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Original Article

The relationship between cognitive functions and indicators of physical condition in men aged 21-25 years of age

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Abstract

The article presents the results of the research of the cognitive functions of men. Altogether 32 men of 21-25 years of age were involved in the research. All of them are students of the Master's Degree course of the National University of Physical Education and Sport of Ukraine. All the men under study have a high level of motor activity with a predominantly cyclic structure of movements. To obtain an objective assessment of the researched topic, we used the following research methods: analysis of scientific and methodological literature, anthropometric methods, physiological methods, psychophysiological methods. Analysis of the average indicators of the morpho-functional state indicates that the men of 21-25 years of age do not have any deviations from the age standards, and the cardiovascular system works optimally. In men, there is a high level of development of the respiratory system. Analysis of the average results of cognitive functions indicates the high level of self-efficacy and psycho-emotional state, and the average level of development of short-term memory. Low average statistical results are observed only in indicators of attention span and number of mistakes. According to the purpose of the research, we established the structure of the relationship between morpho-functional parameters and the cognitive functions of men aged from 21 to 25 years of age. The presence of reliable correlation interrelationships is observed between the vital capacity of the lungs and the indices of the psychoemotional state, the correlation coefficients are in the range of $r = 0.715$ at $p < 0.001$ to $r = 1.000$ at $p < 0.001$; with indicators of short-term memory capacity (STMC) $r = 0.698$ at $p < 0.001$, and the volume of processed information (VPI) $r = 0.757$ at $p < 0.001$. High reliable direct and inverse relationships are observed between anthropometric data. In particular, body length and body weight with indicators of psycho-emotional state, the correlation coefficients are in the range of $r = 0.500$ with $p < 0.01$ to $r = 0.980$ at $p < 0.001$.

Keywords: cognitive functions, physical condition, men.

Introduction

In the modern education system, the issue of preserving the physical health of students is relevant (Ivashchenko, 2017; Gorshova, 2017; Yarmak, 2017). Information and exam stresses, poor nutrition, sedentary lifestyle, lack of work and rest schedule, bad habits, are risk factors for the students' health. (Kozhokar, 2018) Scientific researches have established that a high professional level requires both physical fitness and stable mental performance (Nakonechnyi, 2017).

The workloads related to the educational and everyday activities of students cause chronic mental fatigue (Andreeva, 2004). It is well known, that in the human body, where all elements are interconnected and interact with each other, everything is mostly under the control of the nervous system. Therefore, the mental state makes an impact on the functioning of the cardiovascular, respiratory and immune systems. One of the main indicators of the functional state of the mental sphere is mental performance. Its high level, one of the main indicators of mental health and the functional state of the body as a whole.

In modern conditions of training, the preparedness of young people for mental activity is of great importance. Regardless of the type, mental activity can be represented by the following structure involving mental functions: intellectual, emotional, personal, and motivational (Korobeynikov, 2006; Korobeynikov, 2011). The intellectual component unites human cognitive activity which, in its turn, consists of the main structural and functional factors: thinking, long-term and short-term memory, attention, perception and processing of information, sensorimotor impulses, and operational memory (Korobeynikov, 2012; 2017).

The relevance of our research is attributable to the fact that the cognitive functions of a person during life continue to improve, or vice versa, they experience negative changes. According to researches (Maillot, 2012; Guimarães, 2018), the intellectual abilities reach their maximum at the age of 25 years of age, but at the same

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time fatigue, memory impairment, and reduction of speed of visual-motor reaction gradually begin to manifest themselves. The deterioration of mental performance is an important sign of deterioration of mental health, and if there are still vegetative changes, this may indicate fatigue or overwork. So our research is aimed at determining the structure of the relationship of cognitive functions with indicators of the physical condition of the men aged 21-25 years of age.

Materials and Methods

In order to determine the indicators of the physical condition, anthropometric data were studied, in particular, body length (BL), body weight (BW), body mass index (BMI). The functional state of the cardiovascular system was investigated by indicators of heart rate at rest (HR_{rest}), systolic blood pressure (SBP) and diastolic blood pressure (DBP). The functional state of the respiratory system was determined by the indicator of vital capacity of the lungs (VC). The following methods were used to study the cognitive functions of men aged 21-25 years of age. To determine self-efficacy, the scale of Ralf Schwarzer and Matthias Jerusalem was used. To assess the function of division and refocusing of attention the test "Arrangement of numbers" was used. To determine the emotional state, we used the method of self-assessment of the emotional state of Wessman-Ricks. To determine the psychoemotional state, the method of "WAM" was used. This method is intended for the operational assessment of well-being, activity and mood. The results were processed using the methods of mathematical statistics.

Results

The study was conducted during September-October 2017. In our study, 32 men aged 21–25 years of age took part, who are systematically engaged in motor activity, predominantly with a cyclic pattern of movements. The average results of morpho-functional and psycho-physiological indicators are presented in table 1.

During the study of indicators of the physical development of the 21-25-year-old men, the average values of anthropometric indicators were obtained, the nature of the distribution of which was within the normal range.

It is known that physical activity has a positive effect on human functionality. This is especially reflected in a significant increase in the performance indicators of the cardiorespiratory system.

The average HR_{rest} result in the men aged 21-25 years of age is 58.7 beats min^{-1}. This feature indicates the optimization of the cardiovascular system.

Systolic blood pressure is one of the most informative functional parameters and it keenly reflects changes associated with the state of its regulatory links: peripheral vascular resistance, activity of the sympathetic division of the autonomic nervous system, vasomotor centre tone, heart force, minute blood volume. The value of blood pressure is commonly regarded as a homeostatic indicator, and therefore its deviation to one side or the other may indicate certain changes in the overall functional state of the body. In the course of our research, we found out that the average indicators corresponded to the norm.

Table 1. The average results of morpho-functional and psycho-physiological indicators of men aged 21-25 years of age (n = 32)

Indicators	$\bar{x}$	S	Me	25%	75%	Min.	Max.
Age, years	21.7	1.13	21.0	21.0	22.0	21.0	25.0
BL, cm	177.0	4.82	176.0	173.0	180.0	172.0	185.0
BW, kg	72.2	8.68	70.0	66.0	72.4	66.0	89.0
BMI, kg/m^{-2}	24.8	4.01	24.0	21.2	29.1	21.2	29.1
HR, beats $/min^{-1}$	58.7	5.89	58.0	54.0	62.0	52.0	68.0
SBP, mmHg.	119.2	6.65	120.0	115.0	120.0	110.0	130.0
DBP, mmHg	69.0	8.00	70.0	69.0	70.0	55.0	80.0
VC, l	6.4	0.88	6.7	5.8	7.0	5.2	7.1
STMC, %	47.8	22.38	41.7	33.3	58.3	16.6	100.0
VPI, bit	218.7	86.80	184.3	173.0	260.1	87.1	450.0
Self-efficacy, points	31.8	5.04	33.0	27.5	35.0	24.0	41.0
Well-being, points	5.0	2.04	6.2	3.4	6.3	2.3	6.9
Activity, points	4.9	1.31	5.2	4.6	5.8	2.8	6.1
Mood, points	5.3	1.64	5.6	4.0	6.7	3.2	6.9
Attention span, points	3.8	3.35	3.5	1.0	5.5	0.0	10.0
Number of mistakes	13.5	8.77	12.0	6.0	22.5	1.0	25.0
Calmness and anxiety, points	6.1	2.14	6.0	5.0	7.0	2.0	9.0
Vitality and fatigue, points	6.0	1.29	6.0	5.0	7.0	3.0	8.0
Elation and despondency, points	6.2	1.59	7.0	6.0	7.0	3.0	8.0
Self-confidence and helplessness, points	7.2	2.09	7.0	7.0	8.0	3.0	10.0

The vital capacity of the lungs is one of the main indicators of the state of the human respiratory system. This value depends on the biomechanical properties of the lungs and chest, as well as on gender, age, lifestyle. From literary sources it is known that the value of VC in athletes can vary between 5-8 litres.

The next stage of our research work was the study of the cognitive functions of young men. The actual formation of all cognitive functions of a person, including thinking, memory, attention, perception, ends in adolescence. But throughout the life of a person, improvement continues, or vice versa, the negative dynamics is observed.

The average result of the short-term memory capacity (STMC) in the 21-25-year-old men corresponds to the average level, while the volume of the processed information (VPI), on the contrary, corresponds to a low level.

It should be pointed out that the variability of these indicators is rather high. So the coefficients of variation of the values of the STMC and VPI range from 39.7 % to 46.8 %, which indicates the heterogeneity of the sample.

To assess self-efficacy, we used a technique that makes it possible to evaluate the potential ability to organize and carry out own activity necessary to achieve a specific goal. The self-efficacy is also understood as a productive process of integration of cognitive, social, and behavioural components for implementation of an optimal strategy in various situations. The average result obtained during our research indicates a high level of self-efficacy.

The next stage of our research work was the study of the emotional state, which consists of many factors, including well-being, activity and mood. Emotional state is an important factor affecting a person's vital activity, that is, it improves the tone and overall health, or, on the contrary, lowers it, and as a result, vitality decreases. The emotional state can make an impact on academic performance. The average indicators of well-being, activity and mood in the men under study testifies of a sufficient level.

To determine the emotional state, in particular, vitality and fatigue, calmness and anxiety, elation and despondency, self-confidence and helplessness, we used the methods of the American psychologists A. Wessman and D. Ricks. It is a fairly simple questionnaire for self-esteem of emotional states. The average results show a positive emotional state, above average.

In the research of the scope of attention, we used a technique designed to assess the function of division and refocusing of attention. During testing, the number of errors and missed numbers is calculated by the respondent himself. It should be pointed out that there were 2 minutes for the execution of this test. The average results of the attention span are low. Almost all men made about 50 % of mistakes. The coefficients of variation in the scope of attention and the number of mistakes are within the range from 65.0 % to 88.1 %, which testifies to the heterogeneity of the samples.

Based on the correlation analysis, we found out significantly high correlations between the morpho-functional parameters and the cognitive functions of men under study. The results are presented in table 2.

Table 2. Correlation relationships of cognitive functions and morpho-functional parameters in the men aged 21-25 years of age (n = 32).

Indicators	BL, cm	BW, kg	VC, l	HRrest, beats /min^{-1}	SBP, mmHg	DBP, mmHg
STMC, %	0.012	0.014	**0.757*****	0.175	-0.443*	**-0.885*****
VPI, bit	0.018	0.116	**0.698*****	0.362*	-0.201	**-0.734*****
Self-efficacy, points	**0.971*****	-0.500**	**0.963*****	-0.115	**-1.000*****	**-0.918*****
Well-being, points	**0.872*****	-0.251	**1.000*****	0.193	0.002	-0.501**
Activity, points	**0.636*****	0.115	**0.934*****	0.072	0.043	-0.036
Mood, points	**0.901*****	-0.311	**0.998*****	0.214	-0.073	**-0.642*****
Attention span, points	**0.971*****	0.500**	**0.963*****	-0.115	**-1.000*****	**-0.918*****
Number of mistakes	**0.980*****	0.538**	**-0.950*****	0.070	**0.932*****	**0.934*****
Calmness and anxiety, points	**0.908*****	-0.327	**0.997*****	-0.300	**-0.982*****	**-0.826*****
Vitality and fatigue, points	**0.839*****	-0.189	**0.998*****	-0.433*	**-0.944*****	**-0.737*****
Elation and despondency, points	0.277	0.500**	**0.715*****	**-0.917*****	-0.504**	-0.114
Self-confidence and helplessness, points	**0.971*****	-0.501**	**0.962*****	-0.115	**-1.000*****	**-0.923*****

Notes: n = 32; r = 0.349 at p <0.05; r = 0.449 at p <0.01; r = 0,554 at p <0,001

* - the correlation coefficient is statistically significant at the level of p <0.05;

** - the correlation coefficient is statistically significant at the level of p <0.01;

*** - the correlation coefficient is statistically significant at the level of p <0.001.

A significantly high correlation relationship at the level from r = 0.698 to r = 1.000 at p <0.001 is observed between the VC and cognitive functions of men. This fact indicates the existing dependence of both psycho-emotional state and intellectual abilities on the respiratory system.

The results of the obtained data reflect a significantly high correlation at the level from r = 0.696 to r =

0.980 at p <0.001 between BL and the psycho-emotional state of the 21-25-year-old men. We found out that the men who have an individual indicator of BL above average, are more assertive, they appreciate their capabilities, have a good psycho-emotional state. The results of the data obtained reflect a significantly high from r = -0.500 to r = 0.538 at p <0.01 of the direct and inverse relationship between BW and the psycho-emotional state.

The analysis revealed the presence of reliable direct and inverse correlations at the level from r = 0.362 to r = -1,000 at p <0.05; p <0.01 between the cognitive functions and indicators of the cardiovascular system of men. The presence of a significant number of inverse correlation relationships indicates the compensatory relationship associated with the ability to manage your emotions, dispense them.

Discussion

As it is known, the cognitive abilities of a person at any age play an important role in everyday life. They reflect the level of the mental state and to a great extent ensure the quality of life and adequate human behaviour. The cognitive functions of perception, the speed of information processing, intellectual activity are changed throughout life. Regardless of the type, mental activity can be represented by the following structure of involvement of mental functions in the activity result: intellectual, emotional, personal and motivational component (Korobeynikov, 2013). Among the investigated issues, the main place is occupied by the problem of emotional states, which are an important condition for human activity. Emotional states accompany almost every human activity because they reflect the relationship between motives and the possibility of successful implementation of plans.

The results of our research confirm the data, that systematic exercises of motor activity, mainly with cyclic structure of movements, have a positive effect on human cognitive functions, including memory consolidation (Erickson, 2011), increasing the speed and volume of information processing (Korobeynikov, 2017; Blahii, 2018; Yarmak, 2018).

The results of our studies complement the data concerning the structure of the relationship of psycho-emotional state with morpho-functional indicators (Korobeynikov 2011, Korobeynikova, 2014).

Conclusions

The results of the summative experiment show that 21-25-year-old men have high indicators of the functional state of the cardiovascular and respiratory systems. Individual indicators of heart rate in men are in the range from 52.0 to 68.0 beats per minute, which indicates the optimization of the cardiovascular system. High individual indicators of VC indicate a well-developed system of external respiration. The average results of cognitive functions, including the short-term memory capacity and psycho-emotional state are at a sufficient level. Conversely, the men aged 21–25 years of age have low rates of volume of the processed information, the attention span, and number of mistakes. We have established significantly high correlation relationships between morpho-functional parameters and cognitive functions. The correlation coefficients ranged from r = 0.362 at p <0.05 to r = 1.000 at p <0.001.

Conflicts of interest – If the authors have any conflicts of interest to declare.

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