

REGULATION OF SENSORY RESPONSE STUDENTS WITH DISABILITIES OF UNIVERSITIES THE PROCESS OF INCLUSIVE PHYSICAL EDUCATION

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The purpose of the article is to reveal the impact and effectiveness of inclusive physical education of students with disabilities. *Research methods used:* theoretical analysis, synthesis, systematization, generalization of data from scientific-methodical and special literature, pedagogical experiment, pedagogical testing, mathematical methods of processing digital arrays, comparative-statistical method, system-functional analysis. *The results.* Based on the results of the search activity, we received data indicating the following. Positive changes in the indicators of the experimental group students in all studied parameters of sensorimotor response were established, which testify to the improvement of the functional state of the central nervous system in the students of the experimental group after the end of the experiment. The result of the purposeful correction of the inclusive physical education of students with disabilities was that the positive dynamics of the coefficient of mental performance at the end of the study among the students of the experimental group was within 15 %. According to the integrative assessment of all studied parameters, it can be stated that after the end of the experiment, there is a general tendency to increase the results of the test tasks, which were at an average level in the vast majority of students of the experimental group (63.4 %). *Conclusions.* The results of the conducted research provide grounds for a conclusion regarding the possibility of purposeful correction employing inclusive physical education of the state of the sensorimotor reaction and its components and therefore have a comprehensive effect on the improvement of the main indicators of psychophysiological functions: the final data of the empirical experiment proved the effectiveness of the innovations introduced in the inclusive physical education of students with disabilities.

Key words: students, disabilities, inclusion, physical education, sensorimotor reaction, psychophysiological functions.

Оксана Блавт, Сергій Андреев, Василь Ліщук, Сергій Степанков. Регуляція сенсомоторного реагування здобувачів вищої освіти з особливими освітніми потребами в процесі інклюзивного фізичного виховання.

Анотація. *Мета статті* – виявити ефективність впливу інклюзивного фізичного виховання здобувачів вищої освіти з особливими освітніми потребами на розвиток сенсомоторної реакції. *Використані методи дослідження:* аналіз, синтез, систематизація, узагальнення даних науково-методичної та спеціальної літератури, системно-функціональний аналіз, педагогічний експеримент, педагогічне тестування, математичні методи обробки цифрових масивів. *Результати.* За результатами пошукової діяльності одержали дані, що свідчать про таке. Установлено позитивні зміни у показниках студентів експериментальної групи за всіма досліджуваними параметрами сенсомоторного реагування, які засвідчують покращення функціонального стану центральної нервової системи у здобувачів вищої освіти експериментальної групи після закінчення експерименту. Наслідком цілеспрямованої корекції інклюзивного фізичного виховання здобувачів вищої освіти з особливими освітніми потребами стало те, що позитивна динаміка коефіцієнту розумової працездатності по закінченні дослідження у студентів експериментальної групи перебувала в межах до 15 %. За інтегративною оцінкою усіх досліджуваних параметрів можна стверджувати, що після закінчення експерименту спостерігається загальна тенденція до зростання результатів виконання тестових завдань, які у переважної більшості студентів експериментальної групи (63,4 %) були на середньому рівні. *Висновки.* Підсумки проведеного дослідження, дають підстави висновку щодо можливості цілеспрямованої корекції засобами інклюзивного фізичного виховання стану сенсомоторної реакції та її компонентів, а відтак комплексно впливають на покращення основних показників психофізіологічних функцій: підсумкові дані емпіричного експерименту засвідчили дієвість упроваджених новацій у інклюзивне фізичне виховання студентів з особливими освітніми потребами.

Ключові слова: здобувачі вищої освіти, особі освітні потреби, інклюзія, фізичне виховання, сенсомоторна реакція, психофізіологічні функції.

Introduction

Problem statement. Currently, according to statistics, out of 2.5 million students in higher education institutions in Ukraine, 8 thousand of them have disabilities [1]. Education support for students with disabilities in higher education institutions exists in all developed countries of the world. The education of persons with disabilities is regulated by normative legal acts in the field of education and legislation on the rights of persons with disabilities.

The integration of young people with disabilities into the educational environment, but also society, helps them acquire professional knowledge, get a profession, self-realization, achieve success in life and further career, and feel like full members of society. This inclusive approach also requires the adaptation of teaching strategies [9].

Achieving the benchmarks determined by the state in the process of forming strategies for teaching students with disabilities largely depends on the success of practical

medicine and therapeutic physical education [8]. At the same time, medical experts consider physical activity with the use of physical education as a priority [6]. Systematicity and continuity of its implementation in combination with the efforts of the educational community are considered an effective way to solve the problem of providing quality educational services to students with disabilities in institutions of higher education [7].

Analysis of recent research and publications. The problem of inclusive education in universities is relevant and covers a wide range of scientific research. In scientific publications, special attention is paid to the possibilities of physical education in the process of facilitating the adaptation of students with physical disabilities to the conditions of study in institutions of higher education [6]. It has been proven that one of the most important components of social and mental adaptation to study in institutions of higher education for students with disabilities is physical education [8].

Physical activity is fundamental to health and personal well-being [15]. Providing high-quality physical education is a factor in improving the physical condition of students with disabilities (UNESCO, 2015). It is considered, first of all, as one of the most effective means of improving health (somatic, mental, social), physical fitness, results of educational activities, restoration of general physical and mental capacity [5; 10; 13; 15].

It was determined that the leading role of physical education lies in the prevention of an unsatisfactory state of health for students, as a consequence of adaptation to the process of studying at universities [1]. It is believed [9] that further appropriate correction of this process with adequate pedagogical means and methods with the use of physical exercises is of great importance for achieving the goal [8].

Each student with disabilities has certain characteristics and limitations that make learning difficult. A somatic disease can also negatively affect the change in the biological conditions of activity, under the conditions of changes in the central nervous system under the influence of pathogenic factors. In addition, the presence of the disease determines the dynamics of activity, endurance to loads (both physical and mental), stability of the energy potential of activity, preservation of its operational composition, etc [10; 13; 16; 17].

At present, there is no comprehensive study of the indicators of physical education influence on the correlation of disorders in the body caused by the presence of a somatic disease, which greatly complicates the identification of regular trends, sex-age, and disease-related features of their changes, including issues related to studying the peculiarities of the functioning of the central nervous system under the influence of physical stress.

The purpose of the article is to reveal the effectiveness of inclusive physical education for students with disabilities on the development of sensory reactions.

Materials And Methods

The used research methods of the theoretical and empirical levels are theoretical analysis, synthesis, systematization, generalization of data from scientific and methodological, and special literature.

Methods of obtaining empirical data: pedagogical experiment, pedagogical testing, mathematical methods of processing digital arrays, comparative-statistical method, system-functional analysis.

The level of development of sensorimotor reaction was studied using a specialized test exercise «Test for measuring the reaction to a moving object» [3].

All statistical analyzes were performed using SPSS Version 21. The test results were processed using analysis, only statistically significant values were taken into account, namely at the level of $\alpha = 0.05$. The organization of the study took into account the provisions of the Helsinki Declaration of the World Medical Association (WMA-2013) on the ethical principles of medical research with human participants.

(1) *Participants:* The research was conducted in the Department of Physical Education of the National University «Lviv Polytechnic» during the one-year course of physical education. 20 first-year students (an equal number of girls and boys) took part in the experiment. The study was conducted following the Helsinki Declaration of the World Medical Association (WMA-2013) WMA, Ethical Principles of Medical Research Involving Human Subjects.

Physical education of students with disabilities involves ethical issues and lengthy procedures. The sample size is determined by the number of enrolled students with disabilities. After they agreed to participate, consent was obtained from their classmates and physical education teachers. The limited number of participants in this study suggests obtaining information about group patterns rather than significant values.

The control group (CG) was formed according to the principle of cluster analysis, meeting the requirements for the sufficiency of the sample volume at the probability level of $p < 0.05$. The research took place following the written consent of students with disabilities.

(2) *Organization of the study:* An innovative program of inclusive physical education was used to conduct the empirical study. The defining difference of this program is the individualization of corrective and developmental means used in the process of physical education of students with disabilities.

The experiment was implemented during two academic semesters. At the first stage of the study, all students of the studied sample made three attempts in the

test to determine the sensory response. The results were recorded using a stopwatch. Based on the results of three attempts, the average result was determined.

At the second stage of the study, all students who participated in the pedagogical experiment made three attempts in the test to determine the motor reaction. The results were recorded using the device.

Test control of the speed of a complex sensory reaction using the device does not require special training for students. There is no inconvenience during the tests. This is ensured by the use of wireless data transmission lines in the system. The duration of processing and transmission of information in real-time, which consists of the time of receiving it (usually within 20 seconds), and the time of reviewing the received data and analyzing the results of processing during mass surveys, does not exceed two minutes.

Results

First of all, we note that a complex sensorimotor reaction is determined by the ability to respond correctly and on time to a surrounding irritant. At the heart of responding to a moving object is the ability to constantly keep it in the field of vision. This process is correlated with the activity of the central nervous system, which in turn ensures intramuscular and intermuscular coordination; the mobility of nervous processes, which is manifested in the perfection of the processes of excitation and inhibition in various departments of the nervous system, and the level of neuromuscular coordination. The state of motor

reaction development is an indirect objective indicator of the maturity of various departments of the central nervous system. Most motor acts are possible only under the condition of close interaction of visual, auditory, tactile, and motor-kinesthetic analyzers. That is, precisely those processes that are physiologically disturbed due to the presence of the somatic disease contingent in the students under study.

Control of sensorimotor response was used to determine the speed and stability of motor-sensory response as a predictor of the functional state of the central nervous system. The latter is the main indicator of basic speed capabilities, and in the dynamics of observation, it shows the strength of excitation, internal inhibition, and mobility of the main nervous processes [13]. The study of sensorimotor is due to the need to take into account the functional mobility of nervous processes, which are found in the conditions of professional activity. In addition, the indicators of the sensorimotor test reflect the level of development of cognitive processes and the specificity of programming, regulation, and control of the central motor analyzer. There are also data on the relationship between latent periods of motor reaction and the development of neuropsychological fatigue and the success of the mental activity. The theory about the dependence of the ability to react with mental abilities is confirmed in Galton’s writings.

So, using the developed method, we obtained the following results of monitoring the state of sensorimotor reactions of students of the experimental groups (Table 1).

Table 1 – Results of monitoring the state of sensorimotor reactions

Investigated parameters		EG (n=20)						CG (n=20)					
		at the beginning		after		+	p	at the beginning		after		+ (%)	p
		X	S	X	S			X	S	X	S		
MWC, c.u.	b	6.06	0.44	4.76	0.61	21.4	<0.001	6.26	0.37	6.22	0.44	0.6	>0.05
	g	7.01	0.91	5.72	0.77	18.4	<0.05	7.14	0.29	7.12	0.38	0.2	>0.05
LMA, c.u.	b	2.38	0.61	3.09	0.72	29.8	<0.01	2.47	0.42	2.45	0.48	0	>0.05
	g	2.26	0.68	2.90	0.78	28.3	<0.01	2.30	0.31	2.36	0.61	0.21	>0.05
MWC, %	b	0.53	0.10	0.66	0.09	24.5	<0.01	0.52	0.08	0.52	0.04	0	>0.05
	g	0.51	0.09	0.63	0.11	23.5	<0.01	0.50	0.05	0.51	0.03	2.0	>0.05
CMC, c.u.	b	0.59	0.09	0.75	0.08	27.1	<0.05	0.60	0.07	0.65	0.03	8.2	<0.05
	g	0.53	0.11	0.64	0.04	26.9	<0.05	0.55	0.09	0.58	0.06	4.7	>0.05
LP SV-MR, ms	b	371.2	22.1	316.3	27.1	15.2	<0.05	367.7	23.2	365.2	19.4	0	>0.05
	g	354.2	29.7	315.1	31.2	12.4	<0.05	351.6	28.8	350.6	22.1	0	>0.05
LVA, Hz	b	31.44	1.18	40.4	0.88	28.2	<0.05	31.67	1.23	32.51	1.12	2.3	>0.05
	g	32.04	1.01	42.11	1.31	29.7	<0.05	32.15	1.43	33.78	1.52	3.7	>0.05

Note: b – boys; g – girls; MWC – mental working capacity; LMA – lability of the motor apparatus; CMC – coefficient of mental capacity; LVA lability of the visual analyzer; LP SV-MR latent period of a simple visual-motor reaction; CG control group; EG experimental group; c.u. – conventional units

Since the strength of nervous processes is an indicator of the working capacity of the nervous system. its dynamics. provides the main information regarding the qualitative analysis of mental working capacity as an indicator of the functional state of the students' body (based on motor reactions), the results obtained at the beginning of the experimental study of the coefficient of mobility of the nervous system, which is an indicator of dynamic of working capacity, according to the qualitative criterion, 5.2 % of students had the first degree, all the others – the second. Individuals with a high degree among the students of the research groups were not identified. We believe that the obtained results are the result of an increase in the pace capabilities of the nervous system, which are caused by a complex of central and peripheral changes in its state. As a result, morphological changes in the state of the students' bodies lead to an increase in the mobility of nervous processes based on the improvement of sensorimotor reactions [2].

In general, positive changes in the indicators of the students of the experimental group in all studied parameters indicate an improvement in the state of the neuromuscular apparatus and a shift in the balance towards excitement. Accordingly, the ratio of the number of positive test results gives grounds for asserting the improvement of the functional state of sensorimotor reactions in students of the experimental group after the end of the experiment. In 28.3 % of these students, motor disinhibition was observed, which is a consequence of the increased level of neuromuscular excitement. Students of the control group are significantly behind in the development of sensorimotor reactions.

In addition, the indicator of the speed aspect of psychomotor activity was studied, which is one of the integral signs of its lability, which determines the level of development of such a synthesized parameter as the speed of central processing of information and decision-making – the lability of the motor apparatus. Its indicators among the students of the research groups before the start of the experiment are at a low level, which indicates a decrease and exhaustion of plastic and strengthening of inert processes in the central nervous system. An improvement of up to 19.9 % in the index of the lability of the motor apparatus in students of the experimental group after the end of the experiment indicates the establishment of trophic and energy processes and their vegetative regulation.

Analysis of the stability of the motor system proved that the results of boys were significantly higher ($p < 0.001$) than the results of girls. It is substantiated that the ability

to perform movements at a certain pace and its stable preservation largely depends on individual and typological features [5].

Taking into account the fact that the development of mental capacity takes place according to general ontogenetic laws, the structure and complexity of its formation make it possible, by finding effective means, to correct the psychophysiological mechanisms of its development in physical activity: at the end of the experiment, the coefficient of mental capacity in the students of the experimental group in numerical values approaches one values: its positive dynamics is up to 15 %.

The lability of the visual analyzer was determined as an integrative characteristic of the lability of the central nervous system, the mobility of nervous processes in the central nervous system. and changes in its functional state as a whole. The need to control the functional state of the central nervous system, as a component of psychophysiological functions, is because in certain cases, the presence of diseases in the body at different levels of the nervous system is mainly functional neurodynamic [13].

Many students, along with somatic disorders, have disorders of the cardiovascular, respiratory, endocrine systems, internal organs, vision, hearing, as well as multiple combined defects. According to the integrative assessment of all studied parameters, it can be stated that after the end of the experiment, there is a general tendency to increase the results of the test tasks, which were at an average level for the vast majority of students in the experimental group (63.4 %).

Discussion

Our research is justified by the position that physical education is one of the main ways of correcting violations of physical development, motor readiness, psychomotor skills, and willpower of students with disabilities [13]. We support scientific approaches [1; 11], and to work with such students, it is necessary to introduce special methods, pedagogical technologies, and adaptive technical means into the process of physical education.

Scientific ideas have been expanded [7; 8] regarding the need to take into account that, as a rule, such students have certain problems: gaps in knowledge, characterized by increased fatigue, isolation, low self-esteem, and vulnerability. At the same time, they believe [1] that for them it is impossible to slow down the pace of learning or reduce the number of pairs because this reduces the quality of professional training. In addition, students with disabilities often have delays in the development of gross motor skills due to conditions such as hypotonia

or dyspraxia. Sensorimotor reaction time is considered an independent psychophysical indicator or indicator for students with disabilities [14]. Therefore, our study expands scientific information [3; 11] on the use of complex sensorimotor reaction time as an indicator of mental performance.

Students with somatic diseases are allocated to a special group: diabetes, bronchial asthma, diseases of the cardiovascular system, etc. Such students are characterized by increased excitability and exhaustion of nervous processes, some intellectual inflexibility, weakening of active attention, reduced memory for current events, and increased lability of the autonomic nervous system, which is not accompanied by increased motor activity [5]. The conducted scientific research was based on the fact that the reaction time is used as an indicator of the functional state of the nervous system [13]. The accumulation of knowledge in this field has formed a theory about the connection of a certain reaction time with the development of neuropsychological fatigue and the success of the mental activity [2]. In the implementation of voluntary visual-motor reactions, such components of brain activity as the visual and somatosensory system, chains of simultaneous synthesis of sensory signals, systems of building a program of motor activity and its implementation, which are synthesized with chains of regulation and control of cognitive activity and are an objective indicator of the discriminative function of the brain [3]. Therefore, the results of the conducted scientific research confirm [11; 14] that improving the state of the sensorimotor reaction of students with disabilities improves the state of the functional systems involved in the organization of such a reaction, which, in turn, correlates with the analytical functions of the brain.

The data gained further development that most often scientists study the effects of physical exertion on indicators of physical development and physical fitness, and somewhat less often – on indicators of cognitive activity.

Conclusions

In the search for a solution to the important task of realizing the right of persons with disabilities to receive education at the national and state levels, inclusive educational practices at the university are given priority.

The essence of purposeful influence through physical education, taking into account the age characteristics of the manifestation of the components of physical activity in students with different profiles of functional deviations, is the possible achievement of an individual maximum level of physical and motor development, which ensures a full-fledged, productive life and activities in higher education.

The rational construction of the process of physical education of students with special educational needs requires systematic pedagogical control over psychophysical development, as well as the development of unified means of in-depth examination in the process of individual use of inclusive physical education programs. The results of the conducted empirical investigation show that the use of innovative technologies in the organization of control procedures of physical education of students with special educational needs and their elements contributes to the effectiveness of solving leading tasks and ensures the development of the main components of the psychophysical state.

The results of the conducted research provide grounds for a conclusion regarding the possibility of purposeful correction employing inclusive physical education on the state of the sensorimotor reaction and its components, and thus have a comprehensive effect on the improvement of the main indicators of psychophysiological functions: the final data of the empirical experiment proved the effectiveness of the innovations introduced in inclusive physical education. To improve the general psychophysical condition of students with disabilities, it is advisable to design the content of the corresponding program, taking into account the obtained results.

Conflict of interest. The authors state that there is no conflict of interest.

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