

Criterion score of the physical and psychophysiological condition of students in the context of determining their individual adaptability to physical loads

Yagotin R. S.^{1ABCDE}, Degtyarenko T. V.^{2ABCDE}, Bosenko A. I.^{2ABCDE}, Plisko V. I.^{3ADE}, Dolinsky B. T.^{2CDE}

¹*Department of Physical Culture and Sport, Odessa National Academy of Food Technology, Ukraine*

²*Department of Biology and Public Health, South Ukrainian National Pedagogical University named after K. D. Ushynsky, Ukraine*

³*Department of Pedagogy, Psychology and Methods of Physical Education, National University of «Chernihiv Collegium» Taras Shevchenko, Ukraine*

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Abstract

Purpose: to suggest and to evaluate the criterion score of the physical and psychophysiological condition of students. The basis of the score is the individual-directed pedagogical control at physical education.

Material: the study involved students (n = 75, age - 17-19 years). The physical condition was determined by applying anthropometry and motor skills testing. The psychophysiological condition was studied according to objective parameters of psychomotor qualities and functional capabilities of the cardio-respiratory system.

Results: It was realized the criterion score of the individual degree of students' adaptability to physical loads. It was determined the most significant interrelation between the indicators of motor qualities and psychomotor parameters of students. It was revealed the approaches of realization the complex individual-directed pedagogical control in the physical education of students.

Conclusions: criteria of physical and psychophysiological capabilities of students are recommended for determining their adaptability to physical loads.

Keywords: criterion score, adaptability, physical education, psychomotor system, students.

Introduction

The definition of adaptive abilities of the individual considering his age, gender, and psychophysiological peculiarities is the actual and perspective direction of pedagogical science. The abovementioned is crucial for the organization of physical education and sports classes according to the modern requirements [1, 2]. It is expedient to reveal the neurophysiological and psychophysiological mechanisms of adapting the organism to various factors of the external environment [3]. The development of this scientific direction was carried out in the context of determining the adaptation of the individual to physical loads of different orientations [4]. According to various data, the condition of health of young people has significantly deteriorated in recent years [5-7]. It is noted that among students there is a small proportion of practically healthy persons [8-10]. The introduction of health diagnostic methods according to objective parameters of physical and psychophysiological condition was confirmed in the studies of various authors [11-13]. Il'in [11] emphasizes the continuity of the physical and psycho-physiological component in the organization of human loads. Nikandrov [6], Degtiarenko et al. [7] suggest the application of psychomotor tests as a priority for evaluation of the adaptability of the individual.

A lot of authors emphasize the feasibility study of the interdependence of the functional condition and the

volume of motor loads of students [14-16]. It is proposed to determine the functional level of students on the performance of cardiovascular and respiratory systems. The criteria for adaptation are arterial pressure, heart rate at rest, the vital capacity of the lungs (VCL) and Stanger test [17, 18]. In the process of physical education, there should be performed the complex coordination abilities testing [19]. It is determined the importance of studying power, speed qualities and flexibility in the pedagogical control of the physical education process of students [20, 21]. Sergiienko defines the need to consider the somatotype of students during physical education modeling [22]. It is determined the peculiarities of the development problem individualization in the framework of the psychophysiological paradigm's implementation. It is revealed the high level of correlation between the perceptive-cognitive indicators and psychomotor functions of a person [23]. The necessity of psychomotor qualities research for determining the level of a person's physical development is confirmed in the study of Tarovyket al. [24]. The development of quantitative and qualitative scales to determine the psychophysiological rating of respondents is revealed in the study of Korobejnikov et al. [25]. The comprehensive evaluation of physical fitness and psychophysical status of students of the special medical group is presented in the study of Blavt [16]. It is proved that the intensification of the test process ensures the effectiveness of the implementation of the diagnostic control function of physical education [27-29].

Everyone is able to adapt to constant changes in the

natural and social environment. This requires continuous improvement of personal adaptation resources [4, 21]. It is important to consider the main theoretical and methodological provisions of the medical and pedagogical control of physical education. It is necessary to define the interdisciplinary sense of such a concept as “adaptation”. The phenomenological sense of the adaptation process should be considered in the system “man – environment”. It is important to determine the degree of adaptability of the individual to a particular type of loads. The result of such loads is the success or failure of various tasks. For example, the effectiveness of mastering certain types of physical exercises [30]. It is necessary to emphasize the necessity of experts’ compliance in the interpretation of the terminological definition “adaptation” and “adaptability of the individual”. It is necessary to adhere to the terminology discipline in defining and interpreting the abovementioned concepts. The terms “adaptability or disadaptability” are used in the context of evaluating the effectiveness of different activities. It will be legitimate to use these concepts in determining the success or failure of physical exercise [3, 13].

The actual problem is the implementation of an individual approach to the educational process organization. This principle should be based on the objective evaluation of the adaptability degree of students to mental and physical loads.

Hypothesis. The study of individual characteristics of the physical and psychophysiological condition of students should be conducted on the basis of objective criteria. It provides an opportunity to determine their adaptability to physical loads. Such an approach will allow the implementation of individual pedagogical control in physical education.

The purpose of the work is to offer and test a criterion evaluation of the physical and psychophysiological condition of students. The basis of evaluation is the individual-directed pedagogical control of physical education.

Material and methods

Participants. The students participated in complex research (n = 75, age – 17-19 years). The mandatory condition for participation in the study was a medical examination and the absence of contraindications to physical education. All students give written consent for participation in the research.

Design of the research. The research was conducted during 2017-2018. Complex researches of diagnostic-prognostic direction were performed according to the developed author’s program [1]. The program included an individualized evaluation of the physical and psychophysiological condition of students according to objective parameters [11, 12]. The developed and implemented program included the following stages:

- I. General data (age, gender, medical background).
- II Physical condition (anthropometry and motor quality).
- III Psychophysiological condition (psychomotor

quality).

IV Functional abilities (the potential of the cardio-respiratory system).

Analysis of anthropometric data and motor qualities indicators of student allowed to determine the peculiarities of each student’s physical condition [22, 31, 32]. The following indicators were determined: body length (cm); body weight (kg); chest circumference at rest (cm); dynamometry strength (kg). Individualized evaluation of students’ motor skills was performed applying the following tests: 100 m run (s); 4x9 m shuttle run (s); push-ups (times); sit-ups in sitting position in 1 min (times); standing jump from the spot (cm); forward inclination of body from sitting position (cm) [21, 33, 34]. It was applied the following criteria for evaluating the students’ physical condition: body mass index (BMI); Power index (PI); Index Pynie (IP) [35]; speed of running; Coordination; Power endurance; speed power; Flexibility [22, 30, 36]. In our opinion, these criteria should be considered acceptable for the application in professional loads of physical education teachers. Such criteria are informative, accessible, safe and valid.

The psychophysiological studies were performed to determine the individual peculiarities of the psychomotor system and functional abilities of the body. They allowed to study the condition of perceptive-cognitive function and student psychomotor system. It was determined the parameters of sensorimotor components of motor loads and the students’ cardiorespiratory system potential (CRS). Individualized evaluation of students’ psychophysiological condition is calculated by the computer program (NS-Psychotest) [37]. We have chosen 5 directions: “Visual sensorimotor reactions” (simple and complex), “Reaction to moving object”, “Tap test”, “Kohs Block Design Test” [37, 38]. Testing of individual features of the cardiovascular and respiratory systems allowed to determine their functional capabilities. It was determined the heart rate, timed inspiratory capacity and timed expiratory capacity [35]. Individual peculiarities of the psychomotor system and functional abilities of students were determined according to the following criteria: duration of the latent period of choice reaction; level of sensorimotor excitation; level of sensorimotor accuracy; the speed of a dominant hand; coefficient of functional asymmetry; Loads of thinking; potential of CRS.

Determination of students’ adaptability to physical loads was performed at the following stages:

1. Diagnostic – physical and psychophysiological condition testing.
2. Selection of criteria – according to anthropometric data, motor qualities, the psychomotor system condition and functional abilities [1, 22].
3. Development of a quantitative and qualitative scale – based on the average values of the selected criteria (for transformation the obtained results into the score) [19, 39, 40].
4. Calculation of total points – according to the results of each test.

5. Integrative evaluation of adaptability – according to the appropriate degree (high; significant; insignificant; disadaptation) [41].

6. Analytical interpretation of the distribution of students by the degree of adaptability to physical loads

The results of the testing were given the following score: 1 – failing, 2 – unsatisfactory, 3 – satisfactory, 4 – good, 5 – excellent. The next stage was to implement the interpretation of the total score to determine the students' adaptability degree to physical loads. Criterion-point evaluation of students' adaptability to physical loads was the following: high – 80-61 points; significant – 60-41 points; insignificant degree – 40-21 points; disadaptation – 20 points and less [38]. The proposed criterion evaluation allowed to determine the students' adaptability degree to physical loads and to divide the examined contingent into the appropriate groups.

Statistical analysis: SPSS20 and Excel programs were applied. The following indicators were calculated for each variable: average mean, standard deviation, mean error, the coefficient of variation. The level of correlations between the selected adaptation criteria was determined by correlation analysis.

Results

The results of the conducted research allowed to offer an individualized criterion evaluation of the physical and psychophysiological condition. The average means of the selected criteria of the physical and students' psychophysiological condition evaluation are presented in Table 1.

The percentage division of students into the degree of adaptability to physical loads ($n = 75$) is presented in Figure 1.

The “high” degree of adaptability to physical loads was found in 11.2% of students. “Sufficient” adaptability is determined in 26.6% of students. The most widespread evaluation of the studied contingent was “insignificant” adaptability to physical loads. It was detected in 33 students (44.1%). Disadaptation to physical loads is

determined in 14 students. More than 18% of students were characterized as unable to perform the educational loads in physical education. Only 38% of students can engage in physical education without risk to health (“adapted”). The obtained data became the basis for the correction of educational programs for the students' physical education belonging to the group “unadapted”.

The carried out correlation analysis allowed to determine the most significant correlations between the indicators of motor qualities and the parameters of the psychomotor system. It is determined the significant correlation are between the duration of the latent period of choice reaction and coordination ($r = 0.412$); duration of the latent period of choice reaction and speed of running ($r = 0.393$, $p < 0.01$); potential of the cardiorespiratory system and power endurance ($r = 0.427$, $p < 0.01$).

Discussion

We consider the psychophysical abilities of a person in performing motor actions as his individualized characteristics. The motor actions qualities reflect the unity of neurophysiological and psychological mechanisms of a person's motor loads [11, 12]. Parameters of simple motor actions are well measurable [23, 37]. The evaluation of the functional capacity of the cardiovascular and respiratory systems is successfully applied in the field of physical education and sports [35, 42]. In the course of scientific developments, it is expedient to adhere to the provisions of the theory of evaluations [39]. The logic of our research coincided with this provision and included the following stages: the development of scales which help to transform the test results into points; the transformation of the received data into points; calculation of the total points. We performed the development of the evaluation scale on the basis of the application of square deviations, which is confirmed the position of other researchers [19, 26]. Our approach to the criteria evaluation of the obtained data extends the possibility of interpreting the motor skills testing results of students.

The results of our research confirm that the parameters

Table 1. Average means of the selected criteria for evaluation of the physical and psychophysiological condition of students ($n = 75$)

Criterion	X	m	Criterion	X	m
Body mass index (c.u.)	22.81	0.57	Duration of the latent period of choice reaction (ms)	447.54	5.14
Power index (%)	130.17	2.32	Level of sensomotor excitation (ms)	8.63	1.42
Index Pynie (c.u.)	26.3	0.84	Level of sensomotor accuracy (ms)	29.23	1.09
Speed of running (s)	14.21	0.11	Speed of a dominant hand (times)	7.43	0.04
Coordination (s)	9.87	0.04	Coefficient of functional asymmetry (c.u.)	2.94	0.11
Power endurance (times)	37.17	1.61	Loads of thinking (s)	297.19	12.36
Speed power (times)	39.41	0.98	Potential of CRS (c.u.)	1.59	0.06
Flexibility (cm)	7.88	0.77			

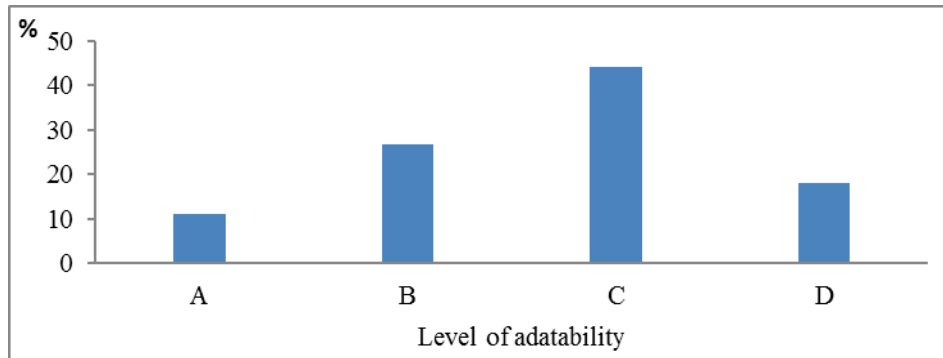


Fig. 1. Percentage of students by degree of adaptability to physical loads (n = 75). A – high, B – sufficient, C – insignificant, D – disadaptation

of the physical and psycho-physiological condition of a person objectively characterize the individual peculiarities of students' adaptation to physical loads [13, 38]. The abovementioned updates existing ideas about the importance of the students' psychomotor system condition evaluation. This allows to determine the student's adaptability to perform various types of motor activity.

It is considered that anthropometric data are an important part of the research and are aimed at determining the somatotype of a person [21, 27]. Evaluation of motor qualities must be included in the programs of physical education of students [20-22]. We consider that the complex testing of the psychophysical condition of students should be carried out three times during the study year (incoming, process-current and stage medical and pedagogical control).

It is proved that the implementation of the psycho-physiological paradigm provides an opportunity to evaluate objectively the individual peculiarities of the psychomotor system [11, 23, 24]. The authors confirmed that psychomotor quality should be determined by latent periods of the visual-motor reaction; levels of sensory-motor excitation and accuracy; the speed of the left and right hands; coefficient of functional asymmetry, the speed of action. Indicators of the cardiovascular and respiratory systems can objectively characterize the adaptive capacity of the body [35]. The application of the indicator "CRS" complete the evaluation of the student's functional reserve.

We indicated correlations between the indicators of motor qualities and psychomotor system. This is due to the unity of mechanisms of neuro-regulation and psychophysiological support of sensorimotor components of motor activity of students [11, 23]. In general, we believe that the proposed criteria for assessing the physical and psycho-physiological condition provide an opportunity to determine the degree of adaptation of students to physical loads [38, 41, 43].

The results of our research indicate the need to introduce an individualized evaluation of students' adaptability to physical loads. This is indicated by the number of students who received from 21 to 40 points. These students had "insignificant" degree of adaptability to physical loads.

The obtained data coincide with the results of other studies [44-46]. Thus, in studies of Khotiienko, students of the first year did not have the highest level of physical fitness [46]. The author revealed a low level of 25% and a lower than average 71% of students. In our opinion, the given data are overestimated and do not correspond to the national indicators. Similar differences confirm the expediency of individual pedagogical control in the process of physical education; to consider the place of residence; to consider the type of professional loads, gender, age.

The need to consider the individual characteristics of the psychophysical condition of students to confirm the results of other studies [24, 25]. The obtained results confirm the data of studies, which apply the differentiated approach to the organization of physical education [24, 25]. We adhere to the concept that the implementation of a comprehensive, individualized pedagogical control will contribute to the improvement of the educational process in the field of physical culture and sports.

The application of mobile devices to monitor the health condition and motor activity of students will also be useful. This allows them to determine their adaptability to physical loads. Modern services provide the exchange of information about the students' physical condition [27]. Similar methods of self-control significantly increase the motivation of students to physical education. However, it is necessary to consider the possibility of uncontrolled application of gadgets. The application of gadgets can have a negative effect on student health. Therefore, individual-directed pedagogical control will contribute to the optimization of approaches to the application of health-improving technologies.

The advantage of our study is substantiation of the expediency of the introduction of complex individual-directed pedagogical control in physical education. The implementation of the principle of in-depth individualization has a medical and social significance. The basis of this approach is to evaluate the psychomotor qualities of students. It promotes the timely detection and prevention of violations of the psychophysical status of students. The introduction of the author's methodology for determining the students' adaptability degree to physical loads will contribute to improving the physical education organization.

Conclusions

The proposed objective criteria of the individual characteristics evaluation of students' physical and psychophysiological condition are acceptable for determining the degree of adaptability of the individual to physical loads. The results of the research conducted have a realistic perspective of implementation in the educational process. The legal and the most appropriate for improving the physical education organization is a comprehensive, individualized pedagogical control. Such an approach considers the peculiarities of physical development and the psycho-physiological condition of students.

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Conflict of interest

The author declares that there is no conflict of interest.

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Information about the authors:

Yagotin R.S.; (Corresponding Author); <http://orcid.org/0000-0002-8342-5156>; iagotin.rodion@gmail.com; Odessa National Academy of Food Technology; Kanatnaya st., 112, Odessa, 65001, Ukraine.

Degtyarenko T.V.; <https://orcid.org/0000-0003-4462-8863>; matanya@ukr.net; South Ukrainian National Pedagogical University named after K. D. Ushynsky; Staroportofrankivs`ka St. 26, Odessa, 65020, Ukraine.

Bosenko A. I.; <http://orcid.org/0000-0003-3472-0412>; bosenko@ukr.net; South Ukrainian National Pedagogical University named after K. D. Ushynsky; Staroportofrankivs`ka St. 26, Odessa, 65020, Ukraine.

Plisko V. I.; <https://orcid.org/0000-0001-8714-985X>; rost0279@gmail.com; National University of «Chernihiv Collegium» Taras Shevchenko ; Hetman Polubotka street, 53, Chernihiv, 14013, Ukraine.

Dolinsky B. T.; <https://orcid.org/0000-0002-3745-2460>; dolinskiy58@ukr.net; South Ukrainian National Pedagogical University named after K. D. Ushynsky; Staroportofrankivs`ka St. 26, Odessa, 65020, Ukraine.

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