvan students who rate their physical development as good was higher than ten years ago [6].

Self-esteem of their physical development significantly exceeds the objective results of a student survey. So, according to some studies, the average

level of physical development prevails among students. A high level of physical development is manifested only in 3-4% of students [7,8].

From the literature it is clear that the level of physical development in megacities is higher than in small cities. It is due to a complex of socio-economic conditions [9].

An analysis of the self-assessment of the students physical development in physical education and non-physical education is presented in Fig. 2.



Please note, UNFN, DNFN are not sports boys and girls; SFD, DFN - sports men and women

Fig. 2. Self-assessment of the students physical development in physical education and non-physical education (%)

A higher assessment of their physical development in young men, both physical education and non-physical education. In DNF, self-esteem is much higher, since in DNF, as a rule, there are no respondents who rate their physical development as

good, and in DNF there are more than half (67.1%).

When asked about self-esteem of their health, most students consider their health to be good, and only 53.2% of SFD consider it to be excellent.

Table 1 – Student self-esteem

Groups	what I consider my health				
	Excellent	Good	Satisfactory	Weak	Can't rate
UNFN	41,4	46,5	8,1	2,0	2,0
SFD	53,2	29,8	2,1	4,3	10,6
DNFD	18,6	57,7	16,5	4,5	2,7
DFN	0	71,4	14,3	14,3	0

It is also important to note that DFN rated their health worse than anyone, because they have a relatively high proportion of respondents with satisfactory and poor health, in the absence of excellent health assessment (Table 1).

The health-saving task of the university should be solved not only with the help of an external system of control over the physical condition, but also due to the ability to independently evaluate the advantages and disadvantages of their physical

condition. In general, everyone agrees that everyone is responsible for their health, but not everyone takes practical steps to maintain it, justifying it with the lack of free time, conditions, desire.

To the question “What interferes with health?” The boys and girls of a non-sports field answered – a lot of work. Among the respondents of the physical education trend, young men noted fatigue, and girls - fatigue and lack of time. It is likely that students in the sports field are experiencing excessive physical exertion. While students in the non-sports field allow themselves to justify their inability to influence their own health due to lack of time.

It should be noted that a special form of improving physical development and strengthening health is a systematic training in health gymnastics. It has a general strengthening anti-stress character, stimulates the production of endorphins and improves the emotional state of the body.

Only about 15% of students regularly do morning exercises, and these are mainly students

from the non-sports group, SFN do not do this because there are no conditions, and DPF, although they do morning exercises, is irregular. It is likely that students with a physical orientation believe that they are already quite busy in certain sports and do not need morning exercises.

The duration of the disease for about two months was noted by respondents from the physical education group: 13.5% of boys and 14.3% of girls. Students who were not involved in sports were less sick: from 41.4 young men to 38.4% of girls were not sick at all during the year, or 48.5% and 50.5% were sick for less than a week, respectively. The long duration of illness among students in the field of sports is additionally associated with sports injuries.

An important component of a person’s healthy lifestyle, indicators of his financial situation and standard of living are the quantitative and qualitative characteristics of his nutrition. It has been established that the health status of students depends on the quality of nutrition [10-13].

Table 2 – Student self-esteem (%)

groups	Do you have breakfast?			How do you eat:		
	Yes	No	Sometimes	I eat well	Not eating enough	Constantly lacking food
UNFN	67,0	12,0	21,0	78,0	18,0	4,0
SFD	36,5	36,5	26,9	48,8	39,5	11,6
DNFD	60,4	13,5	26,1	72,8	23,6	3,6
DFS	42,9	28,6	28,6	50,0	50,0	0,0

Significantly more respondents of non-physical education have breakfast, unlike students of physical education, they are about half as much (Table 2). Exactly the same addiction for those who do not eat breakfast at all. Between 20 and 30% of all respondents eat breakfast from time to time.

The same dependence is observed in relation to nutrition: respondents who are not involved in sports eat more fully, eat completely. Among those who do not eat enough, DFN prevails (50.0%). More youth are constantly malnourished among athletes (11.6%). For boys and girls, physical education is

about 4%.

Thus, physical education students have worse nutritional characteristics.

Good nutrition is provided by a good financial position.

Answering a question about livelihoods, respondents in the profile of physical education called work - 46.7% of boys and 57.1% of girls combine work with study, which probably explains the fact that these students are very tired. Boys in this group also indicated a scholarship as a source of livelihood - 53.3%, but girls were only 28.6%.



Respondents who are not involved in sports provide for their financial situation mainly at the expense of parents and other relatives.

Young men, regardless of direction, believe that they are wealthy, fewer girls, and both groups indicate approximately the same number

of respondents whose financial situation does not allow for good nutrition.

We analyzed the answers associated with bad habits. The most common habits in an unhealthy lifestyle are traditionally smoking and drinking alcohol (Table 3).

Table 3 – Self-assessment of students bad habits (%)

groups	Do you smoke?			Do you drink alcohol?		
	No	irregularly	constantly	no	only on holidays	More often
UNFN	79,8	13,1	7,1	68,7	29,3	2,0
SFD	93,3	6,7	0,0	32,6	67,4	0,0
DNFD	70,4	28,3	1,3	78,1	20,7	1,2
DFS	94,3	4,8	0,9	33,3	66,7	0,0

Most of the respondents do not smoke, but non-sports students have more people with accidental smoking. It is especially true for DNPF. 7.1% of smokers UNFN.

Of concern is the relatively high proportion of respondents who drink alcohol on holidays, especially in the non-sports group, among students engaged in physical education, but about three times less.

### CONCLUSION

The result of the university students physical development self-assessments analysis by physical and non-physical profiles showed the presence of ambivalence with a fairly high self-esteem of the inadequate actual state of affairs in the physical development and health of a modern person. students. It turned out that the lack of personal interest in improving physical condition and maintaining health is especially characteristic of students who do not play sports. Non-athletic boys and girls justify their lack of interest in improving their health with the traditional response to high employment. Among respondents, trends in physical education students indicate fatigue due to excessive physical activity.

A relatively small proportion uses general strengthening types of physical activity as morning exercises. A very large proportion of people with physical education who constantly smoke and drink

alcohol on holidays, and not just on holidays, are of serious concern.

Awareness of personal responsibility for the formation, preservation and strengthening of health and the ability to objectively assess one's physical condition is an important general cultural competence of any university student.

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## **Orientation, content and methodology of comprehensive fitness training for men of the first period of adulthood**

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**Abstract:** As the results of numerous scientific studies show, the first serious health problems in men begin already in the first period of adulthood – from 22 to 35 years. At the same time, it is at this age that a person maintains a high level of fitness for motor functions, favorable conditions are formed for achieving significant health and even sports results. In recent years, a lot of material has been accumulated on the problems of substantiating the effectiveness of fitness programs of homogeneous content: strength, aerobic, game, gymnastic, based on the use of swimming equipment, hatha yoga, etc. However, at the present stage, an integrated approach to the support of scientists and practitioners designing health-conditioning training programs.

**Materials.** The article presents the results of testing and examinations of 35 men aged 22-35 years old. They are the clients of the Fitness Territory Fitness club (Moscow, Russia). Testing materials served as guidelines for substantiating orientation and content, as well as developing methods for comprehensive fitness training for men of the first adulthood period. **Research methods.** Analysis and generalization of literary primary sources on the research problem, survey (questionnaire, interviews), medical history, anthropometric measurements, PWC<sub>170</sub> sample, maximum oxygen consumption measurement, general performance coefficient, body mass index, Romberg test, control exercises method, pedagogical experiment, statistical data processing methods. **Results.** A technique has been developed for comprehensive fitness training for men of the first adulthood period, which includes four thematic blocks of physical exercises: aerobic, functional, corrective and preventive, and relaxation. **Conclusion.** The use of the comprehensive fitness training methodology contributed to the effective solution of the health improvement tasks, normalizing the functional state of the cardiorespiratory system, improving the psychoemotional and general somatic state, reducing the severity of pain in the cervical-collar, thoracic and lumbosacral spine, increasing the level of physical fitness and general physical performance, improving the physique of men of the first period of adulthood.

**Keywords:** men of adulthood, fitness testing, comprehensive fitness training.

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### **INTRODUCTION**

An important role in national health improvement nowadays belongs to health-improving physical culture and fitness [2]. The results of many scientific research works show that most diseases of a person begin when the organism is on the edge of norm and pathology [5, 7]. 70% of adults of this country are in this negative for health state condition and the first serious problems with health among men start during the 1<sup>st</sup> period of adulthood – since 22 till 35 years old [3]. At the same time, during this age period a person preserves a high level of motor functions training capacity, and favorable preconditions for considerable health-

improving and sports results achievement [1, 4].

In recent years the questions of health-improving fitness-training content substantiation and organization among people of adulthood were studied by I.V. Adamova [1], N.N. Vengerova [2], S.A. Golovanov [2], L.D. Nazarenko and V.M. Vavilov [6], N.I. Perevoznikova [8], S.V. Savin, O.N. Stepanova [9], A.V. Stafeeva and A.L. Deryabina [11] and others. At the same time, most mentioned above works and other research works were tested either among women or among men of the 2<sup>nd</sup> period of adulthood.

Speaking about other research works, held among men of the 1<sup>st</sup> adulthood, most works

substantiate the effectiveness of homogeneous content fitness-programs (power [11,12], aerobic [3, 9,13], playing [8, 10,14], gymnastic [6,15,16], based on swimming means use [1], hatha yoga [1] and etc.). At the same time, at a modern stage of fitness theory and methodology development great attention is paid to a complex approach to health-improving conditional program of (fitness) training.

In this connection the aim of the research is the orientation and content substantiation and the methodology creation of complex fitness-training in men of the 1<sup>st</sup> adulthood (22-35 years old).

### **RESEARCH METHODS**

In order to achieve the set aim we used the following research methods: information sources analysis and summarizing, questioning (questionnaire survey, conversations), anamnesis, anthropometric measures, PWC<sub>170</sub> test, maximum oxygen consumption estimation, general working capacity coefficient, body weight index, Romberg test, method of control exercises, pedagogical experiment, methods of statistical data handling.

The research was held on the basis of fitness-club "Territory of Fitness" (Moscow). The research sampling included 35 men of the 1<sup>st</sup> adulthood (22-35 years old). They were going to the mentioned above fitness-club.

### **RESULTS AND DISCUSSION**

As the results of questioning showed the dominant aims (motives) of going in for fitness for these 35 men (fitness-club "Territory of Fitness") were the following: desire to improve health state – the risk of health disorders decrease (23% of respondents), lifetime increase (11%), rehabilitation after the experienced diseases (6%) and injuries (3%); desire to improve appearance – constitution improvement (17%), weight correction (fat decrease or muscles mass increase) (14%), desire to look great for oneself and other people around (11%); need for rest – accumulated emotional tension decrease (9%), and communication (6%). Nobody mentioned the motive of having more motor activity or getting physical load.

During the research we stated the kinds and frequency of locomotor apparatus disorders

occurrence among 35 men of the 1<sup>st</sup> adulthood – the clients of "Territory of Fitness" fitness club. Among the most commonly occurring disorders are the following: overtone of back and neck, chest and loins muscles (69%) and scoliosis in chest, interior thoracic segment and lumbosacral spine (61%). Then comes lordosis, hyper lordosis in cervical parts and lumbar spine, kyphosis in cervical parts (48%) and shoulder girdle asymmetry among 42% of the respondents. 11% of the respondents have cervical, thoracic section and lumbar spine osteochondrosis, 8% of respondents have weak pectoral muscle sling and flat-footedness. Such diseases as intervertebral hernia, arthrosis, not stable cervical parts have 4% of the respondents (each of the diseases). As the conversations showed, the revealed situation of disorders is conditioned by a low level of motor activity: most respondents have professional and habitual hypokinesia.

The results of the held anthropometric measurements show that all constitution indices and physical development indices among the men of the 1<sup>st</sup> adulthood, who train at "Territory of Fitness" fitness club (height 170-185 cm) have the following body sizes: circumferences of chest (99,7±10,4 cm), waist (88,6±13,8 cm), hips (99,7±4,7 cm) correspond or are close to their age-related norms. The exception is body weight index (25,5±4,7 units). It shows the problem of overweight among 42% of the respondents and the weight deficiency among 6% of the respondents.

The results of the functional fitness-test showed the following:

- deviation from the norm (decrease) in the following indices: systolic pressure – 65,4 %, diastolic pressure – 61,5 %, HR at rest – 84,6 %, MOC – 23%, general working capacity – 53,8%, Romberg test – 26,9% of the respondents;

- in the average HR indices at rest in men correspond with "good" state (55-65 beats/min) of heart muscle, systolic (121-126 mm Hg) and diastolic (76-81 mm Hg) pressure indices correspond with "the average" health level;

- PWC<sub>170</sub> test results (950-1500 kgm/min) and MOC indices (39-53 ml/min/kg) are at a necessary level. It proves "good" fitness and "good" adaptive level of respondents' organism to physical

loads;

- General working capacity of the respondents was estimated as 17-22 units; in the average this result can be understood as “high”;

- Romberg test (“stork” position) showed “good” level of the ability to hold static balance (10-25 seconds).

Taking into account the results of the research, we created the methodology of complex fitness-training for men of the 1<sup>st</sup> adulthood.

The main aims and objectives of this fitness-training are the following:

- First of all, personally important results of fitness lessons achievement: appearance improvement, constitution improvement, weight correction (weight decrease or increase); rehabilitation after the experienced diseases and injuries; psycho-emotional state improvement, rest after a hard working day;

- Secondly, the existing locomotor apparatus

problems correction: spine muscle overtone decrease; bearing problems correction; spine and joints diseases prevention;

- Thirdly, constitution and weight indices normalization: fat weight decrease (in terms of muscle mass preservation or increase), weight normalization; circumference body sizes decrease. They go beyond age-related norms (waist, buttocks); body circumferences increase in a given localization (shoulders, hips and others);

- Fourthly, functional state of cardiorespiratory system normalization;

- Fifthly, the level of general physical working capacity increase: the level of general physical working capacity of age-related norms; the level of “not developed” physical qualities improvement – general (aerobic) endurance and coordinating abilities till the level of age-related norm.

During the research we used four thematic blocks (group of means) of physical exercises: aerobic, functional, correctional-preventive, relaxing (Mind&Body) (table 1).

**Table 1 –Thematic blocks of complex fitness-training in men of the 1<sup>st</sup> adulthood, their orientation (objectives) and main means**

<b>Thematic blocks</b>	<b>Orientation (objectives)</b>	<b>Means</b>
Aerobic	The level of general (aerobic) endurance, general working capacity and functional state of cardiorespiratory system (till age-related norm increase) increase, fat mass decrease, weight normalization, circumference body sizes decrease (till age-related norms)	Cyclic exercises at cardio training-simulators: running track, step machine, elliptic training simulator, rowing training simulator and bicycle simulator
Functional	The main muscle groups strengthening, body constitution improvement and appearance improvement, the level of coordinating abilities increase	Power oriented exercises (for muscle mass increase and constitution correction), exercises for power endurance and coordination in a form of circular training from a functional training arsenal: at “not stable surfaces” (fitball, hemisphere “bosu”), with TRX loops, rubber bandage, with own weight
Correctional-preventive	“Muscle corset” (abs muscles, spine stabilizers) strengthening in order to correct bearing, prevent spine and joints diseases, for rehabilitation after the diseases and injuries	Exercises at block type training simulators, with own weight, with additional equipment, complexes of exercises of remedial gymnastics (depending on the existing problems with health)
Relaxing (Mind&Body)	Psycho-emotional state normalization, activity improvement in muscles and joints, spine muscles hypertonia decrease, the accumulated tension decrease after a working day	The exercises from the arsenal of pilates, stretching, fitness-yoga, respiratory gymnastics



The experimental methodology provides the methods of strictly regulated exercises use, repeated off-peak efforts, dynamic efforts, even-continuous, even-alternating, interval methods and the method of circular training.

Each health-improving training includes three parts: preparatory (warming-up), the main (aerobic, functional and correctional-preventive blocks) and the final part (relaxing block).

In different parts of the lesson pulse regimen would be not equal. During the preparatory part the recommended pulse regimen while using aerobic block exercises and general warming-up is 60-70% from maximal  $HR_{max}$  (115-130 beats/min). During the main part of the lesson: pulse regimen of the functional block is 65-75% from  $HR_{max}$  (within 120-140 beats/min), correctional-preventive block –60-70% from  $HR_{max}$  (115-130 beats/min). During the final part (relaxing block) it is recommended to have pulse regimen within 55-65% from  $HR_{max}$  (105-120 beats/min).

During intensive aerobic exercises pulse can be till 70-80% from maximum value, 130-150 beats/min.

The offered methodology predicts not equal amount of lessons a week. At the initial stage it is recommended to have three lessons a week (60-70 minutes each), during the main and the final stages (stabilizing) -4 times a week (duration 60-70 minutes). At the main and the final stages for an intensive aerobic load we gave a separate day. Rest between the training lessons was one day.

The plan for the first 6 weeks of fitness is presented in a form of macro cycle, which includes 3 meso cycles (initial, main and stabilizing) and 24 weekly micro cycles (Table 2).

At the end of the 6th month pedagogical experiment, dedicated to the effectiveness of the offered methodology estimation, weight of the respondents decreased in the average for 3,8kg (4,3%;  $P < 0,05$ ) and became the norm. The index of body weight also became the norm, decreased in the average from 25,5 till 24,7 ( $P < 0,05$ ) units.

The indices of constitution also improved among the respondents, which was reflected in waist (for 4,2cm) and pelvis circumference decrease (for 2,7 cm ( $P < 0,05$ )).

Positive, though statistically insignificant shifts were in HR indices at rest, systolic and diastolic

blood pressure. It corresponded with “slightly above the norm” level. Romberg test results, PWC170 test, MOC level and general working capacity coefficient had “perfect” values.

The respondents also underlined own psycho-emotional and general somatic state improvement, pain syndrome decrease in cervical-collar, chest and lumbar- sacral zones, satisfaction with the results of the training lessons.

## **CONCLUSION**

The methodology of complex fitness-training, which includes four thematic blocks of physical exercises – aerobic, functional, correction-preventive and relaxing, provided effective health improvement, cardiorespiratory system functional state indices normalization, psycho-emotional state and general somatic state improvement, pain syndrome decrease in cervical- collar, chest and lumbar- sacral zones, the level of physical readiness and general physical working capacity increase, constitution parameters improvement in men of the 1st adulthood.

The results of the experimental work show the opportunity to use the offered methodology of complex fitness-training with men of the 1st adulthood and form the base for further research works connected with effective methodologies creation for health-improving-conditional training among the representatives of other social-demographic and nosological groups of population.

Table2 – The structure and content of a macro cycleof a complex fitness-training in men of the 1<sup>st</sup> adulthood

Meso cycles	Initial meso cycle (November)				The main meso cycle (December-March)								Stabilizing meso cycle (April)
	November				December	January	February	March	April				
	1	2	3	4	5-20								21-24
<b>Aerobic blocks</b>													
<b>Cyclic exercises:</b>													
- at bicycle simulator	+				+					+			+
- at step machine		+									+		
- at elliptic training simulator			+								+		+
- at running tracks				+								+	
													+
<b>Functional block</b>													
<b>exercises:</b>													
- power oriented at training simulators	+												
- endurance oriented with own weight		+										+	
- power endurance oriented with rubberbandage			+										+
- power endurance oriented and coordination with TRX loops				+									+
- coordination oriented at stable surfaces													+
- power and power endurance oriented in a form of circular training													+

Meso cycles	Initial meso cycle (November)				The main meso cycle (December-March)						Stabilizing meso cycle (April)	
	November				December	January	February	March	April			
	1	2	3	4	5-20						21-24	
<b>Correctional-preventive block</b>												
<b>Exercises for the existing locomotor apparatus disorders correction:</b>												
- at training simulators	+				+	+						+
- with own weight		+				+	+					+
- with additional equipment				+			+	+				+
- complex therapeutic exercises											+	+
<b>Relaxing block</b>												
<b>Exercises from the arsenal of:</b>												
- pilates	+				+	+						+
- stretching		+				+	+					+
- fitness-yoga				+			+	+				+
- respiratory gymnastics										+	+	+

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## The role of the family, school, university, and state in solving the problem of young people physical education

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**Abstract:** A healthy lifestyle for a modern person is the main guideline and motivation in the process of life, a priority goal and life attitude aimed at preserving health, longevity, successful professional activity and high quality of the individual life. The concept of "quality of the population life" informs about the degree of material satisfaction, spiritual, and social needs of a person.

**Materials.** The article discusses the relationship between the concepts of "healthy lifestyle", "quality of the population life" and the formation of "physiological needs" during systematic physical exercise. **Research methods.** Analysis and generalization of scientific literature.

**Results.** It is shown in what forms ecosystem disturbance affects human health. The authors consider the problems in the pedagogical process aimed at the formation of a healthy person, and justify the high requirements for the level of physical culture and sports workers professional training. The types of family education are classified. The tasks that need to be solved to improve the level of parents pedagogical culture and criteria for the effectiveness of healthy lifestyle education are formulated. On the example of the research conducted by the Russian Academy of education, many problems in the field of professional and General education are revealed. According to the results of this study, factors that negatively affect the processes of forming a healthy lifestyle of young people are identified. **Conclusion.** The study shows the importance of physical culture mass occupations role for the preservation of health and prolongation of human life, the conclusion about the necessity of an integrated approach in achieving this goal – formation of a harmoniously developed personality.

**Keywords:** healthy lifestyle, physical culture, quality of life, professional training, education, ecology, negative factors, family education.

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### INTRODUCTION

A healthy lifestyle for a modern person is the main reference point and motivation in the process of life, a priority goal and life attitude aimed at maintaining health, longevity, successful professional activity and high quality of the individual life. The concept of "quality of the population life" informs about the degree of a person material, spiritual, and social needs satisfaction. Social structures of highly developed countries conduct active educational work among their citizens, aimed at forming a "physiological need" for systematic physical exercise.

The evolutionary processes of society, the development of the economy, industry, and increasing the level of material and technical benefits for a person have a positive effect, along with a different technological side. As a rule, it is the

main cause of environmental pollution. This leads to disruption of the ecosystem. It affects human health. According to statistics from the world Health Organization, the main cause of human disease is adverse environmental conditions (85%). The level of health is indicated as the main criterion for the quality of human life. The environment in all its manifestations can have both a positive and negative impact on it. It exposes the human adaptive and immune systems to additional stress. The human body reacts to any changes in the external environment. The reaction is individual, depending on the following factors: gender, age, health status, physical fitness, professional activity [1].

We draw attention to the problems facing parents, teachers, and the public. They are responsible for the younger generation healthy lifestyle foundations formation, deep knowledge



of physical culture, and the value potential of this phenomenon. Heredity, family upbringing, society or educational state institutions are the dominant structures in the process of educating the younger generation. All this creates high requirements for the level of physical culture and sports employees professional training. The authors tried to consider the problems aimed at forming a harmoniously developed personality in the pedagogical process.

"Healthy lifestyle" is a way of life that corresponds to genetically determined typological characteristics of a person, specific living conditions aimed at forming, preserving and strengthening health, performing its socio-biological functions. A healthy lifestyle, as a system, consists of three main cultures: nutrition, movement, and emotions [4].

Socialization and formation of the child as a person depend on family education. This is the process of influencing children by parents and other family members in order to achieve the desired results from family education. There are the following types of the individual family education: civil, secular, marginal, elite. It is advisable to add scientific-religious, integral, class and party education to this list.

The type of child's personality is formed by the style of educational activity [5]:

- authoritarian;
- liberal;
- humanistic;
- democratic;
- pragmatic.

The content of education in the family is determined by its orientation in the educational process:

- mental;
- moral;
- physical;
- harmonious.

Parents build their behavior differently in the process of raising children. It is classified as follows [6]:

- strict;
- compromise;
- autonomous;
- promotional;
- situational;
- dependent.

Children are a reflection of the family. Speaking about education, P.F. Lesgaft highlighted

the conditions for the formation of a full-fledged child's personality only in an atmosphere of love and mutual respect, without this, the child develops ambition and immorality on the basis of compensatory love for the child, especially from the mother. At the same time, according to the great scientist and teacher, a great role was given to the harmonious development and education of a person by means of physical culture [7].

The education of a healthy person is of the greatest value. It depends on a number of objective and subjective factors. The generally recognized fact of deterioration in the health of modern children and adolescents is associated with a lack of motor activity and a sedentary lifestyle. The rhythm of the twenty-first century, its intensity does not leave time to devote enough time and attention to the physical education of their children. But at the same time, the problem remains the lack of the parents themselves culture. And physical culture is part of the "universal culture". The organization of everyday life, observance of the daily regime, and nutrition of the child do not yet speak about physical education. It is necessary to approach comprehensively, along with the above factors, to master health-saving technologies, knowledge about the optimal combination of motor activity and rest of the child's body, the laws of human adaptive abilities development, taking into account the age periodization. The words A.S. Makarenko remain relevant for parents, educators, and teachers: "And a high demand for yourself, for each step, respect for your family, parental control over each step is the primary and main step in education." Active physical exercise is an integral element of the individual physical education. Parents should act as role models [8].

The family contributes to the formation of a child's lifestyle, skills and abilities, the basics of a healthy lifestyle, and the systematic use of tempering procedures.

One of the problems of raising a healthy lifestyle is to raise the cultural level of parents. Parents bear full legal and moral responsibility for raising a child in the family. It is supported by the laws of any state, as for example, in article 63 of the Russian Federation Constitution on the duties of parents.

Great teachers of the XIX-XX century K.D. Ushinsky, L.N. Tolstoy, P.F. Lesgaft, V.P. Vakhterev,

P.F. Kapterev emphasized the importance of coordination and interaction of family and school education. When laying the foundations of family education, parents rely on their life experience without having pedagogical knowledge. It makes impossible to consciously influence children in order to correct their behavior.

Teacher P.F. Kapterev noted that the basis of interaction between the family and the school is the development of the child's hereditary abilities and capabilities, including physical, creative, and labor ones.

Representatives of pedology P.P. Blonsky, L.S. Vygotsky, D.B. Elkonin considered it necessary to preserve the unity and continuity of upbringing and education in the family and school in accordance with the theory of individual development on the basis of biological and social unity. The Soviet school of pedagogy and its representatives A.V. Lunacharsky, N. K. Krupskaya, and A. S. Makarenko set the main task of studying the microenvironment around the child and providing advice to the family [9]. Nevertheless, the Soviet school behaved authoritatively regarding the family, paying mainly attention to the military - patriotic education of children, teenagers, and young people, and this continued until the 90's. N. K. Krupskaya's ideas about high socialization of children and their implementation had a negative impact on the genetic level of generations, manifested in the separation of preschool and primary school age children from the family way of life and traditions.

### **MATERIALS AND METHODS**

To improve the level of parents pedagogical culture it is necessary to solve the following tasks:

- parents ' understanding of the raising children purpose;
- taking into account the individual characteristics and uniqueness of the child;
- matching children's capabilities and parents ' requirements;
- ability to make decisions in a specific pedagogical situation in order to develop the child;
- variety of applied methods and means of education.

The developed models of behavior are instilled in the child by parents on the basis of ethics and rules, cultural traditions. Self-analysis of children occurs after comparing their own actions with known patterns of behavior, usually

set by parents. Individual experience and physical environment, as well as culture, nature, and climate have a great influence on a person [10].

One of the fundamental tasks of education in the family is the formation of a daily routine, a regime that is important for children of any age. The family organizes the optimal home mode – motor activity that contributes to the physical development of the child, sleep, rational nutrition, tempering, personal hygiene. Home mode should be based on the daily routine of both preschool and school institutions. According to Amosov, the following conditions are necessary for health [11]:

- exercise;
- optimal nutrition;
- adaptation of the body to the environment;
- a harmonious combination of work and leisure.

The family forms a healthy lifestyle for children and instills the following knowledge, skills and abilities:

- knowledge of the personal hygiene rules, hygiene of premises, clothing, shoes, etc.
- the need to strictly observe the daily routine;
- ability to analyze everyday situations, predict the consequences and find a way out of them;
- ability to interact with the environment, compliance with the rules of safe stay in society and everyday life.

Parents need to know the criteria for the effectiveness of healthy lifestyle education:

- positive dynamics of the child's physical development;
- reduce morbidity;
- formation of the child's ability to build relationships with peers, parents and other people;
- reducing the level of anxiety and aggression.

It is obvious that a positive result can only be achieved if the family and the educational institution work closely together. Since the needs for a healthy lifestyle in a child will be formed only on the basis of common requirements for them from parents and teachers. Only if this condition is met, the child will perceive a careful attitude to his health as an immutable truth, the only correct style of life [12].

We see how a person, engaged in physical culture, changes himself, at the same time influencing, changing the world around him. It is advisable to consider how society affects the

physical development of a person. We imagine that in the primitive communal system, the physical development of man was extremely necessary for elementary survival in the environment. We will understand the simple postulate that the comprehensive development of man corresponds to his time and epoch. That is, physical culture, its level of development corresponded to the requirements of a particular socio-economic formation – primitive, slave-owning, feudal, capitalist [1].

The material side of society causes the emergence of physical culture as an integral part of human culture. The conditions of human life were such that he was in an atmosphere of confrontation between strength, speed, and dexterity with the world around him and nature. But not only physical culture was in demand, since it is difficult to separate the concept of "physical culture" from culture in General. Humanitarians consider the concept of "culture" as a bridge between the human "bio - structure" and the environment. The concept of "culture" includes philosophy, ideology, morality, art, and many other disciplines of humanitarian orientation. Culture reflects the most complex processes of material and spiritual life of society. It is not given to man by nature, being the result of social and individual creativity of people. The basis of the content of the cultural process is formed by means and methods that develop the physical and intellectual abilities of a person [6].

It is difficult to overestimate the importance of mass physical training for preserving health and prolonging the life of mankind. The costs of civilization have affected the health of modern man. The only way to survive today is to neutralize or minimize the impact of adverse environmental factors:

- hypodynamia;
- excessive high-calorie food;
- nervous overstrain.

The role of the state in managing the development of physical culture and its influence on the education of its citizens is great. That is, the state is still the main customer, which citizen is needed today in the country. But the main "accumulator" and conductor of the educational process is the teacher. The basis of the professional competence the criterion of the effectiveness of its level, is the quality of the lesson it conducts. At the same time, it is necessary to systematically monitor the

educational process, program and methodological material in order to make timely adjustments to the studied disciplines, "responding" to the "requests and requirements" of modern youth, society, and the state in this discipline.

## **RESULTS**

Using the example of a study conducted by the RUDN in 2016, in which the author of the publication participated, many problems in the field of professional and general education and the role that is assigned to state institutions in the formation of a healthy lifestyle for young people are revealed. Among the respondents were about 60 thousand students of various Russian universities.

Based on this data, 80% of students are not distributed by sports and are engaged in general physical training groups (OFP). This contradicts the requirements of the Federal educational standard. 55.6% of students rate classes positively. 73% of students receive explanations and methodological support of the study material, including 22.9% using modern computer and media technologies, and 24% using manuals and methodological material. Students attending lectures on physical culture - 54.8%.

Additional dance classes, hiking trips, and exercises on simulators are of increased interest among young people - 86% of the respondents. Medical and practical classes that provide information about the health of 72%, diagnostics of the functional state-in 48% of students. As a necessity for improving the quality of physical education classes, as well as the criteria for evaluating the teacher's work will be the following factors:

- availability and quality of developed documentation during planning;
- planning and monitoring classes;
- rational distribution of classes ("motor" and "general" density).
- compliance with safety rules and sanitary requirements;
- taking into account individual, age and gender characteristics;
- creative use of health-saving technologies;
- control of knowledge and skills;
- use of modern inventory.

The higher school teacher completes the formation of students' conscious attitude to a healthy lifestyle by means and methods of physical

culture:

- improves knowledge, skills and abilities of basic body exercises;
- maximizes motor experience;
- masters the techniques of psych when create a positive emotional background during class.

According to the results of this study, the factors that negatively affect the processes of forming a healthy lifestyle of young people are identified.

Physical improvement is hindered by the following reasons:

- insufficient level of information for young people in the field of fundamental knowledge of anatomy, physiology, morphology, as well as the theory and methods of physical education;
- negative experience of physical education at school or other educational institution;
- conditions for independent studies are not comfortable enough;
- systematic violations and ignorance of the healthy lifestyle basics (work and rest, food, sleep);
- lack of psychological support for independent activities with family and friends;
- temporary illness and ill health;
- lack of inventory, equipment, equipment and other support necessary for systematic physical training.

Solving the above-mentioned problems, increasing the level of knowledge in the field of health-saving technologies, forming internal psychological confidence in the vital need to strengthen one's own health as a basis for happiness, career success, and longevity, all of these together are attributes of modern man and his life.

Physical development of a person is a natural change in anatomical, physiological, and biological structures in the course of an individual's life.

Indicators of a person physical development:

- functional capabilities of the body cardiovascular and respiratory systems;
- physique indicators;
- the level of the physical qualities status;
- functional physiological changes;
- age period of development.

Factors affecting a person's physical development:

- endogenous, these include genetic features that are carriers of hereditary diseases and pathologies that affect the process of growth and development of the individual;

- exogenous (climate indicators, natural, water resources, ecology, area of residence);
- social (food, education, status of the child in the family, medical care).

Physical education in high school is of paramount importance for the study and development of rational and effective use of human motor abilities and capabilities. Directly the object and factor of management is motor activity, training in movements, education of physical qualities, their relationship. Physical education is aimed at morphological and functional improvement of the body, strengthening the health of the body, performing the following functions:

- developmental;
- educational;
- health and hygiene;
- general cultural.

## **DISCUSSION**

On the example of the Russian Federation, we can consider the mechanisms of state internal policy aimed at preserving and improving the health of its citizens.

The current Concept of long-term socio-economic development of the Russian Federation until 2020 provides for increasing the level of physical culture development, reducing mortality among the working-age population of the country and stabilizing the demographic situation. Involving children in systematic physical exercise will help improve socio-economic indicators in the country in the near future. In the opposite case, the trend of reducing life expectancy will continue. It will also be accompanied by large financial and economic losses of the state due to the growth of diseases [14]. Almost all aspects of human life are determined by the level of health.

The state has a broad influence on physical culture and sports activities in two main areas:

- creation and development of the legal framework;
- financing and investment in this area.

The activities of any state in this area are based on the international legal framework. The main documents in the field of sports are the international Charter of physical education and sports of 1978, adopted in Paris, as well as the European sports Charter of 1992.

The sports Charter was adopted in 1992 by representatives from thirteen European countries.

Dominating in this law were the rights of citizens about everyone's access to physical education, knowledge acquisition, protection and development of the moral and ethical aspects of sport. It is also pointed out that special care is taken for the environment, both during the construction of sports facilities and during sports events.

Another document that I would like to draw attention to is the European Manifesto "Young people and sport", adopted in may 1995.

The main goal of this Manifesto is to promote a healthy lifestyle among young people and solve the following tasks:

- development of physical, mental and social qualities;
- teaching ethical values of justice;
- mutual respect;
- tolerance;
- promotion of healthy lifestyles [13].

The Manifesto States that family and school play a unique role in promoting healthy lifestyles. As we can see from the Manifesto, the main directions of physical culture activities are humanization and humanitarization of both the process itself and the relationship between teachers and students. When organizing the process and classes in the epicenter is the student, the person's personality and self-realization, the manifestation of his abilities. The formation and realization of its potential as an individual is possible only in the conditions of a coordinated unity development of its intellectual, spiritual, moral, aesthetic and physical aspects. Humanization educational processes contributes to the development of individual abilities based on a healthy lifestyle.

Analyzing the achievements and problems of modern civilization, the authors of the article note the increasing role of a healthy lifestyle in human life. Humanity in the 21st century has achieved great evolutionary progress in almost all spheres of society life. The development of a person as a person, an individual, takes place on the basis of his socio-biological abilities and needs. The main ones are motivations for self-realization and self-actualization. But it is impossible to achieve your goals in a highly competitive environment without mastering the skills and fundamentals of a healthy lifestyle. Despite the many contradictions that are taking place in the world today, we can distinguish two main problems-the preservation

of human health and the environment. Man as a biological structure can not exist in a vacuum, and environmental problems humanity can solve only by combining efforts and aspirations for this. Scientists predict an increase in the average life expectancy of a person to 120 years, and this is real. But it should be taken into account that along with the development of health-saving technologies, the environment is deteriorating at a high rate. This is especially true over the past decade in the tourism industry. It is growing at an annual rate of 2.8%.

In the process of educating a healthy lifestyle, the main role is given to the family. The first example of a healthy lifestyle is taught to their children by their parents. Educational institutions systematize the acquired skills in the field of health preservation and raise the level of the need awareness to preserve and strengthen health as the basis for a successful professional career and longevity. Creating conditions for the organization of the child correct mode, a combination of activities, rest, sleep, and food intake is a direct responsibility of parents.

In the educational institution, children will get the necessary knowledge about the means and methods of physical culture, about harmonious physical development based on their individual abilities. At the University, the educational process should be based on the democratic choice of sports, the maximum implementation of its motivations for the conscious development of physical qualities and abilities, to achieve its life goals based on a healthy lifestyle [14].

## **CONCLUSION**

The state, at the legislative, regulatory and legal level, creates conditions for systematic training in maintaining a healthy lifestyle for its citizens, while improving the material and technical base of sports halls and stadiums. Provides free access to sports facilities for various social groups and segments of the population, in accordance with signed international documents and Charters. A modern person who leads a healthy lifestyle is a harmoniously developed person. He is capable of a successful career, longevity and creating a basis for a happy future for future generations.

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## **The effectiveness study of park volleyball use during extracurricular activity of senior pupils**

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**Abstract:** Nowadays scientists pay more attention to modified kinds of sport, such as park volleyball, beach volleyball, football and handball, street-ball, foot-volleyball, show-ball and other games. They are characterized by the dynamic actions. For additional lessons in these kinds of sport we can use open sports grounds, park and beach zones. In order to define the effectiveness we studied the results of park volleyball use in terms of sectional lessons among senior pupils of municipal budgetary educational establishment “Gymnasium 3” in Astrakhan. **Materials.** Theoretical analysis and results summarizing of scientific methodical works and materials, which correspond with this work. The results of physical fitness control tests, medical check-up results, the results of the functional tests, initial information collection in a form of a questionnaire survey. **Research methods.** Information sources analysis and summarizing, pedagogical experiment. Statistical significance of the received results differences from the control group and the experimental group was estimated using Student t –test. Correlation analysis was fulfilled using Pearson correlation coefficient. **Results.** We tested the methodology of additional park volleyball lessons. We registered valid increase of physical qualities and functional indices level. **Conclusion.** Park volleyball use as additional lessons helped to realize productive use of free time, increase the level of physical readiness and pupils’ communicative abilities.

**Keywords:** senior pupils, park volleyball, additional lessons.

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### **INTRODUCTION**

Studying the tendencies of physical culture and sport development in modern society and these tendencies reflection in physical upbringing programs for educational establishments shows that some changes should happen in the content of additional physical culture and sport lessons [1,11]. Extracurricular activity in terms of Federal State Educational Standards (FSES) introduction becomes urgent, as standards underline that extracurricular activity should be used obligatory. It is the resource, which helps a school to achieve new quality of education [3]. In a new Federal state educational standard of the initial secondary education special attention is paid to extracurricular activity among schoolchildren [4]. Modern process of physical upbringing among schoolchildren is mainly

directed toward high level of physical readiness achievement. It is defined by the corresponding state educational standards and physical upbringing programs [9]. At the same time senior pupils don’t have the skills of self-organization, motivation and interest in physical culture lessons during their free time [10]. Specialists in the sphere of physical upbringing in Russia and abroad search for new ideas and approaches to physical upbringing among youth [13,14,15,16]. The main thing in this problem solution is upbringing motivation of young people to go in for systematic physical culture and sports lessons not only under the direction of the coaches teachers, but also independently [2]. An important factor of independent lessons organization among the pupils is physical load correspondence with the level of readiness [8]. Not adequate physical

load together with tense emotional atmosphere in some cases can lead to pathological changes development in different system of an organism [5,6,7]. That is why we studied the characteristics of park volleyball lessons organization in terms of extracurricular activity at a secondary school. The aim of the research: to define the effectiveness of park volleyball use during free time among senior pupils. The objective: to substantiate experimentally the methodology of park volleyball use in the practice of sectional work.

### **MATERIALS AND METHODS**

The students of the 10<sup>th</sup> grades from Gymnasium 3 (Astrakhan) took part in the experiment (36 people- 22 boys and 14 girls). Two groups were formed: the experimental group –  $n_1 = 15$  people (9 boys and 6 girls), who went in for park volleyball and the control group  $n_2 = 21$  people (13 boys and 8 girls), who had physical culture lessons in terms of secondary school educational program.

During the work we used complex physical culture programs, created in accordance with state educational standard of secondary education and methodical manuals of additional pedagogical education. For the system analysis of the set objective we used the research works of the leading specialists on the basis of publications in scientific journals, indexed in scientific bases RINTS (Russian Index of Scientific Citation), Scopus, WoS. The held questionnaire survey helped to define motivational attitude and level of interest among senior pupils in physical culture lessons, helped to reveal the priorities according to the kinds of sport. The research was held on the basis of two-stage pedagogical experiment. On the first stage we estimated the level of physical and functional readiness among all respondents and formed the groups for additional park volleyball lessons without taking into account gender differences. During the second stage realization we estimated the effectiveness of created by us park volleyball methodology. We defined the degree of the lessons influence effectiveness on the level of physical qualities development. We held a comparative analysis of physical readiness in the control and experimental groups. The research results were handled with the help of standard

statistical packages of Statistica 11 programs. Critical level of validity of null statistical hypothesis  $p$  was equal to 0,05. The research works were held at sports bases of “Gymnasium 3” in Astrakhan, of Astrakhan State Medical University and Astrakhan State University in 2018/19 (Russia).

### **RESULTS AND DISCUSSION**

The main peculiarity of the experimental methodology for the experimental group ( $n_1 = 15$ ) was variable orientation of conditions for the pupils participation in park volleyball lessons. We mainly used game and competitive methods in the methodology in order to create and support active interest in lessons. Density of the lessons was planned in accordance with the functional and technical level of pupils' readiness. The experimental methodology of park volleyball lessons included three-component structure of the main part. It had the alternation of stretching, generally developing, power oriented and playing volleyball exercises. They were necessary for a complex physical and technical-tactical readiness. The main criterion of the results estimation in tournaments was not the victory or the taken place, but the amount of the held games by the definite respondent and the percentage of the victories. The content of the team was not limited according to gender and the teams, as a rule, had mixed content.

The density of lessons was defined by the playing regimen. It was characterized by intensity increase in terms of pupils' technical level increase. Typical to volleyball high emotional atmosphere influenced greatly hemodynamic indices. Heart rate (HR) during the game was  $125 \pm 9,2$  beats/min at the beginning of the research and  $153 \pm 8,8$  beats/min during the last month of the observations. It should be noted that early HR renewal during passive rest after the game (10 min) was  $97 \pm 7,3$  beats/min at the beginning of the experiment and  $91 \pm 8,3$  beats/min at the end of the experiment. Arterial and pulse pressure indices didn't change much.

During physical readiness level estimation in the experimental group ( $n_1 = 15$ ) we revealed that the most distinct dynamics was in speed-power oriented indices: 30 meters running boys at the beginning of the academic year –  $5,92 \pm 0,53$ s., at the

end of the year –  $5,10 \pm 0,47$  s. ( $p < 0,041$ ;  $r = 0,433$ ), girls at the beginning of the research –  $6,41 \pm 0,59$  s., at the end of the experiment –  $5,73 \pm 0,31$  s ( $p < 0,041$ ;  $r = 0,433$ ). 100 meters running, the initial result –  $15,73 \pm 1,01$  s, the final result –  $14,27 \pm 0,67$  s ( $p < 0,037$ ;  $r = 0,513$ ); girls at the beginning of the academic year –  $18,39 \pm 1,33$  s, at the end –  $17,12 \pm 0,45$  s, ( $p < 0,037$ ;  $r = 0,513$ ). Standing long-jump: boys at the beginning of the research showed the average result  $191 \pm 12,3$  cm, at the end of the research –  $205 \pm 11,3$  cm ( $p < 0,043$ ;  $r = 0,571$ ), among girls the indices at the initial protocol were  $168 \pm 11,2$  cm, at the end of the research –  $183 \pm 10,0$  cm ( $p < 0,044$ ;  $r = 0,527$ ). Shuttle run 4x9 m: the initial testing in boys –  $11,35 \pm 1,23$  s, in the final protocol –  $10,00 \pm 0,87$  s, ( $p < 0,045$ ;  $r = 0,497$ ), in girls at the beginning of the research –  $11,73 \pm 1,22$  s, at the end of the experiment –  $10,5 \pm 0,57$  s ( $p < 0,047$ ;  $r = 0,479$ ).

During comparison of physical qualities indices development in two groups ( $n_1 = 15$ ) and ( $n_2 = 21$ ) the differences between the average value of speed-power oriented indices and coordination in the experimental group were defined as statistically valid ( $p < 0,005$ ). During endurance, power oriented and directly power indices estimation considerable intergroup differences were not defined.

### CONCLUSION

Thus, the received results prove valid effectiveness of park volleyball use as one of the kinds of sport for sectional lessons. Flexible methodology of teams formation, simplified rules of competitions, the availability of the lessons organization places help to form sports-health improving orientation of park volleyball, directed to independent organization and the conditions creation for social activity of pupils.

Using game and competitive methods of lessons organization gave an opportunity to plan the intensity and the volume of physical load in terms of difficult playing elements technique mastery improvement.

At the same time, most respondents had not high level of physical and functional readiness that is why special attention should be paid to the adequate character of physical load, especially during the

initial period of going in for park volleyball.

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## European experience of sports cluster associations creation and development

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**Abstract:** Sport is an important economic sector and plays a great role in national economies. Moreover, sport can play an important role in solving the range of serious social problems, such as the absence of physical activity, steady development and the gaps in education. It should be noted that in Russia the existing mechanisms of physical culture and sport control, possessing several advantages, also have serious drawbacks, which restrict their effectiveness. In these terms there is a constant search for scientific-theoretical models of effective control over this sphere. In our opinion, the most prospective instrument of authority, sports organizations, federations and population integration into the considered sphere can become a cluster approach. **Materials.** Information about the activity of European territorial sports clusters for the present research work organization was received from the official sites of the studied European sports cluster associations. **Research methods.** The documents of European sports cluster associations study; strategic programs of European sports cluster associations study; comparative method; the method of theoretical modeling. **Results.** The potential of European Union countries sports clusters was considered as the main power of innovative development. During sports cluster associations creation cluster initiative belongs to the organizations of the national and international level. On the territory of European Union countries such organization is European Commission. Owing to it "European Platform of Sports Innovations" (EPSI) was created in 2008. "EPSI" generates international sports and innovative projects in sports sphere, including modeling sports business-clusters. Nowadays "EPSI" realizes 6 big regional and national projects. "EPSI" presents itself in the context of the European regional and municipal associations social-economic changes. "EPSI" projects give new opportunities for sports clusters capitalization. **Conclusion.** As there is no practical experience of sports clusters formation and development and their associations on the territory of Russia we analyzed the experience of European sports cluster association functioning. Such kind of analysis is useful for methodological substantiation of formation strategy and territorial sports clusters program development in Russia.

**Keywords:** physical culture and sport, sports cluster, the aim and objectives of creation, participants, projects.

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### INTRODUCTION

In accordance with different research works, the part of gross value added (GVA), connected with sport, in general volume of GVA of European Union countries varies from 1,76% till 3% in a wide sports sector. General involvement in European Union, created by sports events, is 7,3 million people and is similar to 3,5% from general involvement in EU [10-12]. These numbers prove that sport is an important economic sector in EU and plays an important role in national economies.

Moreover, sport can play an important role in

several social problems solution, such as the absence of physical activity, steady development and gaps in education.

In terms of the sports clusters formation and development and their associations experience absence on the territory of Russia we analyzed the experience of European sports cluster association functioning.

Such kind of analysis is useful for methodological substantiation of formation strategy and the programs of territorial sports clusters development in Russia.

The aim of the research – to analyze the experience of European sports cluster association functioning for methodological substantiation of formation strategy and the programs of territorial sports clusters development in Russia.

### **MATERIALS AND METHODS**

The information about the activity of European territorial sports clusters for the present research work organization was received from the official sites of the studied European sports cluster associations.

The documents of European sports cluster associations study; strategic programs of European sports cluster associations study; comparative method; the method of theoretical modeling.

### **RESULTS AND DISCUSSION**

According to the information presented on the official site of “European Platform of Sports Innovations” (EPSI) [3], the organization is an official partner of the European Commission. It was created in 2008 during the first European conference dedicated to sport and innovations in Brussels (Belgium).

"EPSI" was created in a form of non-commercial European association with three layer system of management: General Assembly, board of directors, president. Two executive-directors control everyday activity: Alberto Beachi and Renee Veyles [3].

"EPSI" presents a net organization. Nowadays the members of organization are 65 national innovative organizations. They present 19 countries, oriented toward innovations in the sphere of sport, sports industry, active rest, health service, tourism and many other spheres.

The key objectives of "EPSI" are the following: more favorable innovative environment creation for sports industry of EU countries, technological innovations stimulations and enterprises creation. They use innovative technologies [4].

Since December 2010 "EPSI" generates International sports and innovative projects in sports industry and models sports business-clusters [9].

In "EPSI" sports clusters activity special attention is paid to quadruple helix conception use, where together with science, business and state key

role in the sphere of physical culture and sport plays society, as the final consumer of sports product.

Every year, since 2008, "EPSI" organizes meetings both for the participants of the associations and for all people that are interested. The meetings are held in terms of conferences and forums.

The representatives of the organizations, connected with the technologies and innovations used in sport take part in the conferences. They are experts in the discussed questions. As a result of conferences different recommendations for the participants of "EPSI" are produced.

International "EPSI" forums give the opportunity to exchange information, present new information, discuss the future directions and priorities in the sphere of sport, sports innovations and sports products creation, improve partnership and create mutual projects.

During 10 years the themes of conferences didn't change greatly and was in terms of the aims. They were defined in the strategic program of "EPSI" development and presented during the first "EPSI" conference.

The sphere of sport was always considered by the participants of the International conferences and "EPSI" forums as a multidimensional social phenomenon. The organizers of the conferences had the aim to intensify the activity of sport clusters according to different directions. They were urgent for the society and demanded special attention at the definite stage of activity. For example, realizing that sports clusters have high potential for inter-sectorial interactions and interconnections in different social and economic spheres, one of the first conferences was dedicated to the following topic: “Sport as the driver of industry and economic growth modernization”.

Later the attention of the sports cluster association participants was paid to the following topic: “Sports innovations in town” [2].

Achieving the definite social-economic results the participants of a sports cluster association broadened the limits of own activity. In terms of the International forums and conferences the progressive experience was studied and the key ideas were revealed. They provide the International integration of sports clusters.

The topic “Innovative technologies creation and use in the sphere of sport and other transboundary spheres” was specially discussed at all International forums and conferences of “EPSI”.

Thus, "EPSI" International forums and conferences are the platform, which helps:

- the corporations demonstrate own products and projects;
- scientific-research organizations, which work in the sphere of innovative technologies in sport, reveal new partners and consumers of the services;
- Universities and other educational establishments to stimulate transboundary contacts and cooperation;
- Sports organizations/associations to find new partners in the sphere of business, in the sphere of new technologies creation and use and in the sphere of carrying out research works in sport;
- authorities to reveal the gaps in legislation in the sphere of sport, create, present and discuss new projects.

Nowadays "EPSI" realizes 6 big regional and national projects [9].

One of the most important and big projects is “Inno4Sports” project. The project is directed toward EU countries interaction in the sphere of sport and sports industry.

“Inno4Sports” project (Sport for Growth and Healthy & Vital Communities) lasts 54 months (the period since June, 1, 2018 till November, 31, 2022) [8].

Five "Erasmus+" programs. "Erasmus+" program is a new program of EU directed toward cooperation support in the sphere of education, professional teaching, youth policy and sport within the period since 2014 till 2020:

- "BIG4SPORTS" project – innovative control over sports sphere creation;
- "SCORES" project –skills and competencies development estimation, which provide employment in the sphere of sport;
- "SPHERE" project – sports health improvement and rehabilitation;

"EYVOL" project - the opportunities of youth *volunteering* in the sphere of sport. In terms of the project the following things would be created and introduced: innovative educational methodologies of sport use for the intercultural dialogue development, social-economic development, including social integration by means of sport and big sport events [9].

"Hema" project - healthy, mobile and active worker. "Hema" project has the aim to increase the level of awareness concerning the importance of health-improving training, especially at a working place.

According to the research results, held in 2017 in terms of the project, it was stated that 210 million European citizens were physically not active.

Revealing the forms of physical activity among European citizens the scientists received the following results:

- 13% of *European citizens* fulfill physically active actions at work;
- 36% of *European citizens* are physically active at home and this activity is realized in two directions: household chores and physical exercises fulfillment;
- 13% - in sports clubs;
- 40% - at outdoors town sports grounds and rest zones (parks, squares);
- 15% - in health and fitness centers;
- 25% - while they go home, go to work or to shopping centers (walking, going by bicycle, roller skates and etc.) [6].

The absence of physical activity cost 80 billion dollars a year for EU countries, almost 80% of regional managers don't have information about the existing situation [1].

In terms of competitive selection of the applications from the participants of cluster association for created by them projects “EPSI” realizes their examination and forms favorable conditions for modification if it is necessary. The information about the selected projects of “EPSI” is available.

"EPSI" realizes cooperation in the sphere of innovations and experience exchange. For this purpose sports cluster association realizes the following:

- "TRUST" project organizes special training for businessmen, who work in the sphere of tourism in the countryside;

- "TEAMS" project teaches sports specialists for athletes' psychic and psychological problems treatment;

- "ASEE" project provides the system of sports innovations creation and the level of engineering education improvement in the sphere of sport.

In order to support political reforms of "EPSI" "SPORTWIND" project is realized. The project integrates sports movement and a structured dialogue between young people and politicians. The project stimulates talents development and provides career creation of socially unprotected youth.

Special attention should be paid to "EPSI" projects. They are realized in terms of pilot project of the European innovative council (EIC) "H2O2O INNOSUP" ("Horizon 2020").

The pilot project is oriented toward extremely new products, services processes or business-models creation. They would open new markets to European business [5]:

- "FEELGOOD" project creates intersectoral net of price creation of sport/tourism/way of life, in order to combine European business-structures;

- "SMARTS SPORTS 4 GOOD LIFE" project provides sports clusters and European business-structures cooperation;

- "DIGITAL SPORTS HUB" project-provides cooperation with SINN-i for new projects presentation in the sphere of sport and innovations.

Taking into consideration the existing situation on the territory of EU countries in terms of repeated flow of refugees and illegal migrants increase "EPSI" realizes "SPRINT" project.

The project is directed toward refugees integration through sport and physical activity [9].

The potential of EU clusters is considered the main power of innovative growth. Sports clusters have a great potential for cross-sectoral cooperation and interactions in different social and economic spheres. Nevertheless, sports clusters are not sufficiently developed at the municipal and regional levels.

The reason for the existing situation is in the absence of information among the authorities about potential and real opportunities of sports clusters for innovative technologies development, which stimulate business in the sphere of leisure, transport, education, tourism, environment, building and health and as a result, the opportunities of sports clusters are almost not reflected in regional programs of development.

In order to stimulate the activity of sports clusters at a regional and municipal level in summer, 2018 "EPSI" started to realize "Inno4Sports" project. "InnoSports" is presented in terms of social-economic transformations of regional and municipal associations of Europe. They open new opportunities for sports clusters capitalization [8].

The participants of "Inno4Sports" project are five regions, the activity of which, in terms of the project, is combines by one aim: "the effectiveness of territorial clusters increase in the sphere of sport".

The key objectives of the project are the following:

- the opportunities of cooperation revelation and strengthening among sports clusters according to "quadruple helix" (business, scientific associations, state authorities and consumers);

- synergy creation with intellectual processes of specialization;

- the problem of social role of sport change solution;

- the use of sport as the means of regional economic growth.

The activity of the regions-participants is directed toward their regional development programs' effectiveness increase. The participants of the project are the regions. They are able to support the processes of sports clustering on the basis of cooperation according to "quadruple helix" and provide innovative nets of added value in sport creation.

Taking into account different regional characteristics (for example, the level of economic development, expert knowledge about the processes of clustering) we defined the following directions of interaction:



- the opportunities creation for access to markets;
- studying the questions of transboundary cooperation;
- the processes of coordination development with regional programs of development;
- the needs of consumers and social tendencies revelation.

Deep cluster integration, an intensive process of interregional teaching, knowledge exchange and a long-term process of inter-cluster cooperation are directed toward the set aims achievement by the partners in terms of the project.

"EPSI" is not only the coordinator of the project, but also the consulting partner. Owing to it the results of the project became available not only for regional, national, but also for directive authorities at EU level. The experience of Project realization helps to reveal and level the problems of cooperation between sports clusters and regional authorities.

### CONCLUSION

Thus, "EPSI" is a cluster of above-national level, as its participants are involved into transboundary cooperation. "EPSI" fulfills the function of the specialized organization of sports cluster associations, the activity of which is directed toward more favorable innovative environment creation in the whole sports industry of EU.

"EPSI" realizes the activity directed toward the projects creation, coordination and control in the sphere of sport. Owing to "EPSI" lobby activity the questions of sport and sports industry development were included into social-economic EU programs of development. In 2014 EU created special funds to support the sphere of sport and sport industry. Every year EU increases the volume of means, given for sports projects.

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## **The problem of periodization of the International Olympic movement on the basis of Olympism evolution**

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**Abstract:** The article gives the main model characteristics of the stages and periods of the International Olympic Movement (IOM) on the basis of the Olympism evolution idea. We tried to define evolutional-historical events in IOM system in order to define scientific basis during IOM periodization construction on the basis of Olympism evolution ideas. We present the content of IOM periodization on the basis of Olympism evolution ideas and participation in the Games of the Olympiads and Winter Olympic Games of the Republic of Belarus national team in summer and winter kinds of sport. **Materials.** The article presents two pictures and one table. They describe the evolution of the Olympism ideas at the ancient Olympic Games and modern Olympic Games and Games periodization on the basis of Olympism evolution. **Research methods.** Bibliographic search, literature and documents analysis and summarizing, comparative analysis, historicism method, theoretical modeling. **Results.** We created model characteristics of the IOM stages and periods on the basis of Olympism evolution ideas. We stated evolution-historical events in IOM system. We present the periodization of IOM on the basis of the ideas of Olympism evolution and participation in the Games of the Olympiads and Winter Olympic Games of the Republic of Belarus national team in summer and winter kinds of sport. **Conclusion.** The article describes model characteristics of the IOM stages and periods on the basis of the ideas of Olympism evolution, we present the author's model of IOM system periodization on the basis of Olympism evolution.

**Keywords:** International Olympic Movement, periodization, BSSR, the Republic of Belarus.

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### **INTRODUCTION**

The urgency of the research topic is conditioned by great social-political importance of the International Olympic Movement (IOM). The Olympic Games are the greatest International competitions, an important event in the life of professional athletes and world cultural society. They are the part of the World culture. The Olympic Movement, which involves athletes, judges, audience from all parts of the World, is the most mass social-cultural phenomenon of modern life. During the Olympic Games thousands of people from all parts of the planet come to the town. The town organizes the Games; millions of people watch the competitions using mass media (MM). The Olympic sport attracts attention of the International MM. They create the image of the Olympic movement. The Olympic Games are discussed by journalists, historians, writers, scientists and other people. Millions of

people gather near TVs and follow the performances of athletes, newspapers and magazines write about the struggle between athletes at running tracks and cycling tracks, in swimming pools and gymnastic halls. Olympiads become great sports event and gain important meaning in the system of World culture values [1].

The results of many research works (the Ukrainian school of scientists: Bubka S.N., Platonov V.N., Bulatova M.M.; Moldavian school of scientists: Manolaki V.G. Vizitei N.N.; Russian school of scientists: Rodichenko V.S., Stolyarov V.I., Stolbov V.V., Kuznetsova Z.M., Lubysheva L.I., Melnikova N.Yu.; Belorussian school of scientists: Kobrinskiy M.E., Kulinkovich E.K., Guslistova I.I., Kruglik I.I. and others)) prove the interest in the questions, connected with the Olympic problems [2-9].

However, having analyzed many works of the mentioned above scientists in the sphere of

Olympic problems, we can define that evolution-historical peculiarities of the Olympism evolution ideas in the IOM system are not discussed enough. The works of mentioned above authors, apart from the representatives of the Ukrainian scientific school, are mainly connected with the Olympic education and its different technologies introduction into pedagogical process, starting from kindergartens to higher educational establishments and sports schools. In foreign literature more often works analyze Coubertin concept of Olympism (works by I. Andronov, P. Graham, J. Manuelun, M. Mzali, H. Yuberhorst), moral ideals and values of the Olympic movement, questions of the Olympic education (V.N. Platonov, S.N. Bubka, M.M. Bulatova, Zh. Atanasova, Kh.M. Kakhigala, K. Khenily, Z.M. Kuznetsova, I.I. Kruglik and others). However, it should be noted that the absence of scientific works of summarizing and systematizing character, which study evolution of the Olympism ideas in IOM system at different historic stages of its formation under the influence of different factors and time and their influence on society.

Thus, author's IOM system Periodization construction (taking into account the evolution of Olympism) since ancient times till modern times gives an opportunity to set integration processes and cause-effect relations in IOM [4-6], helps to analyze evolution peculiarities of the Olympic movement in the Republic of Belarus, defining the ways of its development on the basis of the Olympic ideology of Olympism.

The urgency of studying the system of the International Olympic movement as the subject of scientific research is evident. The stages and periods of the International Olympic movement (IOM) formation and determination is a debatable and scientific problem for scientists, who study the Olympic problem [7-15].

The aim of the research is to create model characteristics of the stages and periods of the International Olympic movement in terms of the Olympism evolution ideas on the basis of evolutional-historical approach.

## **RESULTS AND DISCUSSION**

During the research it was stated that during the ancient Olympic Games the model was created. It was based on evolutional-historical and complex approaches and was used in knowledge systematization concerning the peculiarities of Olympism ideas evolution during the ancient Olympic Games.

As a result of Olympism ideas evolution study during ancient Olympic Games we define three main directions:

1. Background for the ideas appearance about ancient Olympic Games organization.

Include studying the following things:

- 1) the main preconditions for the ideas appearance concerning ancient Olympic Games;
- 2) myths and legends concerning ancient Olympic Games appearance;
- 3) social-cultural peculiarities as the factor, which provides ancient Olympic Games appearance.

2. Ancient Olympic Games as the subject of the research.

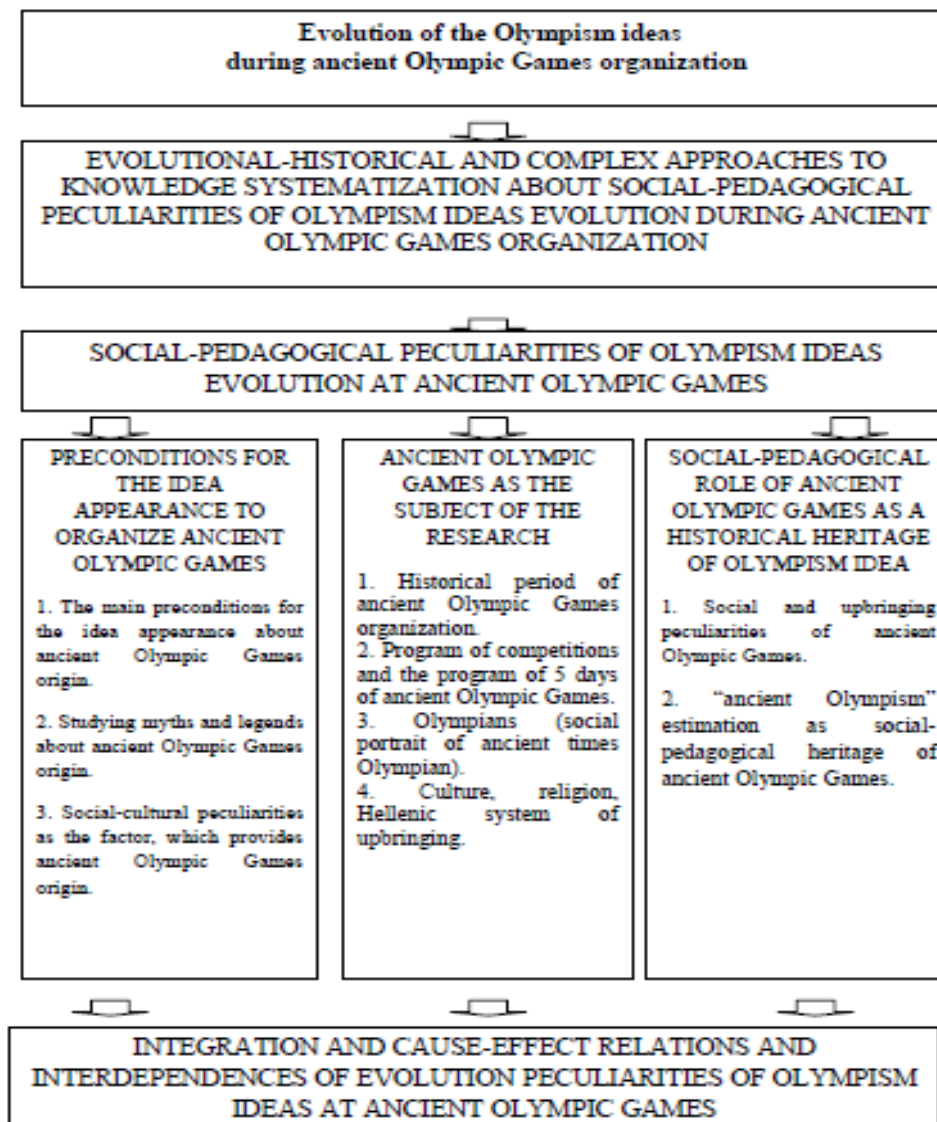
Includes studying the following things:

- 1) historical period of ancient Olympic Games organization;
- 2) programs of competitions and programs of five days of ancient Olympic Games;
- 3) Olympians (social portrait of ancient times Olympian);
- 4) cultures, religions, Hellenic system of upbringing.

3. Social-pedagogical role of ancient Olympic Games as a historical heritage of the Olympism idea.

Includes studying the following themes:

- 1) social and upbringing peculiarities of ancient Olympic Games;
- 2) "ancient Olympism" estimation as social-pedagogical heritage of ancient Olympic Games (picture 1).



Picture 1 – Olympism ideas evolution during ancient Olympic Games

Model of studying Olympism ideas at modern Olympic Games. We used evolutionary-historical and complex approaches to knowledge systematization concerning evolutionary peculiarities of modern Olympic Games. When we stated the peculiarities of Olympism ideas evolution during modern Olympic Games the model was created. It was based on evolutionary-historical and complex approaches and used in knowledge systematization of social-pedagogical peculiarities of Olympism ideas evolution during modern Olympic Games organization.

As a result of studying social-pedagogical peculiarities of Olympism ideas evolution at modern Olympic Games we can define three main directions:

1. Preconditions for the idea appearance of

the Olympic Games revival.

1.1. The main preconditions for the ideas appearance of modern Olympic Games revival.

1.2. The contribution of the separate personalities into the ideas of Olympism development.

1.3. Factors of environment, which provide ancient ideas revival during the Olympic Games revival.

2. The Olympic Games as the subject of the research.

2.1. Historical period of the Olympic Games organization.

2.2. Different kinds of the Olympic Games periodization.

2.3. Main "challenges" thrown down to the Olympic movement, which contradict the ideology

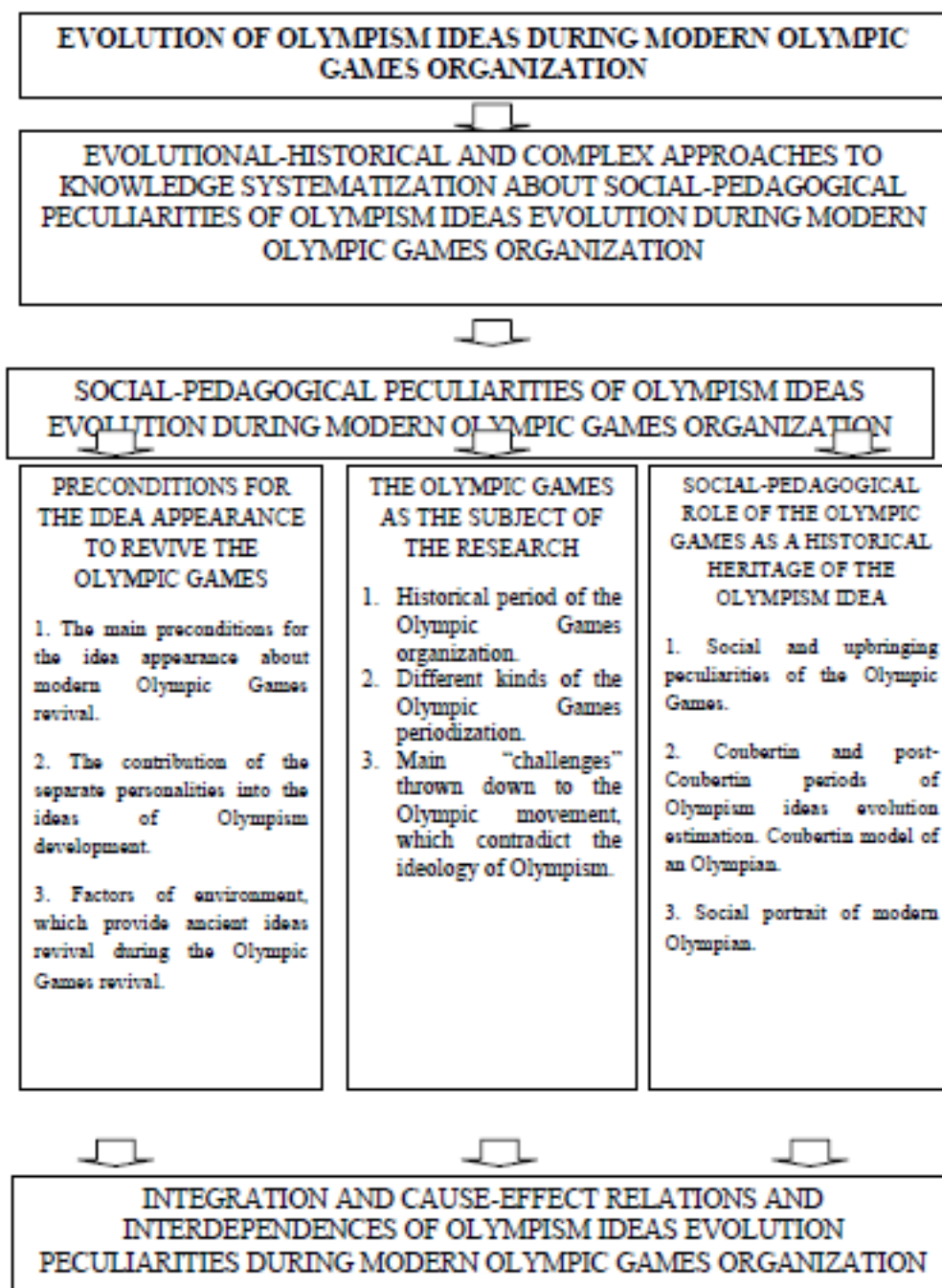
of Olympism.

3. Social-pedagogical role of the Olympic Games as a historical heritage of Olympism idea.

3.1. Social and upbringing peculiarities of the Olympic Games.

3.2. Coubertin and post- Coubertin periods of Olympism ideas evolution estimation.

3.3. Social portrait of modern Olympian (picture 2).



Picture 2 – Olympism ideas evolution at the Olympic Games



During periodization of modern Olympic Games creation we offer the following Games periodization:

Table 1 – The Olympic Games periodization on the basis of Olympism evolution and territorial belonging of a national team (BSSR, CIS, the Republic of Belarus)

Historical period of the Games of Olympiads (dates)	Period	The main peculiarities
1) 1894-1912 (Games of the I-V Olympiads)	Renaissance /Formation	Session of the first IOM content, the Olympic charter adoption, 5 Olympic Games organization
2) 1913-1920 (Games of the VI-VII Olympiads)	Prewar/war/after- war	World War I, after war Games in 1920 in Stockholm
1921-1935 (Games of the VIII-XI Olympiads)	Interwar (historical period in IOM between World War I and World War II)	The Olympic Games in Paris, Amsterdam, Los Angeles, Berlin
3) 1936-1951 (Games of the XI-XIV Olympiads)	Prewar/war/after war (World War II)	Military period in IOM
4) 1952-1992 (Games of the XV-XXV Olympiads)	Period of participation of BSSR and CIS	The USSR acceptance by the Olympic Committee, the USSR team participation in 10 Olympiads
5) 1993-2022 (Games of the XXVI – XXXIII Olympiads)	the Republic of Belarus at the Games of Olympiads	the Republic of Belarus recognition by NOC, the separate team participation in XXVI – XXXIII Games

1. The first period (Renaissance / Formation) – 1894-1912.

2. The second period (Prewar/war/after-war) – 1913-1920.

3. The third period (interwar) – 1921-1935.

4. The fourth period (Prewar/war/after-war) – 1936-1948.

5. The fifth period (BSSR and CIS) – 1952-1992.

6. The sixth period (the Republic of Belarus) – 1993-2022.

The basis of this periodization (especially the first four periods) is military factor as the main crisis of Olympism in IOM system. It should be said that war period the most difficult period in the history of IOM, as the Games were not held during this period. All athletes took part in war. Countries

were involved into military world conflict, the infrastructure for the Olympic Games organization was ruined and the main thing was that people died during the war, people, who were potential athletes, judges and audience. The fifth period of periodization was based on the criterion of BSSR (1952-1988) and the united team of CIS (1992) participation. The last period is connected with the Republic of Belarus recognition by NOC, the national team participation in the Olympic Games.

During periodization of the Olympic Games formation we offer the following:

1. The first period (Renaissance / Formation) – 1924-1936.

2. The second period (Prewar/war/after-war) – 1936-1948.

3. The third period (without the USSR) – 1948-1952.

4. The fourth period (the USSR and BSSR-1964 at Winter Olympic Games) – 1956-1992.

5. The fifth period (the Republic of Belarus at Winter Olympic Games) – 1994-2018.

The basis of this periodization forms Olympism ideas evolution and territorial belonging. In terms of the Republic of Belarus independence recognition the national team (winter kinds of sport) for the first time participated in Lillehammer in 1994 [1].

### CONCLUSION

The article describes model characteristics of the stages and periods of IOM on the basis of the Olympism evolution ideas. We set evolutionary-historical events in IOM system. We presented the periodization of IOM on the basis of Olympism ideas evolution and the Republic of Belarus taking part in the Games of Olympiads and Winter Olympic Games. We present the author's model of IOM system periodization on the basis of Olympism evolution.

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## **Physical culture teacher's professional activity effectiveness monitoring**

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**Abstract:** The article is about the approach to estimating the effectiveness of professional activity of a teacher in terms of native education paradigm change in the existing standards of education. The aim of the research: to reveal and test the mechanisms and ways of estimating professional activity of a teacher on the basis of secondary schools, taking into account modern demands claimed on educational results. **Research methods.** The research methods included information sources analysis and summarizing, questionnaire survey and the methods of mathematical statistics. Student t-test was also used. **Results.** We revealed the degree of the educational results achievement according to Federal State Educational Standards and the degree of labor activity realization by teachers according to professional standard of a teacher. We revealed correlational connections between the components and estimation criteria on the basis of the educational standards demands. We formulated possible reasons of difficulties during a teacher's professional activity realization. We present general recommendations concerning the problem zones elimination, revealed in this research work, and concerning further research works.

**Conclusion.** We made some conclusions concerning creation and testing the methodology of a teacher's professional activity estimation. We present general results of the methodology use and the recommendations concerning its further use.

**Keywords:** effectiveness of educational activity organization, federal state educational standard, professional standard of a teacher, personal and metasubjective educational results, labor actions of a teacher, correlational analysis, educational results specification.

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### **INTRODUCTION**

Nowadays the quality of a teacher's professional activity estimation is mainly determined by such indices, as the results of Unified National Exam (UNE), students' results at the olympiads and other results. The estimation is also held during teachers' accreditation in order to define his or her qualification category. However, with the pedagogical paradigm of education renewal the demands claimed on a teacher's professional activity had also changed. It leads to some contradiction: a teacher's work, which has to correspond with the demands of modern educational standards. It is estimated using out-of-date approaches and mechanisms of evaluation. At the same time, if subject educational results are traditionally achieved at a high level, then personal and metasubjective educational results achievement

by the pupils is difficult.

The problem of effectiveness evaluation of physical culture teacher's work is in evaluation criteria and parameters, forms and methods determination, their introduction into practice, providing reasonable use of staff, administrative and methodical solutions and stimulating professional development of a teacher.

The problem of evaluation criteria and indices substantiation is presented in some works of native scientists: B.G. Ananov, E.M. Ivanova, E.A. Klimov, A.G. Kovalev, V.N. Myasishchev, I.M. Paley, K.K. Platonov, Yu.P. Povarenkov, V.D. Shardrikov and others. The questions of choosing the parameters of pedagogical activity effectiveness evaluation are considered in the works of I.A. Zimnyaya, N.V. Klyueva, L.S. Kolesnikov, V.A. Krutestkiy, N.V. Kuzmina, A.K. Markova, L.M.

Mitina, Yu.A. Samarin and others [1; 2; 3; 4; 5; 6].

The aim of the research: to reveal and test the mechanisms and ways of estimating professional activity of a teacher on the basis of secondary schools, taking into account modern demands claimed on educational results.

### **MATERIALS AND METHODS**

Theoretical base of the methodology creation of physical culture teacher's professional activity effectiveness evaluation is the following: system-activity based, activity based-personal and competence based approaches to educational practice effectiveness estimation.

During the estimation we used such research methods as a questionnaire survey, comparative analysis, methods of mathematical statistics.

A questionnaire survey meant that during the process of effectiveness evaluation teachers were offered 2 lists of criteria according to the existing educational standards.

The diagnostics criteria of the professional activity effective evaluation were 11 personal (P.1 – P.11) and 12 metasubjective (M.1 – M.12) educational results according to Federal State Educational Standards of the main general education (MGE) with the opportunity to estimate according to 5-point scale [7-12].

The criteria of a teacher's professional activity effectiveness estimation procedural component diagnostics are the labor activities of "Teacher" professional standard: 10 labor actions of such labor function, as "General pedagogical function. Teaching" (T.1 – T.10), 11 labor actions of labor function "Upbringing activity" (U.1 – U.11), 11 labor actions of labor function "Developing activity" (D.1 – D.11), 7 labor actions of labor function "Pedagogical activity directed toward general and secondary education programs realization" (PR.1 – PR.7), also with the opportunity to estimate according to 5-point scale [8].

The research was held in 84 teachers on the basis of municipal budgetary educational establishment "Secondary school № 1", municipal budgetary educational establishment "Secondary school № 8", municipal budgetary educational establishment "Secondary school № 9", municipal

budgetary educational establishment "Secondary school № 10" in Yelabuga region of the Republic of Tatarstan.

### **RESULTS AND DISCUSSION**

During the questionnaire survey some teachers failed to understand the formulation of professional activity effectiveness evaluation criteria. They were taken without changes from the text of the official educational standards.

Defining qualitative degree of educational results achievement, we came to the conclusion that a minimal necessary level of each effectiveness index is 75% from the maximal possible mark. Thus, minimal necessary level of professional activity effectiveness is achieved if each criterion had 4 points.

As professional pedagogical activity is directed toward the definite results achievement during teaching and upbringing process, the effectiveness is estimated, first of all, according to educational results. It is common knowledge that each teacher doesn't have to achieve the full volume of each educational result according to FSES MGE, as these results achievement is realized through mutual activity of the whole educational organization teachers. That is why the effectiveness of teachers' professional activity estimation is realized, first of all, as a result of the selective average educational results comparison and labor functions according to the whole sampling with the necessary level.

The results of the questionnaire survey went through the initial statistical handling by means of calculating the means of central tendency and the measures of data scattering. Selective average educational results and labor actions of a teacher according to the whole sampling in general are presented in a form of radar charts (picture 1).



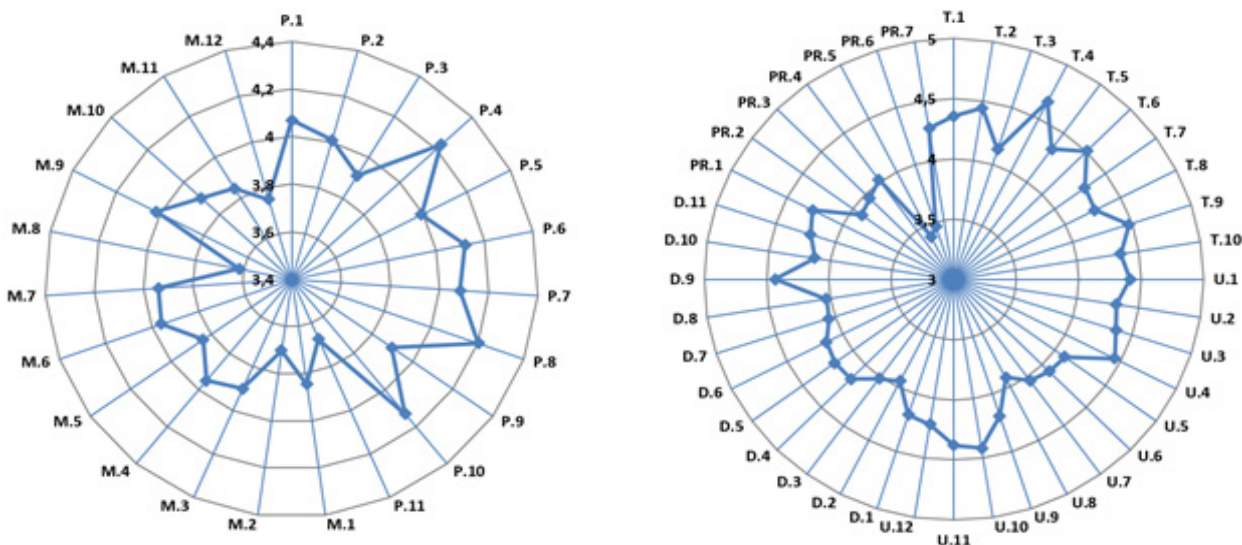


Fig. 1. Mean values of the degree of educational results achievement (on the left) and a teacher's labor actions realization (on the right)

As the selective mean value went through statistical discrepancy during empirical results collection, we checked statistical validity of the differences from the necessary level with the help of Student t-test.

During the check (at the significance level  $p < 0,05$ ) it was stated that insufficient degree is achieved by 8 educational results (1 personal and 7 metasubjective results):

P.11 – aesthetic consciousness development through mastering art heritage of the Russia and the World nations, creative activity of aesthetic character;

M.1 – the ability to define independently the aims of own education, set and formulate new objectives in education and cognitive activity, develop motives and interests of own cognitive activity;

M.2 – the ability to plan independently the ways of achieving aims, including alternative ones, choose the most effective ways of educational and cognitive problems solution;

M.3 – the ability to correlate own actions with the planned results, realize control over own activity during the results achievement, define the ways of actions in accordance with the changing situation;

M.5 – mastering the basis of self-control, self-estimation, decisions making and choice realization in educational and cognitive activity;

M.8 – notional reading;

M.11 – competence formation and development in the sphere of information-communicative technologies use; motivation development to the culture of active dictionaries and other searching systems use;

M.12 – ecological thinking formation and development, the ability to use it in cognitive, communicative, social practice and professional orientation.

These results prove that students' regulative universal educational actions are not sufficiently developing during professional pedagogical activity.

It was also revealed that (at the level of significance  $p < 0,05$ ) only 2 labor actions are not sufficiently realized:

PR.5 – special language programs use (including Russian language as foreign), the programs of language culture improvement and the skills of multicultural communication development;

PR.6 – cooperative (with students) use of foreign sources of information, instruments of translation and pronunciation.

Moreover, with the help of statistical analysis methods we defined how many teachers achieve validly high personal and metasubjective educational results. The results of the differences significance analysis between the selective means of teachers' educational results and the necessary level of their achievement at the level of significance  $p < 0,05$  are presented in table 1.



Table 1 – Teachers, who achieve high educational results

Educational result	Sampling (N)	The number of teachers, who achieve high educational results (T)	Part of T from N
Personal	84	25	29,8%
Metasubjective	84	19	22,6%

We studied the interconnection between the evaluation criteria of professional activity effectiveness by means of correlation analysis. The results of the interconnection analysis between the degree of personal and metasubjective educational results achievement show strong direct correlation connection in terms of correlation coefficient  $R=0,73$  at the significance level  $p<0,05$ .

The results of correlational analysis between the mean values of the personal and metasubjective results achievement degree, according to FSES of MGE, and the degree of labor actions realization, according to the professional standard “Teacher”, at the level of significance  $p<0,05$ , are presented in table 2.

Table 2 – Interconnection between the groups of education quality criteria

FSES		Prof. standard	Labor activities			
			Teaching	Upbringing	Development	Programs realization
Educational results	Personal		0,293	0,565	0,430	0,345
	Metasubjective		0,290	0,328	-	0,275

We revealed moderate direct correlational connection between personal educational results and upbringing labor actions. Other connections are weak or are absent at all, however, there are connections between the separate evaluation criteria.

During further study of interconnection between the components of estimating the effectiveness of a teacher’s professional activity we organized correlation analysis of the definite evaluation criteria of effectiveness at the significance level  $p<0,01$ . Most received correlation connections are direct and weak, however, there are moderate connections and one weak negative correlation connection.

We should mention weak negative correlation connection between «M.3» и «D.5». It proves that during the direct help concerning students, they achieve less results concerning: the ability to correlate own actions with the planned results, realize control over own activity during the results achievement, define the ways of actions in accordance with the changing situation. Thus, we can say that direct help realization can have

excessive character.

As we revealed insufficient degree of educational results achievement by teachers according to FSES of MGE, it is necessary to realize further work in the sphere of quality improvement of subjective activity organization among senior teen-agers at school. Such situation could be caused by the fact that teachers independently interpret or sometimes don’t understand general formulations of the standard. Thus, we think that it is necessary to realize specification of the definitions of FSES demands together with the demands claimed on labor actions in accordance with professional standard of a teacher in order to create theoretical base not only for monitoring instruments creation, but also for the opportunity to organize some events directed toward problem zones evasion during the necessary level of educational results achievement. These events can be at the level of educational organization and in the form of qualification improvement courses.

### CONCLUSION

As a result of creating and testing the

methodology of a teacher's professional activity effectiveness estimation on the basis of several secondary schools we revealed the following:

– educational results according to FSES of MGE are not achieved at a sufficient degree, especially in the sphere of regulative universal educational actions formation and development;

– teachers' labor actions are not sufficiently realized in accordance with professional standard of a teacher in the sphere of special language programs use, the programs of language culture improvement and the skills of multicultural communication development; cooperative (with students) use of foreign sources of information, instruments of translation and pronunciation;

– teachers independently interpret or sometimes don't understand general formulations of the standard. It can cause the problems during the necessary level of educational results achievement;

– there is a strong direct correlation between personal and metasubjective educational results. There are usually either direct and weak, or no connections between the degree of educational results achievement according to FSES of MGE and the degree of labor actions realization according to professional standard of a teacher;

– it is necessary to specify general definitions of educational standards demands with close connection in order to create theoretical base for monitoring instruments creation and for the opportunity to organize some events directed toward problem zones evasion during a teacher's professional activity organization.

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## Modeling adaptive reactions of young 15-17 year-old football players- professionals functional state on the basis of integral monitoring

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**Abstract:** Adaptation to different kinds of loads is a difficult, multilevel process. It influences modulation of an organism different systems functional state. In order to increase functional abilities of athletes' organism concerning constantly increasing loads (stimuli) and decrease individual dysfunction we create micro-, meso- and macro cycles of sports training. The parameters monitoring, which reflect external stimuli and reaction of an organism to these effects, helps to define quantitative characteristics of motor activity taking into account functional abilities of athletes' organism, get objective information about adaptive processes of different systems functioning under the influence of this load. Analytical platform formation about adaptive-regulating changes would provide the mentioned problems solution for sports longevity and functional shifts prediction in urgent and long-term adaptation. It is important for youth professional sport. **Materials.** The article presents the results of modeling adaptive reactions of the 15-17 year-old football players' organism functional state in the structure of a micro cycle of the sports training preparatory stage. **Research methods.** During the experiment we used modern technologies: GPS CATAPULT (Australia), POLAR (Finland), OMEGA-SPORT (Russia). **Results.** The models of adaptive reactions (created during the research) reproduction and visualization provides functional abilities prediction in age-related vector of adaptation. Waviness of tension in the activity of systems, which provide motor activity, doesn't duplicate fully motor activity parameters modulation. It can be connected with structural trace and age-related peculiarities of adaptive processes formation. **Conclusion.** It was stated that the models reproduction is the instrument of functional abilities prediction among young football players at the age vector of adaptation, waviness of the system tension, which provide muscle activity, doesn't duplicate fully the parameters of motor activity.

**Keywords:** football, adaptation, functional state, integral monitoring, modeling.

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### INTRODUCTION

Adaptation to different kinds of loads is a difficult, multilevel process, which influences modulation of functional state of different systems of an organism. In order to increase functional abilities of athletes' organism concerning constantly increasing loads (stimuli) and decrease individual dysfunction we create micro-, meso- and macro cycles of sports training [9]. The parameters monitoring, which reflect external stimuli and reaction of an organism to these effects, helps to define quantitative characteristics of motor activity taking into account functional abilities of

athletes' organism [13], get objective information about adaptive processes of different systems functioning under the influence of this load and in terms of age-related dynamics [12]. Analytical platform formation about adaptive-regulating changes would provide the mentioned problems solution for sports longevity and functional shifts prediction in urgent and long-term adaptation. It is important for youth professional sport.

The aim of the research is modeling adaptive reactions of the 15-17 year-old football players' organism functional state in the structure of the sports training preparatory stage micro cycle

by means of the integral monitoring.

### **MATERIALS AND METHODS**

We examined athletes football-players ( $n=20$ ,  $16,2\pm 0,3$  years old,  $173,3\pm 5,6$  cm,  $68,9\pm 4,9$ ). The spectrum of the indices was registered every day during 4 weeks of the preparatory period. The activity of the players at a football field was registered during each match and training using portable device GPS with 10 Hz frequency (Catapult, Australia). Each device was put into mini-pocket, between the shoulder blades of the vest. In order to avoid interblock mistake the player used the same device during the whole preparatory period. At the end of the training sessions and games GPS-results were received with the help of analytical platform OpenField. As the registered indices we used the following: Total Duration, Total Distance, Total Player Load, Total Jump, Speed zone 4,5-5 m/s (amount of meters in speed zone 4,5-5 m/s), Speed zone 5-7 m/s, Speed zone  $>7$  m/s. Inertial movement analysis (IMA) presents the results received from built-in accelerometers, gyroscopes and magnetometers for athlete's space orientation estimation [8]. We registered the following indices: IMA accel high (highly intensive acceleration); IMA decel high (highly intensive inhibition), IMA Cod left high (highly intensive direction change to the left); IMA Cod right high (highly intensive direction change to the right). Vegetative regulation monitoring was realized since 9:00 till 10:00 inside, where the temperature was from 22 till 24°C. During the study each player was protected from acoustic and visual interference. In order to define the variables of heart rate variability (HRV) at rest we used ECG II signal of sports technology OMEGA-SPORT (DYNAMICS, Saint-Petersburg, Russia) from sitting position. Bioelectric heart activity was registered during 5-7 minutes, all premature heart ventricle contractions, missing strikes and any artifacts were filtered out manually. The range of 300 serial intervals RR without artifacts was received from each phase. In order to estimate vegetative cardiac activity we used statistical, spectral and integral indices. In general we analyzed 9 indices of heart rate variability: FS% (functional state), TI (tension

index), VR (variation range), AMo (amplitude of mode), SDNN (Standard deviation of NN pairs of intervals), RMSSD (Root mean square of square differences of NN pairs of intervals), pNN50 (sinus intervals R-R, differentiating more than 50 ms), LF (low-frequency waves of the spectrum), HF (high-frequency waves of the spectrum). Blood circulation system functioning during the training session was studied with the help of sports technology of Polar enterprise, Finland. We registered the following: HR max (maximum HR – heart rate), HR mean (mean HR), HR min (minimal HR); TRIMP (estimate indicator of tiredness). The results of the statistical analysis we present as the arithmetic mean and mean square deviation ( $M\pm\sigma$ ). According to Student t-test the sampling was examined for the equipartition law belonging. The analysis was held with the help of statistical package Microsoft Excel 2017.

### **RESULTS AND DISCUSSION**

The specific muscle load estimation in football corresponded with the realized distance and time [13]. The base for adaptive processes modeling was valid mean values of transfers within the period of the research (table 1). It was stated that Wednesday was the day of the most intensive motor activity at a football field. The results of the training sessions duration (Total Duration) and general distance (Total Distance) show wavelike dynamics of relatively initial measurements (fig. 1). The value of total play load revealed the greatest volume of the specific muscle work on Tuesday and Wednesday. Total Play Load is the main parameter in the system of global CATAPULT positioning, reflected in c.u. and defined as “momentary speed of speeding up estimation divided to the coefficient of scaling” [8]. Jumping load monitoring (Total Jump) showed valid mean values on Wednesday and Saturday (table 1).

Table 1 – General indices of duration, distance, paly load, amount of jumps in the structure of micro cycle of the preparatory stage of training

Day of the week/Indices	Total Duration (min)	Total Distance (m)	Total PL (c.u.)	Total Jump (amount)
Monday	1102,2±302,7*	78230,6±22544,4*	7993,6±2730,4*	125±48,2
Tuesday	1093,6±161,2	80759,6±9196,3*	8151±807,1*	108±60,9
Wednesday	1165,4±35,7*	84545±7899,9*	8122±834,6*	136,3±7,6*
Thursday	997,1±358,6*	55365,2±48218,8	6724±2386,2	87, ±5,1
Friday	913,3±62,7*	63287,6±7455,7*	5996,3±879,1*	114,6±38,7
Saturday	861,5±123,9*	77348,5±12849,3*	7078,6±286,3	178,2±34,1*

\* - differences are valid in comparison with the initial results during the preparatory period, p<0,05



Fig. 1. Dynamics of mean values of general physical indices Total Duration, Total Distance, Total Play Load, Total Jump in the structure of the micro cycle of the preparatory stage of sports training

Individual reaction of myocardium to the load reflects the level of blood circulation system adaptation during muscle load [4]. We revealed relatively low average group values of minimal (HR min) and mean heart rate (HR mean) (table 2). It is conditioned by the increased tonus of parasympathetic part of autonomous nervous system prevalence over sympathetic one as a result of systematic training loads (fig. 4) [5]. Peak valid values of minimal (HR min) and mean (HR mean) HR happen on Friday and Saturday. The research showed that valid mean values of maximal HR (HR max) on Monday, Tuesday and Saturday (table 2). It should be noted that high values happen at the beginning and the end of a weekly micro cycle. We connect it with several factors: the age of the respondents and the specificity of organism

reactions to the previous load. Individual tiredness index (TRIMP) is a quantitative measure of estimation for the training and competitive load. TRIMP takes into account the intensity of exercises, calculated by means of HR reservation method, the duration of the exercises and weight coefficient [10]. Fig. 2 presents valid dynamics of mean values of TRIMP index among young football players-professionals during the preparatory period in the structure of the micro cycle, which proves different reactions of athletes' heart and organism to the load in general. The research shows that tiredness develops wavelike, peak values happen on Wednesday and Saturday.



Table 2 – HR indices (HR min, HR mean, HR max) and an objective estimate indicator of tiredness (TRIMP) in the structure of micro cycle of the preparatory stage of training

Day of the week/ Index	HR min (beats/min)	HR mean (beats/min)	HR max (beats/min)	TRIMP (c.u.)
Monday	79,6±1,5	138,6±10,6*	210,3±14,1*	1888±508,8*
Tuesday	78,2±8,5	138,7±7,3	202,2±17,7*	1985±775,5*
Wednesday	82,7±8,3	131±10,5	190,3±15,4	2282±844,1*
Thursday	86,1±4,2	132,6±5,5	188,3±23,7	1670,6±673,8
Friday	100,3±3,2*	137,5±14,1*	185,4±13,4	1771,1±100,6*
Saturday	94,1±6,2*	140,1±7,8*	199,6±12,7*	2038,7±104,8*

\* - differences are valid in comparison with the initial results during the preparatory period, p<0,05

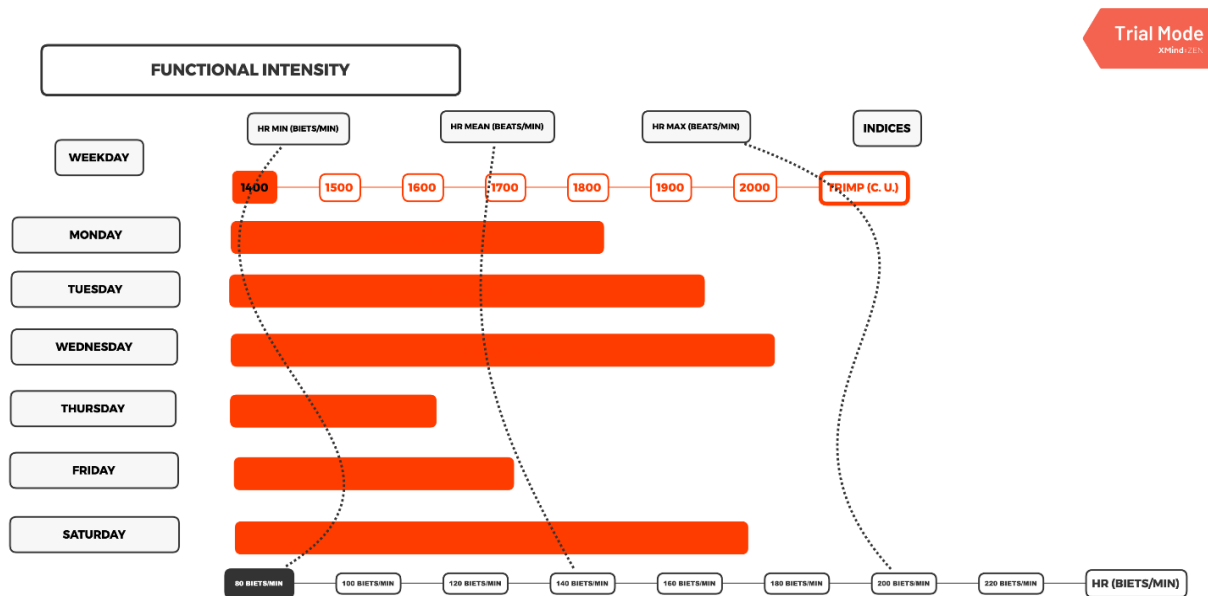


Fig. 2. Dynamics of mean values of functional indices TRIMP, HR min, HR mean, HR max in weekly micro cycle of the preparatory stage of sports training

High intensity of the specific muscle work is an important component of effectiveness in football [7]. In the group of 15-17 year-old respondents there was the average metrage in speed zone of high intensity (speed >7 m/s) and valid increase on Tuesday and Thursday. It is connected first of all with the planned physical load of speed-power oriented orientation and morphological and biochemical transformations of the organism during the training period of this age group [12]. The mean values of metrage, realized in the zones of low (speed 4,5-5,5 m/s) and moderate (5,5-7 m/s) intensity, increased on Tuesday and Wednesday and decreased validly on Friday (table 3). We agree with Alemdaroglu,

who explains this factor with different homeostatic state and variation of energetic systems work.

The results of inertia sensor are able to show locomotor movements at not long distances with high speed. It is a valuable instrument of muscle load control on lower extremities joints in team kinds of sport [8]. Table 3 shows the average group values of micro movements indices within the research period, which reflected shifts of motor load forward (IMA accel) and left (IMA Cod left high). It is obvious that unchangeable load excess can lead to muscle disbalance and asymmetry of locomotor apparatus and to bending and extensor function of knee joint decrease [11].

Table 3 – The indices of meters, realized in speed zones, and the amount of micro movements, in the structure of micro cycle of the preparatory stage of sports training

Day of the week \ Indices	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<b>Speed zones</b>						
Speed 4,5-5,5 m/s (m)	6223,6±1575,1	6531,6±1154,2*	7630,3±1197,1*	6727,3±3153,1	5275,3±1626,5*	7499,4±1730,3
Speed 5,5-7 m/s (m)	1086,3±105,6	1612,6±492,3*	1618±255,3*	1557,3±773,9	1105±564,3*	1275,1±323,9
Speed >7 m/s (m)	87,3±79,6	301,3±145,7*	103,3±70,5*	189±109,5	98,1±21,1	162±59,4
<b>Micro movements analysis</b>						
IMA accel (amount)	50±7,9*	51±19,1*	84±33,7*	68±34,6*	46,3±20,4	59,2±16,5*
IMA decal (amount)	47,2±18,5*	48±14,7	68,3±37,1*	53,6±37,1	50±33,1	47,2±14,5
IMA Cod Left high (amount)	69,3±25,5*	62,6±16,9*	94±22,7*	75,3±55,7	69,6±27,7*	66,5±11,1*
IMA Cod Right high (amount)	51,6±18,1	38,3±14,1	81,2±35,1	80,6±44,4	56,1±31,8*	51,2±14,6

\* - differences are valid in comparison with the initial results during the preparatory period,  $p \leq 0,05$



Fig. 3. Mean values of physical indices dynamics Speed 4,5-5,5 m/s, Speed 5,5-7 m/s, Speed >7 m/s in weekly micro cycle of the preparatory stage of sports training

In order to estimate functional state of blood circulation system the results, which characterize rehabilitation processes are very important. An informative method in sports physiology is mathematical heart rate analysis [3]. Sinuatrial block of heart is studied not only in the aspect of automatic contraction, but also as activity predictor of higher levels of control [5]. Picture 4 shows that the integral index of heart rate regulation (FS %) during the preparatory period decreased validly since Monday till Thursday, which shows

functional optimum achievement and organism adaptation to stress effects [4]. Before control Saturday games this parameter starts to grow. We agree with Shlyk N.I. and connect this case with psycho-emotional tension before competitive load, which is validly proves low-frequency (LF) component of the spectrum increase (table 5) [5]. Table 4 shows that the values of tension index reflect vegetative balance shift among young football players with parasympathetic part of autonomous nervous system prevalence, providing

necessary oxygen at rest and during rehabilitation after the training loads. AMo% values more than 3% show the effective work of blood circulation

system owing to reserve capacities of an organism and the resource of adaptation [4].

Table 4 – Activity indices of sympathetic and parasympathetic parts of autonomous nervous system among young football players-professionals in the structure of micro cycles of the preparatory stage of sports training

Day of the week \ Indices	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
<b>Sympathetic activity ANS</b>						
TI (c.u.)	110,7±40,4*	66,8±23,7*	99,1±51,5*	40,1±17,8*	43,5±14,1*	93,9±22,3
AMo %	38,1±23,2*	29,2±3,9*	26,7±10,5	24,1±10,4	22,3±6,5	30,8±3,2*
LF (c.u.)	2173,1±210,1	1459,9±840,7	2083,1±221,5	2930,7±194,6*	2889,6±63,4*	1470,1±64,7
<b>Parasympathetic activity ANS</b>						
S D N N (c.u.)	58,6±28,4	57,3±10,9*	71,4±18,8*	77,8±27,3	87,3±16,3*	58,2±8,3
R M S S D (c.u.)	36,6±21,5*	28,6±7,1	54,9±32,9*	53,9±21,3*	73,1±28,3	39,2±7,8*
VR (sec)	267,4±18,8	260,2±11,4	320,7±35,7	334,8±28,7	384,7±4,1	282,4±18,7
HF (c.u.)	606,4±174,6*	1287,5±45,8	1693,4±146,6*	1631,1±252,1*	796,8±190,2*	1602,8±54,5
pNN50 %	26,6±7,3*	32,1±4,2*	28,7±3,8*	36,2±8,7*	33,5±6,2*	29,1±2,7
<b>Integral index of heart rate regulation</b>						
FS %	80,3±6,2*	76,5±1,1*	75,9±2,8*	74,3±3,1*	74,9±4,7*	78,3±7,5

\* - differences are valid in comparison with the initial results during the preparatory period,  $p \leq 0,05$

pNN50 index is more reliable concerning random situations and has high level of correlation with different high-frequency indices of time and spectral analysis, doesn't decrease in terms of frequent breathing and other artifacts [2]. Parasympathetic regulation activity prevalence can be explained according to statistically valid withdrawal from of this parameter. At the same time young athletes had the main time indices increase, which reflected vagal (RMSSD) and humoral-metabolic (SDNN)

influences, showing high activity of autonomous contour of regulation [4]. The differences in dynamic observation had the separate parts of spectral analysis. Young athletes, who specialize in football, on Monday and Friday had statistically low values of high-frequency spectrum component (HF), however, on Wednesday and on Thursday we saw this index increase. It demonstrates high lability of vegetative nervous system according to autonomous contour of age group.

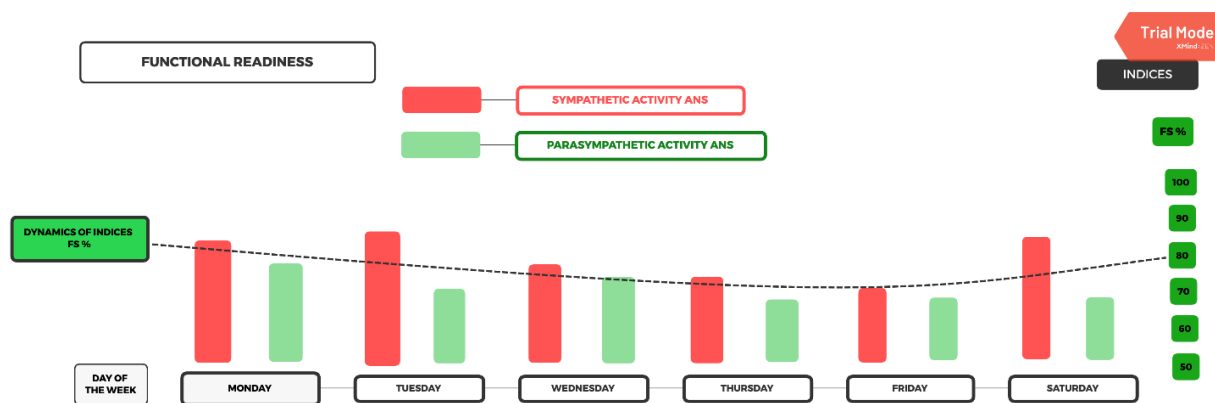


Fig. 4. Dynamics of heart rate vegetative regulation indices mean values in a weekly micro cycle of the preparatory stage of sports training

Thus, young 15-17 year-old football players had parasympathetic part of autonomous nervous system intensification; the greatest motor volume of the specialized muscle load and excess functional tiredness on Wednesday; the vector of high-intensity locomotor load shift forward and leftwards.

### CONCLUSION

1. The models of adaptive reactions (created during the research) reproduction and visualization provides functional abilities prediction in age-related vector of adaptation.

2. Waviness of tension in the activity of systems, which provide motor activity, doesn't duplicate fully motor activity parameters modulation. It can be connected with structural trace and age-related peculiarities of adaptive processes formation.

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## **Functional state of athletes during testing loads**

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**Abstract:** Testing loads use for functional state determination and functional abilities of athletes' organism revelation is necessary in order to improve the quality of educational-training process and to achieve high sports results. **Materials.** Testing loads of different physiological orientation and power revelation for athletes' functional state determination. **Research methods.** Information sources analysis and summarizing, tetrapolar chest rheography method according to W.G. Kubicek with other authors, testing, mathematical statistics method. **Results.** The held research showed that in terms of active body position change the whole complex of cardiorespiratory system indices takes part in compensatory-adaptive reactions of athletes' organisms. Among them it is impossible to define the leading factor in organism adaptation. That is why the importance of the offered physical load is leveled by the received research results. They prove low importance of this load. The last two loads use for the peculiarities revelation in the activity of athletes' organism gains important scientific-practical meaning as an additional factor of control over athletes' functional state and the changes introduction into the regimen of the training lessons. During the functional state determination it is reasonable to take into account the testing loads of dynamic character. In this case their individual characteristics are revealed. They are connected with adaptive relations between the components of cardiorespiratory system and demonstrated in different variants of reaction. They depend on age-related peculiarities, kinds of sport and the power of the used physical loads. **Conclusion.** Testing loads meaning revelation for their further use would provide correct educational-training process organization. **Keywords:** testing physical loads, work capacity, bicycle ergometer, functional state.

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### **INTRODUCTION**

P.K. Anokhin offered to consider the activity of a person from the position of physiology and psychology in terms of an integral functional architecture. He took into account functional system as "a closed physiological education with constant back information concerning the success of such adaptive action" [1]. In his opinion, functional state is a difficult system reaction. It changes dynamically during activity and is the result of interaction between functional systems of a person's

organism. It means that functional state should be considered as the result of an organism dynamic interaction with environment. It reflects the state of "the organized unit". Nowadays functional state is a functional background or factor. It conditions a person's behavior, his abilities (including labor and connected with physical exercises fulfillment). It reflects the characteristics of regulating processes in a norm and pathology [2,3]. In this case we consider background activity in terms of which the activity is realized.



Different testing loads use, which model different sides of environment, is one of the principles formed at the beginning of the last century by I.P. Pavlov (1999) [4]. With their help information can be received concerning objective characteristics of an organism functional state [5]. Such kind of test can be body position change in space. It is natural, not connected with any additional efforts use, functional test. It is the model of everyday loads of a person and the result of vegetative regulation. Taking this into consideration in order to get valid estimation of cardiovascular system adaptive abilities, as the part of cardiorespiratory system, different tests are used with body position change. Moreover, in medical and biological research works motor activities are widely spread. They have high level of diagnostic value. In this case generally adopted and preferable is considered bicycle ergometry, owing to which there appears the opportunity to get physiological information during the activity itself [6].

The aim of the research is to reveal the testing loads of different physiological orientation and power for functional state of athletes' organism determination.

#### **MATERIALS AND METHODS**

In terms of an active body position change we examined the group of male athletes at the age of 22-26 (20 people). The average body length was 175,45 cm, the average weight - 73,90 kg. All respondents had orthostatic steadiness and during the first minute in lying, standing and sitting position using tetrapolar chest rheography method by W.G. Kubicek and other authors (1966) we registered their differential rheography and ECG in order to determine cardiac stroke volume and heart rate [11-13]. 108 male athletes at the age of 18-53 (who go in for different kinds of sport and who have sports qualification of master of sport till the second category) took part in the work at bicycle ergometer with the increasing power till 200W. Also the group of male athletes (12 people) at the age of 19-44, who have high total body sizes, was examined.

In medical-biological research works the testing loads were applied [7,8,9,10]. Natural, not connected with some additional efforts use, active

body position in space (active orthostasis). It is the result of vegetative regulation and the work at bicycle ergometer of gradually increasing power with precise dose of physical load. Owing to it there is the opportunity to get physiological information during motor activity itself. All these testing loads are widely used in examination of athletes during physiological mechanisms of adaptation study and in order to change educational-training process for high sports results achievement in a chosen kind of sport [8,9].

#### **RESULTS AND DISCUSSION**

The most available testing load is an active change of body position or an active orthostatic test, used for shifts in cardiovascular system revelation and for control over rehabilitation processes in an athlete's organism. In order to reveal the shifts during the initial period of an active body position change we used orthostatic test. As a result it was stated that during the transfer from the lying position into standing position, which was called partial orthostasis, during the first minute after body position change blood minute volume changed for a valid volume (table 1). During the first 10 seconds it was connected with cardiac stroke volume (CSV) and HR and at the end of the first minute with the shift only in heart rates. In this connection we define two phases of compensatory reactions of cardiac output. The first phase- duration since the beginning of the research till 10 seconds. It is characterized by defined tachycardia and CSV decrease.

The second phase (50-60 seconds) is in stabilization of stroke output and heart rates decrease. All this was reflected in a wave-like character of MBV change.

During the transfer to standing position changes in cardiac output volume are connected only with valid shifts in CSV index, and chronotropic reaction of heart is not the main in MBV support. In this case we can define two phases of compensatory shifts: the first (0-10 s) is defined by valid chronotropic reaction of heart increase and steady CSV, the second (50-60 s)- contrary phenomena. During the first seconds of body position change the initial effects appear and later secondary,

compensatory ones, directed toward the initial changes of blood circulation evasion and toward circulatory homeostasis preservation.

Activity at bicycle ergometer of gradually increasing power till 200W led to one of cardiorespiratory system reactions demonstration: inotropic, chronotropic, respiratory or mixed (chronotropic-respiratory, inotropic-respiratory) (table 2). The most optimal reaction from these

reactions is connected with inotropic function of heart increase. It can provide physical working capacity increase and sports results owing to functional reserve of blood circulation and respiratory systems increase. The load of 3 W/kg, which we defined as maximal power loads, provided the mixed type of reaction revelation: chronotropic-respiratory; inotropic-respiratory (table 3). It proves additional mechanisms connected with oxygen provision during motor activity.

Table 1 – Heart activity indices in the group of athletes during the initial period of an active body position change

Indices	The position of the respondent				
	Lying	Sitting		Standing	
		0-10 s	50-60 s	0-10 s	50-60 s
CSV, ml	109.84*	93.93*	91.77	91.43 <sup>0</sup>	77.37 <sup>0</sup>
	3.34	3.65	3.88	3.17	3.04
HR, beats/min	67.84*	86.97**	74.74 <sup>+x</sup>	87.80 <sup>x</sup>	85.85
	2.04	2.45	2.63	2.18	2.82
MBV, l/min	7.39*	8.30**	6.81 <sup>+x</sup>	8.13 <sup>x0</sup>	6.16 <sup>0</sup>
	0.47	0.39	0.33	0.46	0.32

Notes. \*, +, x, 0 – statistical validity of differences between one and the same indices, but in terms of different body positions and time periods

Table 2 – Types of cardiorespiratory system reaction in the groups of athletes during bicycle ergometric load of 200 W power

<b>Type of reaction</b>	Indices		
	HR, beats/min	CSV, ml	RMV(respiratory minute volume), l
<b>Inotropic</b>	141.83±	147.53±	58.511.16
Chronotropic	169.34±	103.96±	63.04±
Respiratory	149.42±	112.11±	78.71±
Chronotropic - respiratory (HR – RMV)	173.62±	111.88±	84.35±
Inotropic - respiratory (CSV – RMV)	146.74±	144.75±	86.83±

Table 3 – Types of cardiorespiratory system reaction in groups of athletes during bicycle ergometric load of 3 W/kg power

Type of reaction	Indices		
	HR, beats/min	CSV, ml	RMV, l/min
Inotropic	146.34±4.15	135.29±3.93	60.37±2.06
Respiratory	157.89±5.61	119.55±3.27	85.63±3.17
Chronotropic - respiratory (HR – RMV)	171.46 ±	107.67 ±	84.60 ±
Chronotropic - inotropic - respiratory (HR – CSV – RMV)	184.09 ±	149.70 5.02 CV = 7.51 %	95.76 2.48 CV = 5.81 %

### CONCLUSION

The held research showed that during an active body position change, which we define as minimal physical load, the whole complex of cardiorespiratory system indices takes part in compensatory-adaptive reactions of athletes' organism and the leading factor can't be defined among them. That is why the importance of the offered physical load is leveled by the received research results. They prove low importance of this load. The last two loads use for the peculiarities revelation in the activity of athletes' organism gains important scientific-practical meaning as an additional factor of control over athletes' functional state and the changes introduction into the regimen of the training lessons. During the functional state determination it is reasonable to take into account the testing loads of dynamic character. In this case their individual characteristics are revealed. They are connected with adaptive relations between the components of cardiorespiratory system and demonstrated in different variants of reaction. They depend on age-related peculiarities, kinds of sport and the power of the used physical loads. Thus, testing loads meaning revelation for their further use would provide correct educational-training process organization.

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## The effect of the combined aerobic and power training in the patients with chronic heart disease

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**Abstract:** Cardiovascular rehabilitation is generally adopted component of a complex treatment for patients with cardiovascular diseases. It improves physical fitness, improves the quality of life and decreases death rate from cardiovascular diseases. **Materials.** The effectiveness of combined trainings (aerobic and power) estimation according to the indices of physical readiness and muscle power among the patients with chronic heart disease (CHD). In general 32 patients were examined before and after 12 weeks of aerobics lessons together with 3 weeks of power training (with weight) (3 times a week). One training lesson lasted 60 minutes (10 minutes of warming-up phase, 25 minutes of aerobic load at ergometer, 15 minutes of training). **Research methods.** Information sources analysis and summarizing, testing, rehabilitation training, monitoring, methods of mathematical statistics. **Results.** The results of our research showed that 12 weeks of cardiovascular rehabilitation combined training provided statistically valid increase of throughflow capacity of oxygen-transportation system, physical working capacity increase, skeletal muscles strength and the quality of life improvement in the patients with chronic heart disease. **Conclusion.** We can suppose that a positive effect from such training lessons can be only in case if the patient regularly fulfills power and aerobic exercises. If regular exercises don't correspond with created by us program of cardiovascular rehabilitation, the values of aerobic capacity and physical working capacity, muscle power return to the initial level.

**Keywords:** chronic heart disease (CHD), cardiovascular rehabilitation, aerobic and power trainings, ergometer, power training with weight lifting, relaxation phase.

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### INTRODUCTION

Cardiovascular rehabilitation is generally adopted component of a complex treatment for patients with cardiovascular diseases [13]. It improves physical fitness, improves the quality of life [14] and decreases death rate from cardiovascular diseases. Dynamic exercises, directed toward aerobic endurance (walking, riding a bicycle, recreational running, swimming and others) form the base of cardiovascular system rehabilitation program [5;6;7;11]. If we speak about cardiovascular safety of power training (the trainings with weight use), as it was underlined in some research works

[4,13,8,15,16], they are safe part of cardiovascular rehabilitation.

The aim of the research work is to create and test an effective program of cardiovascular rehabilitation in men with chronic heart disease using aerobic and power exercises.

### RESEARCH METHODS

32 men at the age of 63,0±10 years with CHD were examined. The indices of the left ventricular ejection fraction (LVEF) among them were in the average 42 ± 8%. All patients went through coronary angiography. They took part in



the experiment (12-weeks) connected with studying the effectiveness of created by us cardiovascular rehabilitation program. During the experiment the patients didn't take pharmacological treatment with beta-adrenergic blocking agents, ACE inhibitors and statins. All patients went through the course of rehabilitation training and finished successfully the whole rehabilitation program. The research was approved by local Ethical Committee. All patients gave written informed consent.

Before and after the rehabilitation training patients had ECG monitoring at rest, in a lying position and on back with further three minutes adaptation of sitting at ergometer. The load increased each 2 minutes for 20 W till the symptoms of the restricted (limited) maximum. They were revealed using spiroergometry.

The anaerobic threshold was determined according to the changes of ventilation-respiratory parameters. Physical load, heart rate and RPE values for the training lessons corresponded with anaerobic threshold (AnT). Before the beginning of the training with the weight (the third week of rehabilitation training) with the patients we organized isometric test, in order to define the influence of isometric load on the level of blood pressure. In case of normal value of blood pressure the test was fulfilled – a single maximum (1-RM) for all exercises with the weight. The test was repeated on the 6<sup>th</sup> and the 12<sup>th</sup> weeks of the rehabilitation training program.

The rehabilitation training program was realized during 12 weeks. The training lessons lasted 60 minutes and were held 3 times a week.

During the first and the second weeks the training lessons of aerobic orientation were held. They included warming-up (10 min.), aerobic exercises (40 min.) and relaxation exercises (10 min.).

During further 10 weeks combined lessons were held. They included warming-up (10 min.), aerobic (25 min.) and power (15 min.) physical exercises and relaxation exercises (10 min.).

The aim of warming-up was to prepare cardiovascular-system and locomotor apparatus to the training load and prevent osteoarticular and muscle systems injuries. Warming-up included

the complex of exercises for dynamic endurance (generally developing exercises and gymnastic exercises at special training simulators) and flexibility development (stretching exercises).

Aerobic phase of the training lessons was held at a bicycle ergometer (Ergoline REHA E900), controlled by ErgoSoft + for Windows program. The intensity of aerobic trainings was defined at the level of anaerobic threshold (AnT).

Power oriented part of the trainings was held using multifunctional power training simulators TK-HC COMPACT. The patients fulfilled four power oriented exercises from lying and sitting positions: bench press, sitting chin-up, legs extension and bending.

The intensity of the fulfilled exercises was estimated with the help of methodical technique of 1-RM value measurement; the training load was calculated in percentage of maximum: 30-60% for 1-RM, and every week there was 10% increase. In terms of one training lesson each exercise was fulfilled in three series with 5 repetitions. Before the power oriented trainings all patients studied the demands claimed on correct correspondence between respiration and the phases of power oriented exercises fulfillment.

Heart rate, blood pressure indices, ECG were controlled during the whole training. ECG was stated both during aerobic phase and 1-RM test.

## **RESULTS AND DISCUSSION**

Rehabilitation program led to statistically valid throughflow capacity increase of oxygen-transfer systems, physical working capacity increase, muscle power increase (table 1).

Isometric stress-test use during diagnostics among the patients with heart diseases was earlier considered not reasonable. Nevertheless, the elements of isometric muscle tension are the part of everyday activity even among this kind of patients.

Static power oriented loads very often lead to blood pressure increase in comparison with aerobic training. It can cause after effects, including ischemia, serious rhythm violations and unfavorable influences on left ventricle remodeling after acute myocardial infarction.

Table 1 – Aerobic load indices, working characteristics and maximum load in 1-RM test before and after the rehabilitation training

Parameters of physical working capacity and power qualities	Before the training	After the training	P
VO <sub>2sl</sub> [ml/min]	1536± 245	1768± 421	<0,01
VO <sub>2sl</sub> /kg[ml/min]	17,4± 2,8	20,9± 4,7	<0,01
Wsl[W]	95,0± 19,0	120,0± 33,0	<0,01
Wsl/kg[W/kg]	1,0± 0,21	1,3± 0,37	<0,01
Bench press[kg]	35,0± 9,0	42,0± 8,0	<0,01
Sitting chin-up[kg]	36,0± 8,0	44,0± 6,0	<0,01
Knee joint extension [kg]	33,0 ± 8,0	42,0 ± 8,0	<0,01

Notes: VO<sub>2sl</sub> – symptoms of the limited oxygen consumption, Wsl – symptoms of limited productivity, p – statistical significance

Earlier held research works showed positive influence of static load on cardiovascular system functional abilities development. Since 1990-s training with weigh (or power oriented training) was the part of rehabilitation traditional programs among patients with heart diseases. This form of training has less ischemic aftereffects, than aerobic trainings (including stress-tests).

As a possible reason for this is considered a low frequency of heart rate, which together with diastolic pressure leads to myocardial perfusion improvement.

An important role of power oriented trainings is muscle power increase. It leads to working capacity and endurance increase in terms of sub-maximum loads. We also have the results. They prove positive influence of the trainings with weight on tolerance to glucose and sensitivity to insulin.

The results of our research also prove positive influence of power oriented exercises together with aerobic exercises on health and functional state of patients with CHD.

Sporoergometric study, held in terms of created by us program of cardiovascular rehabilitation, is a necessary and important diagnostic event: the received during the test results show the amount of used by organism oxygen and have high predicting power for the patients with

CHD and cardiac decompensation [10].

In the end of 1980-s K. Weber offered his own classification for the degree of functional state estimation in the patients with CHD depending on peak oxygen consumption indices (table 2) [16]. For decades this classification was the only one classification, based on peak oxygen consumption indices, for the patients' state determination and to decide whether heart transplantation is necessary or not [1; 2; 3]. Later this classification was added, however, it was based on the indices offered by K. Weber [3].

Maximum aerobic load indices less than 10 ml prove hard heart injury with unfavorable results. Patients with oxygen consumption more than 20 ml belong to the group of people with low or zero functional disability.

Some research works prove positive influence of power oriented load safety for the patients with left ventricle disorder [12;7]. The authors of these research works didn't reveal any complications during power oriented exercises fulfillment.

None of our patients had clinical indices characteristics of ischemia. The results of a continuous monitoring also didn't reveal serious heart rate violations during cardiovascular rehabilitation program realization. Training lessons

with weight didn't have negative effects and the patients were tolerant.

We can suppose that the training lessons with weight of low and moderate intensity are safe and provide power increase of great muscles groups. Power oriented exercises fulfillment leads to symptoms of limited oxygen consumption increase.

After 12 weeks of cardiovascular rehabilitation we revealed not only considerable muscles power increase. Owing to the combination of aerobic

and power exercises aerobic working capacity and patients' tolerance to physical load also increased.

Thus, power oriented exercises combination with aerobic load at the level of anaerobic threshold in terms of combined training lessons is safe and physiologically effective for the patients with cardiac decompensation with the indices of oxygen consumption during the peak of the limited maximal symptoms more than 20 ml.

Table 2 – Cardiac decompensation classification according to K. Weber [3]

Class	Peak, ml/kg/min	Anaerobic threshold, mlO <sub>2</sub> /kg/min	Functional status
A	> 20	> 14	Good
B	16–20	11–14	Satisfactory
C	10–15	8–11	Moderate injury
D	< 10	< 8	Hard injury

### CONCLUSION

1. The results of our research showed that 12 weeks of the combined training program of cardiovascular rehabilitation provided statistically valid through flow capacity increase of oxygen-transfer systems, working capacity increase, skeletal muscles strength and quality of life improvement in the patients with CHD.

2. We can suppose that a positive effect from such trainings preserves only if a patient continues going in for regular power oriented and aerobic exercises. If regular exercises don't correspond with the created by us program of cardiovascular rehabilitation, the values of aerobic capacity and physical working capacity, muscle power become initial, as they were before the trainings.

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## **Control over the training process on the basis of athletes' organism functional state analysis**

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**Abstract:** Functional state is a special state of an organism. It provides correspondence with the demands of different kinds of sport, including cyclic kinds of sport. We consider the functional state as a difficult system reaction, dynamically changing during activity. It is estimated according to the results of labor and professional activity. **Materials.** The indices of cardiorespiratory system study and these results use for the athletes' functional state control. **Research methods.** Scientific literature analysis and summarizing, methods of mathematical statistics, tetrapolar chest rheography method by Kubicek (1970) in modification of Yu.S. Vanyushin (2011); the indices of external respiration (FR(frequency of respiration), RV(respiration volume), MVR(minute volume of respiration)) were defined by pneumotography; the indices of gas exchange were defined with the help of gas analyzers of oxygen and carbon dioxide. The coefficient of oxygen use (COU<sub>2</sub>) and arterial-venous difference according to oxygen (AVDO<sub>2</sub>) were calculated. **Results.** According to the research results functional state of an organism adaptation and change happens mainly in the subsystems. They take an active part in motor actions fulfillment by a person. The most developed are the following mechanisms, connected with MVB and COU<sub>2</sub> indices increase. **Conclusion.** The revealed age-related characteristics of oxygen provision help to use physical loads during the training process and solve the problems concerning endurance development in different periods of postnatal ontogenesis. **Keywords:** functional state, cardiorespiratory system, bicycle ergometer, ontogenesis, training process.

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### **INTRODUCTION**

Functional state is a special state of an organism. It provides correspondence with the demands of different kinds of sport, including cyclic kinds of sport. We consider the functional state as a difficult system reaction, dynamically changing during activity. It is estimated according to the results of labor and professional activity [1]. The results decrease in these kinds of activity is the sign of the functional state disorder. Each functional state is demonstrated as a unique combination of different indices and organism reactions. The notion "functional state" is closely connected with the notion "functional system". Cardiorespiratory system belongs to functional system. This system belongs to individual functional systems and its function is to provide oxygen. [5]. It influences sports results and health state of those, who train.

It is the indicator of the whole functional state of an organism. It is important to study cardiorespiratory system in order to estimate athletes' functional state, especially in athletes, who go in for the kinds of sport directed toward endurance development.

The aim of the research work is to study cardiorespiratory system indices with the help of noninvasive research methods and control functional state of athletes on the basis of these indices.

### **RESEARCH METHODS**

Methodical techniques choice and the volume of the research work were conditioned by the aim of this research work. The research work was held in the laboratory of functional diagnostics of "Physical upbringing" department at Kazan State Agrarian University. 15-16 year-old teen-agers and



adults-athletes (36-60 years old) took part in the research work.

The indices of the central hemodynamics (HR, SV(stroke volume), MVB) were determined by tetrapolar chest rheography according to Kubicek (1970) in modification of Yu.S. Vanyushin (2011). The indices of external respiration (FR(frequency of respiration), RV(respiration volume), MVR(minute volume of respiration)) were defined by pneumotography. The indices of gas exchange were defined with the help of gas analyzers of oxygen and carbon dioxide. The coefficient of oxygen use ( $COU_2$ ) and arterial-venous difference according to oxygen ( $AVDO_2$ ) were calculated.

### **RESULTS AND DISCUSSION**

The way of sports results improvement in kinds of sport, connected with endurance development, is functional and reserve capacities of cardiorespiratory system widening. [3]. In this case the most reasonable mechanism of oxygen provision is cardiac output increase. However, the results of our research works prove MVB (minute volume of blood) growth decrease during the transfer from one load to another. It is achieved by not efficient way, owing to HR (heart rate) increase in terms of insignificant increase of impact output. [2, 4] That is why we can come to the conclusion that there are other mechanisms, directed to oxygen consumption satisfaction during motor activity. These mechanisms include external respiration. It belongs to the factors, which limit the opportunity of achieving high sports results.

At the level of respiratory system the adaptation is characterized by maximal mobilization of external respiration. It is demonstrated by lung ventilation increase. [7-16]. The highest values of lung ventilation were registered in the groups of teen-agers (15-16 years old) and athletes at the age of 36-60. The mechanism connected with external respiration indices increase during the load of the increasing power fulfillment at bicycle ergometer in these groups, is a dominating one and physical working capacity is provided by significant cardiorespiratory system tension. In this case there are different ways of achieving maximum values of lung ventilation. In the group of teen-

agers it happens owing to the rate of respiration increase, in the group of adults it happens owing to respiration depth increase. This fact can be explained by age-related characteristics of organism development, as by the age of 16 the process of morphofunctional respiration system formation is finished. The training process should be directed toward respiration system potential development. It will provide aerobic productivity of an organism increase. It should be noted that the received by us results of lung ventilation are not the criterion of a high training level. In this case oxygen and energetic values of respiration increase. In these conditions the adaptation to physical loads is realized best of all by means of effectiveness increase of oxygen transport and utilization system. [8-10] It is proved by great blood circulation index and cardiac index in the group of teen-agers at the age of 15-16. In the group of adults (36-60 years old) in terms of the same oxygen consumption during the load of the increasing power fulfillment  $COU_2$  values increase.

### **CONCLUSION**

Thus, the process of functional state of an organism adaptation and change happens mainly in the subsystems, which take an active part in motor actions fulfillment by a person. [6] The most developed are the following mechanisms, connected with MVB and  $COU_2$  indices increase.

The revealed age-related characteristics of oxygen provision help to use purposefully physical loads during the training process and solve the problems concerning endurance development during different periods of postnatal ontogenesis

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## Functional interaction between cardiovascular and respiratory systems during testing loads

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**Abstract:** Modern scientific research works in the sphere of physiology are mostly oriented towards studying difficult signals. They are formed as a result of interaction between the indices of one functional system or between different physiological systems. Such interconnection leads to the processes, which form the base for varied physiological functions of an organism. It provides organism integrity, an effective adaptive reaction formation to external stimuli. They include physical load of dynamic and static character. One of such systems is cardiorespiratory system, the signals of which are formed as a result of interaction between varied elements of cardiovascular and respiratory systems. **Materials.** Functional interaction of cardiovascular and respiratory systems study during testing loads and dominating factors revelation during adaptation to these loads. **Research methods.** Information sources analysis and summarizing, volume and differential rheograms registration, electrocardiograms, external respiration and gas exchange indices determination during physical load of the increasing power at bicycle ergometer, methods of mathematical statistics. **Results.** The complex character of our research works provided compensatory reactions of cardiac output revelation during active body position change. As a result we revealed chronotropic, inotropic, vascular and respiratory compensatory reactions of cardiac output. One of the ways of sports results improvement, especially in the kinds of sport, connected with endurance development, is functional abilities of cardiorespiratory system broadening. It depends on the age of the athletes. **Conclusion.** The processes of adaptation and functional interaction change between cardiovascular and respiratory systems during testing loads depends on different physiological orientation of these loads. The revealed physiological peculiarities of oxygen provision help to solve the problems connected with motor qualities upbringing and development during educational-training process of athletes.

**Keywords:** adaptation, cardiorespiratory system, load, functional system, blood circulation, respiration.

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### INTRODUCTION

Abbreviations:

respiration rate – R.R., breathing apparatus – B.A., oxygen utilization – O.U., arterio – venous oxygen difference<sub>2</sub> – AVOD<sub>2</sub>, minute volume of respiration – MVR, maximum oxygen consumption – MOC.

Modern scientific research works in the sphere of physiology are mostly oriented towards studying difficult signals. They are formed as a result of interaction between the indices of one functional system or between different physiological systems

[1, 5, 10].

Such interconnection leads to the processes, which form the base for varied physiological functions of an organism. It provides organism integrity, an effective adaptive reaction formation to external stimuli. They include physical load of dynamic and static character.

One of such systems is cardiorespiratory system, the signals of which are formed as a result of interaction between varied elements of cardiovascular and respiratory systems. That is why cardiorespiratory system study in all its variants is

still an important problem of physiology, in spite of the fact that more than 50 years passed since the first work was published (E.D. Adrian et al, 1932). Cardiorespiratory system is the result of a long-term interaction between cardiovascular and respiratory systems [3, 7, 11, 12]. Central interactions of these systems are realized by an independent system of neurons. It reacts to the signals with the receptors of lungs retraction, vessels and heart. The main role of these neurons is in the objectives of respiration and blood circulation combination into one function. It provides constant functions of an organism support, in particular, gas exchange of the organism [2].

**The aim of the research** is to study functional interaction between cardiovascular and respiratory systems during testing loads of different physiological orientation and power and also dominant factors revelation during adaptation to these loads.

#### **RESEARCH METHODS**

The research work was held in the laboratory of "Physical Education" department functional diagnostics at Kazan State Agrarian University. 105 male respondents took part in the research (18-35 years-old). We simultaneously registered volume and differential rheograms, electrocardiograms, defined the indices of external respiration and gas exchange during physical load of the increasing power at bicycle ergometer.

#### **RESULTS AND DISCUSSION**

One of the important parameters, which provides oxygen, is maximum oxygen consumption (MOC). It is considered that the need of the tissues for oxygen is the main factor. It controls and regulates the volume of cardiac output. In physiology there is a well-known fact of MOC decrease during an active transfer of the respondents from the lying position to standing one. In this case heart rate and peripheral resistance of vessels reflexly increase. However, not often they are able to compensate considerable changes in impact blowout.

Respiratory system also takes part in MOC compensation during transfer of the respondents from the lying position to standing and sitting position. This is proved by the increase of minute

volume of respiration (MVR) and the depth of respiration. They increase in sitting and standing position. Moreover, the conditions are created for the increased oxygen use by the tissues of the organism. This is also proved by the values of arterio-venous oxygen difference<sup>2</sup> (AVOD<sup>2</sup>) which increased in sitting and standing position in comparison with horizontal body position. Such kind of shift in gas exchange is a compensatory reaction during cardiac output decrease.

The complex character of our research works provided compensatory reactions of cardiac output revelation during an active body position change. As a result we defined chronotropic, inotropic, vascular and respiratory compensatory reactions of cardiac output.

In accordance with modern notions, oxygen provision in an organism is realized by the degree of oxygen regulation system development and an optimal interaction between different parts of this system. It includes external respiration, blood circulation and gas exchange. That is why one of the ways to increase sports results, especially in kinds of sport, connected with endurance development, is functional abilities of cardiorespiratory system broadening. This, as our results showed, depends on the age of those, who train.

The most effective mechanism in providing oxygen is considered to be cardiac output increase. However, the results, received by us [4, 8, 9], prove MOC decrease during the transfer from one load to another. In this connection we can suppose that there are other mechanisms. They are directed toward oxygen needs satisfaction of an organism during muscle activity. One of them is external respiration. It is considered by some scientists [6] the factor, which limits the ability to achieve high sports results.

At the level of respiration system adaptation is characterized by maximal mobilization of external respiration. It is demonstrated by the increase of lung ventilation, as a result of respiration depth and frequency increase. The greatest values of lung ventilation we registered in the groups of 15-16 year-old teen-agers and adults athletes at the age of 36-60 (table 1). It is obvious that the mechanism, connected with external respiration increase during

the load fulfillment at bicycle ergometer in these groups is the leading one and physical working capacity is provided by considerable tension of cardiorespiratory system. In the group of teen-agers it happens owing to respiration frequency increase. This factor can be explained from the point of view of age-related characteristics of an organism

development, as by the age of 16 morpho-functional formation of respiration system finishes and the training process orientation should be directed toward respiration system potential development. It would provide organism aerobic productivity increase.

Table 1 – The indices of external respiration in the groups of teen-agers (1), young men (2) and adults athletes (3,4) during the increasing power load

Load	Indices	Groups of athletes			
		1	2	3	4
Initial state	R.R, res/min	18,09±1,28	17,04±0,59	15,12±0,48	13,75±0,68 <sup>vx</sup>
	B.A., ml	0,56±0,05	0,61±0,03	0,64±0,04	0,76±0,04 <sup>vx</sup>
	MVR, l/min	9,73±0,81	10,24±0,40	9,59±0,61	10,15±0,47
50 W	R.R., res/min	22,81±1,82	20,80±0,86	19,04±0,82	19,42±0,51
	B.A, ml	1,17±0,08	1,12±0,04	1,24±0,04	1,41±0,05 <sup>vx</sup>
	MVR, l/min	25,76±1,74	22,85±0,87	23,41±1,00	27,25±1,01 <sup>x</sup>
100 W	R.R., res/min	26,09±2,02	22,35±0,99	20,02±0,75 <sup>*</sup>	19,04±1,17 <sup>vx</sup>
	B.A., ml	1,58±0,09	1,56±0,06	1,67±0,05	1,93±0,07 <sup>vx</sup>
	MVR, l/min	40,35±3,04	33,11±1,27 <sup>+</sup>	33,50±1,44 <sup>*</sup>	37,87±0,89 <sup>x</sup>
150 W	R.R., res/min	30,19±1,78	25,00±0,94 <sup>+</sup>	21,47±1,00 <sup>*o</sup>	23,83±0,89 <sup>v</sup>
	B.A., ml	1,83±0,10	1,88±0,07	2,20±0,08 <sup>*o</sup>	2,42±0,11 <sup>vx</sup>
	MVR, l/min	54,15±3,21	45,96±1,28 <sup>+</sup>	46,49±1,60 <sup>*</sup>	56,55±2,15 <sup>x</sup>
200 W	R.R., res/min	33,00±2,28	27,46±0,85 <sup>+</sup>	24,35±1,13 <sup>*o</sup>	27,78±1,08 <sup>v</sup>
	B.A., ml	2,13±0,11	2,20±0,07	2,49±0,09 <sup>*o</sup>	2,77±0,12 <sup>vx</sup>
	MVR, l/min	68,57±3,84	59,34±1,48 <sup>+</sup>	59,55±1,79 <sup>*</sup>	75,65±3,26 <sup>x</sup>

Notes:

- + - statistical validity of differences between groups 1 and 2
- \* - statistical validity of differences between groups 1 and 3
- v - statistical validity of differences between groups 1 and 4
- o - statistical validity of differences between groups 2 and 3
- x - statistical validity of differences between groups 2 and 4
- - statistical validity of differences between groups 3 and 4



It should be mentioned that received by us results of lung ventilation don't form the criterion of sufficiently high training level. In this case oxygen and energetic value of respiration increases. In these conditions adaptation to physical loads is better realized by means of effectiveness increase of oxygen transportation and utilization system. It is proved by validly high values of blood circulation index and cardiac index in the group of boys at the age of 17-21 (table 2). Moreover, the values of oxygen utilization<sup>2</sup> (OU<sub>2</sub>) also increase in the group of adults athletes at the age of 22-35 in terms of the same oxygen consumption during the load of the increasing power fulfillment. Thus, with the mass of mitochondria increase in skeletal muscles considerable aerobic power of an organism increase is achieved and the ability of the respiration center to support excitation increases.

### CONCLUSION

Thus, the processes of adaptation and functional interaction change between cardiovascular and respiratory systems during testing loads depends on different physiological orientation of these loads. The revealed physiological peculiarities of oxygen provision help to solve the problems connected with motor qualities upbringing and development during educational-training process of athletes.

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Table 2 – Changes of blood circulation index (BI, ml/kg), cardiac index (CI, ml/min/m<sup>2</sup>), gas exchange (O.U.<sub>2</sub> ml/l) in the groups of teen-agers (1), young men (2) and adults athletes (3, 4) during the increasing power load

Load	Indices	Groups of athletes			
		1	2	3	4
Initial state	BI, ml/kg	90,15±7,32	74,50±3,42	72,97±2,38*	75,36±4,59
	CI, ml/min/m <sup>2</sup>	3,01±0,22	2,78±0,13	2,78±0,09	2,84±0,15
	O.U. <sub>2</sub> ml/l;	21,36±1,98	22,73±0,82	23,71±1,15	22,44±0,61
	BI, ml/kg	159,78±12,37	148,08±7,97	137,69±6,15	128,78±7,48 <sup>v</sup>
50 W	CI, ml/min/m <sup>2</sup>	5,34±0,38	5,41±0,29	5,24±0,23	4,86±0,26
	O.U. <sub>2</sub> ml/l;	28,52±1,86	34,30±1,37	34,76±1,03	32,35±0,81
	BI, ml/kg	197,93±11,98	203,80±5,72	187,87±7,01	176,66±6,91 <sup>x</sup>
100 W	CI, ml/min/m <sup>2</sup>	6,63±0,34	7,45±0,21	7,14±0,24	6,68±0,23
	O.U. <sub>2</sub> ml/l;	33,39±2,02	39,45±1,43 <sup>+</sup>	39,85±1,30*	38,18±0,93 <sup>v</sup>
	BI, ml/kg	231,03±13,82	260,05±7,90	243,38±10,67	233,48±6,16 <sup>x</sup>
150 W	CI, ml/min/m <sup>2</sup>	7,76±0,42	9,49±0,26 <sup>+</sup>	9,24±0,35*	8,85±0,22 <sup>v</sup>
	O.U. <sub>2</sub> ml/l;	36,35±2,56	43,31±1,28 <sup>+</sup>	43,36±1,20*	39,89±1,03 <sup>x</sup>
	BI ml/kg	234,69±17,83	312,48±7,19 <sup>+</sup>	278,17±9,81 <sup>o</sup>	267,95±7,12 <sup>x</sup>
200 W	CI, ml/min/m <sup>2</sup>	7,96±0,58	11,42±0,25 <sup>+</sup>	10,58±0,33 <sup>o</sup>	10,18±0,28 <sup>vx</sup>
	O.U. <sub>2</sub> ml/l;	40,82±1,64	44,30±1,00	47,64±1,17 <sup>o</sup>	40,37±1,21 <sup>x</sup>

Notes:

- + - statistical validity of differences between groups 1 and 2
- \* - statistical validity of differences between groups 1 and 3
- v - statistical validity of differences between groups 1 and 4
- o - statistical validity of differences between groups 2 and 3
- x - statistical validity of differences between groups 2 and 4
- - statistical validity of differences between groups 3 and 4

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## Dynamics of indices of reserve and functional abilities of the 1<sup>st</sup>-3<sup>rd</sup> course students' organism at Izhevsk State Agricultural Academy

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**Abstract.** Nowadays scientists still search for the ways of physical training optimization among students of higher educational establishments. Among them we define: the use of elements of different kinds of sport, exercises with dumb-bells, interval and circular training, active games. It is a well-known fact that the base of physical training is physical qualities development, among which one of the most important one for students are different kinds of endurance, quickness and power oriented qualities. These qualities development is possible only in terms of influence on their physiological basis and in particular on the mechanisms of muscle activity energy supply. **Materials.** Studying the dynamics of the 1<sup>st</sup>-3<sup>rd</sup> course students' organism reserve and functional abilities indices at Izhevsk State Agricultural Academy. **Research Methods.** Information sources analysis and summarizing, method of express-diagnostics of the functional state and reserve abilities of an organism «D&K Test». The method of express-diagnostics of the functional state and reserve abilities of an organism «D&K Test» helps to estimate indirectly not only propensity for aerobic or anaerobic work (the prevalence of slow or quick fibers). It helps to also estimate power oriented characteristics of alactate-anaerobic, lactate-anaerobic and aerobic systems of energy supply for an effective use at physical culture lessons.

**Keywords:** physical qualities, reserve and functional abilities of an organism, students.

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### INTRODUCTION

Nowadays scientists still search for the ways of physical training optimization among students of higher educational establishments. Among them we define: the use of different kinds of sport elements, exercises with dumb-bells, interval and circular training, active games. It is a well-known fact that the base of physical training is physical qualities development. One of the most important for students are different kinds of endurance, quickness and power oriented qualities. These qualities development is possible only in terms of influence on their physiological basis and in particular on the mechanisms of muscle activity energy supply.

In most works, which are dedicated to students' physical training, there is no sufficient

information. It characterizes the peculiarities of muscle activity energy supply and their use for physical training process differentiation.

### MATERIALS AND METHODS

The students of the 1<sup>st</sup>-3<sup>rd</sup> course (girls and boys) from three medical groups (main, preparatory, special) took part in the research – 175 female and 175 male students from Izhevsk State Agricultural Academy in Izhevsk, Russia. As the initial results we took the reserve and functional abilities of the 1<sup>st</sup> course students.

The method of express diagnostics of the functional state and reserve abilities of an organism [4,5,6,7] was used in order to define the students' bioenergetics types [8-12]. The program analyzed

the height of R and S waves of electrocardiogram. It was taken in standard and group leads. As a result the indices are calculated, which characterize power, capacity, efficiency of anaerobic and aerobic systems of muscle activity energy supply:

1. ANAMC – capacity of anaerobic energy supply source, characterizes the ability to fulfill the load in the 3<sup>rd</sup>, 4<sup>th</sup> and the 5<sup>th</sup> zones of intensity.

2. ANAMC% – capacity of anaerobic utilization, characterizes propensity for anaerobic work in percentage.

3. AMC – capacity of aerobic source of energy supply, characterizes the ability to fulfill the load in the 1<sup>st</sup> and the 2<sup>nd</sup> zones of intensity.

4. AMC% – capacity of aerobic utilization, characterizes propensity for aerobic work in percentage.

5. GMC – general metabolic capacity, characterizes general working capacity of an organism.

6. PCP – power of creatine phosphate source of energy supply, characterizes speed-power oriented abilities.

7. PGS – power of glycolytic source of energy supply, characterizes speed and power oriented endurance.

8. PASES – power of aerobic source of energy supply, characterizes the ability to demonstrate general endurance and to realize rehabilitation after anaerobic work.

9. WTANM – threshold of anaerobic metabolism, characterizes the effectiveness of aerobic source of energy supply use.

## **RESULTS AND DISCUSSION**

During the research we received positive results, presented by pictures 1-11. Let's consider the analysis according to the separate indices. Anaerobic metabolic capacity is the index. It characterizes the ability to fulfill the load in the 3<sup>rd</sup>, 4<sup>th</sup> and the 5<sup>th</sup> zones of intensity. Picture 1 presents the indices of anaerobic abilities increase among girls and boys. Among the girls of the 2<sup>nd</sup> course anaerobic abilities increased in the main group by 34,8%, at the 3<sup>rd</sup> course we revealed the indices decrease by 1,8%.

In the preparatory group we also revealed the indices increase: in the girls from the 2<sup>nd</sup> course by 14,8%, in the girls from the 3<sup>rd</sup> course by 31% (in terms of the 1<sup>st</sup> course). In a special medical group in the girls of the 2<sup>nd</sup> course anaerobic abilities

decrease, but insignificantly, by 0,5%. In the girls of the 3<sup>rd</sup> course the indices increase till 4,5%. Anaerobic metabolic capacity (anaerobic abilities) (c.u.) in boys of the main group decreases by 11,3% by the 2<sup>nd</sup> course, at the 3<sup>rd</sup> course in comparison with the 1<sup>st</sup> course it decreases by 9,5%. In the boys of the preparatory group there is anaerobic abilities increase by 11,4% at the 2<sup>nd</sup> course, at the 3<sup>rd</sup> course by 20,2%. In the boys from the special group this index decreases by 1,79% at the 2<sup>nd</sup> course, at the 3<sup>rd</sup> course by 3,96% .

The capacity of anaerobic utilization (anaerobic genotype) characterizes propensity for anaerobic work. In the girls from the medical groups there is the indices increase, both at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses. The greatest index was revealed in the girls of the main group at the 2<sup>nd</sup> course (28,8%), preparatory group – 1,5%, special – 28,2%. By the 3<sup>rd</sup> course the propensity for anaerobic work in girls decreases in the main group till 9,1%, in special group – till 22,8%. In the preparatory group it insignificantly increases by 3%.

The index of anaerobic utilization capacity in boys from the main group at the second course decreases by 7,38%, in the boys from the 3<sup>rd</sup> course by 15,6%. In the boys from the preparatory group at the 2<sup>nd</sup> course it decreases by 23,2%, in the boys from the 3<sup>rd</sup> course it decreases by 12,3%. In the special group in boys of the 2<sup>nd</sup> and the 3<sup>rd</sup> course this index decreases by 8%.

Results of aerobic metabolic capacity indices increase in girls and boys. This index characterizes the ability to fulfill the load in the 1<sup>st</sup> and the 2<sup>nd</sup> zones of intensity. In the girls from the main and the special medical groups this index increases at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses.

In the main medical group the index of aerobic abilities in girls increases by 4,9% at the 2<sup>nd</sup> course, by the 3<sup>rd</sup> course – by 26,7% in terms of the 1<sup>st</sup> course.

Among the girls from the special medical group this index increases by 23% at the 2<sup>nd</sup> course and by 10,6% at the 3<sup>rd</sup> course. In the preparatory medical group this index increases by the 2<sup>nd</sup> course by 0,5% and decreases by the 3<sup>rd</sup> course by 6,5%.

Aerobic metabolic capacity (aerobic abilities) in the boys from the main medical group at the 2<sup>nd</sup> course increases by 4,5%, in the 3<sup>rd</sup> course boys it decreases by 1% in comparison with the indices of the boys at the 1<sup>st</sup> course, in the boys from



the preparatory group at the 2<sup>nd</sup> course this index decreases by 3%, in the boys at the 3<sup>rd</sup> course it decreases by 1,6%. In special group in the boys at the 2<sup>nd</sup> course the index of aerobic abilities decreases by 0,17%, in boys at the 3<sup>rd</sup> course this index increases by 3,13%.

The capacity of aerobic utilization (aerobic genotype) characterizes propensity for aerobic work. This index in girls of the main medical group increases at the 3<sup>rd</sup> course by 2,4%, in girls of the special group at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses by 10,7% and 17,3%. At the 2<sup>nd</sup> course in the girls of the main medical group this index decreases by 8,6%, in the girls of the preparatory group it decreases by 4,9%, in the girls at the 3<sup>rd</sup> course by 1,1%.

The indices of capacity of aerobic utilization in the boys of the 2<sup>nd</sup> course of the main medical group increases by 3,7%, in the boys at the 3<sup>rd</sup> course increases by 10%. In the preparatory group in the boys of the 2<sup>nd</sup> course this index decreases by 6,1%, in the boys of the 3<sup>rd</sup> course it decreases by 4,2%. In the special group in the boys of the 2<sup>nd</sup> and the 3<sup>rd</sup> courses the index of aerobic genotype increases by 6,8% and 8,6%.

General metabolic capacity (the level of working capacity) (c.u.) characterizes general working capacity of an organism. During the results analysis in the girls this index increases in all medical groups. In the main medical group at the second course it increases by 10,8%; by the 3<sup>rd</sup> course –17,7%; in the preparatory group at the 2<sup>nd</sup> course –24,9%; at the 3<sup>rd</sup> course –21,1%; in the special medical group at the 2<sup>nd</sup> course –18,9% at the 3<sup>rd</sup> course –3,1%.

The index of working capacity index in the boys at the 2<sup>nd</sup> course in the main group decrease by 4,5%, in the boys from the 3<sup>rd</sup> course decrease by 9% in comparison with the results of the 1<sup>st</sup> course students. In the boys of the preparatory medical group this index decreases by 1%, in the boys of the 3<sup>rd</sup> course decreases by 0,94%. In the boys of the special group at the 2<sup>nd</sup> course the index of working capacity level decreases by 2,2%, in the boys of the 3<sup>rd</sup> course increases by 0,36%.

Results of power endurance indices increase in girls and boys at Izhevsk State Agricultural Academy. Power endurance, or the power of creatine phosphate source of energy supply, characterizes the speed of power ability. In the girls power endurance decreases at the 2<sup>nd</sup> course by 18,9% (main medical

group); at the 3<sup>rd</sup> course by 22,2% (special medical group) in comparison with the power endurance of the girls at the 1<sup>st</sup> course. But there is the abilities increase in the preparatory group at the 3<sup>rd</sup> course 12,1%.

The indices of power endurance in boys of the main medical group increases by 18,2%, in the boys of the 3<sup>rd</sup> course – 11,5%. In the boys of the preparatory group at the 2<sup>nd</sup> course the index of power endurance decreases by 4,1%, in the boys of the 3<sup>rd</sup> course it increases by 11,7%. In the boys of the special group at the 2<sup>nd</sup> and the 3<sup>rd</sup> course this index decreases by 1,38% and 13,8%.

Power of glycolytic source of energy supply (speed endurance) (c.u.), characterizes speed and power oriented endurance. In girls the indices of speed endurance decrease at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses in all medical groups.

In the boys of the 2<sup>nd</sup> course at the main group the index of speed endurance increases by 5,4%, in the boys of the 3<sup>rd</sup> course –2,2%. In the boys of the 2<sup>nd</sup> course in the preparatory group this index increases by 14,1%, in the boys of the 3<sup>rd</sup> course – by 22,3%. In the special group this index decreases in students of the 2<sup>nd</sup> course by 2,3%, in the students of the 3<sup>rd</sup> course –8,76%.

Power of aerobic source of energy supply (maximum oxygen consumption) (ml./kg) characterizes the abilities to demonstrate general endurance and to realize rehabilitation after anaerobic work.

In the girls at the 3<sup>rd</sup> course in the main group the indices of MOC increase by 12,5%; in the girls in the preparatory group at the 2<sup>nd</sup> course MOC indices increase by 30,8%; in the girls of the 3<sup>rd</sup> course –6,6%; in the respondents from the special medical group at the 2<sup>nd</sup> course MOC increases by 9,9%; in the girls at the 3<sup>rd</sup> course –14,8%. Only at the 2<sup>nd</sup> course in the main medical course this index decreases insignificantly by 1,8%.

Power of aerobic source of energy supply (maximum oxygen consumption MOC) in the boys of the 2<sup>nd</sup> course in the main medical group decreases by 2,2%, in the boys of the 3<sup>rd</sup> course by 2,9%. In the boys of the 2<sup>nd</sup> course in the preparatory group it increases by 2,5%, in the boys of the 3<sup>rd</sup> course it decreases by 2,3%. In the boys of the special group at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses MOC index decreases by 2,6% and 1,4%.

Threshold of anaerobic metabolism

(efficiency, technicality, learning capability) (c.u.) characterizes the effectiveness of aerobic source of energy supply use. In the girls at the 2<sup>nd</sup> course in the main and special medical groups this index decreases by 1,1% and 1,8%, and in the preparatory medical group at the 3<sup>rd</sup> course – by 5,8%. This index increases in the main medical group at the 3<sup>rd</sup> course by 1,7%; in preparatory group at the 2<sup>nd</sup> course– by 10,9%; in special medical group at the 3<sup>rd</sup> course– by 8,3%.

Threshold of anaerobic metabolism (efficiency, technicality, learning capability) (c.u.) in boys in the main group at the 2<sup>nd</sup> course increases by 0,87%, in the boys of the 3<sup>rd</sup> course decreases by 2%. In the boys in the preparatory group at the 2<sup>nd</sup> course this index decreases by 1,68%, in the boys of the 3<sup>rd</sup> course – by 3,4%. In the boys of the special group at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses the index of threshold of anaerobic metabolism decreases by 2,1% and 0,5%.

Heart rate TANM (effectiveness criterion of aerobic source use) (HR/TANM) increases in the girls of the 3<sup>rd</sup> course in the main medical group by 2,1%, in preparatory group– by 4,4%; in special medical group – by 5,3%, in preparatory and special medical groups – by 15,6% and 4,6%. At the 2<sup>nd</sup> course in the girls in the main medical group this index decreases by 1,2% in comparison with the indices of the same medical group at the 1<sup>st</sup> course.

Heart rate at TANM in boys of the 2<sup>nd</sup> and the 3<sup>rd</sup> course of the main medical group decreases by 1,5%. In the boys of the preparatory group at the 2<sup>nd</sup> course this index increases by 2,7%, in the boys of the third course decreases by 1,1%. In the boys of the special group at the 2<sup>nd</sup> course decreases by 0,1%, in the boys of the 3<sup>rd</sup> course increases by 0,06%.

General energetic atmosphere (c.u.). This index among girls of the main medical group decreases at the 2<sup>nd</sup> course (4,6%) and insignificantly increases at the 3<sup>rd</sup> course (0,05%); in the preparatory and special groups the situation is opposite – at the 2<sup>nd</sup> course the index increases by 6,6% in preparatory medical group; by 3,3% in special medical group. By the 3<sup>rd</sup> course the index of general energetic atmosphere decreases in the preparatory group by 2,9%; in special medical group – by 0,2%.

General energetic atmosphere among boys of the 2<sup>nd</sup> course in the main medical group increases by 1,45%, in the boys of the 3<sup>rd</sup> course – by 0,45%. In the boys of the preparatory group at the 2<sup>nd</sup> course

it increases by 1,3%, in the boys of the 3<sup>rd</sup> course decreases by 1,5%. In the students of the special medical group at the 2<sup>nd</sup> course the index decreases by 2,7%, in the boys of the 3<sup>rd</sup> course increases by 0,05%.

## **CONCLUSION**

During the research we revealed the dynamics of reserve and functional abilities of the students' organism at Izhevsk State Agricultural Academy and the differences in the students' indices at the 2<sup>nd</sup> and the 3<sup>rd</sup> courses in comparison with the indices in girls and boys of the 1<sup>st</sup> course.

This research work analysis showed that the female students of the 2<sup>nd</sup> course, who belong to the main medical group, have the highest index of anaerobic, aerobic abilities and the capacity of anaerobic utilization (anaerobic genotype). The capacity of aerobic utilization (aerobic genotype) prevails among female students of the 3<sup>rd</sup> course in a special medical group. In the girls of the 2<sup>nd</sup> course in the preparatory group some indices are higher: the level of working capacity, maximum oxygen consumption, threshold of anaerobic metabolism, criterion of aerobic source use, general energetic atmosphere. Power of creatine phosphate source of energy supply (power endurance) is higher in the 3<sup>rd</sup> course female students in special medical group.

This analysis according to 9 indices among boys revealed that most boys of the main group at the 1<sup>st</sup>-3<sup>rd</sup> courses have higher values of the indices, that in the preparatory and special groups.

Boys of the 1<sup>st</sup> course in the main group have higher results, than boys of the 2<sup>nd</sup> and the 3<sup>rd</sup> course of the main group according to the following indices: anaerobic abilities, anaerobic genotype, the level of working capacity and HR TANM. In the following indices: aerobic abilities, power and speed endurance, general energetic atmosphere the values are higher among the students of the main group at the 2<sup>nd</sup> course. In the index of aerobic genotype we revealed high values among the students of the 3<sup>rd</sup> course in the main group.

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