

# Control and assessment monitoring technologies of students' physical health protection

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**Abstract** - The health of a nation is an obligate social value, the well-being foundation and the basis of a state's economic development, the condition of its national security, determining the vector of its geopolitical perspectives and viability. Therefore, in pursuance of the social order for the professional development of the personality during the period of students education at higher education institutes, the priority direction in the higher education management policy is the idea of preserving and promoting the health of the young generation, educational process optimization under the complex modern conditions of society informatization, compacting the living space of a young person. The only non-drug and most effective means of preserving and promoting the health of young people at higher education institutes is organized physical education classes. Assessment and control monitoring of technical university students' physical health forms a constituent part of the Russian public health care system and allows not only to plan and efficiently organize the educational process, to make adjustments to its optimization, giving an objective assessment of the teaching staff work regarding the Physical Education discipline. The innovative technologies introduction into the health protection system of students makes it possible to take preventive measures before spreading of diseases, to find effective means of influence targeted prenosological correction, changing the vector of interaction between the teacher and students towards creating conditions for the initiative and activity of students in the process of their healthy lifestyle formation.

**Keywords** — *monitoring, control, assessment, physical health, students.*

## I. INTRODUCTION

The beginning of the XXI century is characterized by the rapid growth of informatization addresses all spheres of modern society, increasing the importance of information and communication, bio-and nano-technologies. In this regard, the digital revolution (the revolution in information

technologies), which had a significant impact on the transformation of the social relations system in the labour activity, demands higher standards for students, whose future professional activity requires close cooperation with each other and is associated with data processing, informatization and management [1].

The foundation of the modern stage of social development is knowledge, and the most demanded in the labor market are workers who have their knowledge as a necessary production resource. With the benefit of unique qualities and abilities only highly intellectual, capable of self-education throughout life, specialists are the most in demand in the labor market, subjected to the least competition and able to withstand the impact of powerful information flows [2].

Obviously, the social, psychological and neurophysiological mechanisms of such an impact, as well as the dynamization of the life rhythm, are bound to affect the health of the modern person, and especially, the young organism, which flows into the boiling stream of the educational environment of higher educational institutions and subsequently into the system of labor relations. For this reason the preservation, promotion and enhancement of the physical and mental health of a young person, which condition is also significantly affected by climatic and geographical living conditions, is of paramount importance for creating the prerequisites for his successful educational activity [3,4,5].

In addition, environmental conditions of living have a significant impact on students' health status [6]. The industrial centers of the Baikal region, for example, are characterized by intense air and environmental pollution [7].

In terms of emissions, which occupy a dominant place in the hierarchy of the most significant factors influencing the health of the population, among the subjects of the Russian

Federation, the Irkutsk region is second only to the Krasnoyarsk Territory and the Kemerovo Region. According to the Russian scientists this explains the fact that in terms of the total incidence rate of children and adults, the Irkutsk region occupies one of the leading positions in the Siberian Federal District, yielding to the Altai Territory and the Omsk Region [8]. In the view of the authors [9], more than 98% of the ecological component of the incidence is associated with the gross emissions value of harmful substances into the atmosphere.

According to the hygienic studies of air and soil substances conducted in the region for 20 years, the dependence of the diseases of the musculoskeletal system and the overall incidence of children and adolescents on technogenic pollution was confirmed [10]. The authors presented experimental evidence of an increase in the incidence of osteo-muscular system among children by 5.6 times and among adolescents by 12 times (in Irkutsk and Shelekhov), which certainly affects their health, both in adjacent age periods and in more mature age.

It is taken for granted that other potentially dangerous risk factors for diseases also affect the student's health. These include behavioral, biological, genetic, social, organizational and medical factors. Their presence increases the likelihood of disease development among students, their complications and progression.

Behavioral factors, which importance in the structure of factors forming the health of young people has increased significantly over the past decade, characterize, first of all, their attitude to their health. However, health is not of primary importance in the system of vital values for modern youth. On the one hand, this is due to the fact that for a long time the social policy of the state in the field of health care was not aimed at spreading health-saving technologies and development the physical culture of the individual, as the only non-drug means of the nation's health improvement, but at quality improvement of the medical care. Such a policy, as a rule, relieve the person of responsibility for his/her health, did not focus him/her on a healthy lifestyle. On the other hand, in the current socio-economic situation, a significant part of today's youth is often forced to exploit the most accessible for them, and sometimes the only resource - their health.

The lack of physical education of a student's personality is reflected in the manifestation of such negative factors like smoking, the spread of drugs, alcoholism, crime, the inability to resist the effects of stressful influences.

Financial insecurity forces students along with studying at a higher education institute to look for additional sources of funding, even to the detriment of their health.

Therefore, the search for ways to prevent various kinds of diseases, restore disordered body functions, preserve and promote health, increase physical performance and adapt young people to a serious educational process, are of paramount importance today.

Modern state policy implemented in socially-oriented projects in the field of health care and education is aimed at promoting the health of the population, however, despite this, the health status of students on the basis of annual medical examinations still continues to deteriorate. Against

the background of an increase of diseases manifestation toward graduation from a higher education institute, when, according to the curriculum, organized physical education classes are unscheduled, the predominant diagnosis of most students also acquires combined pathologies [5, 11].

In the Irkutsk National Research Technical University (INRTU) over the past decade there is a tendency to increase the number of students of the third functional group: in 2009 their number corresponded to 29.6%, in 2014 - 31.2%, in 2016 - 39.2% [12]. At the same time, in 2018-2019 among the students dominate diseases of the cardiovascular (28.1%) and respiratory systems (19.4%, asthma, chronic bronchitis), the musculoskeletal system (24.3%, scoliosis, osteochondrosis), and, as a consequence, the number of students in this group increases, accounting for 45.6% of students.

Consequently, the problem of preserving and promoting the health of modern youth is relevant even when students of the main (28.7%, 2019) and preparatory (21.6%) departments are concerned. The physical load offered to this category of students is not always adequate to the functional capabilities of their body and, as the express control of their blood circulation efficiency index shows, the magnitude of which indirectly determines the degree of the body oxygenation, can lead to overtraining and exhaustion of the myocardium [13].

At the same time, some authors [14] propose to use the aerobic and anaerobic "set of physical exercises" in preparation, the systematic implementation of them contributes to a more efficient energy supply of various reactions occurring in the body, where oxygen is supplied to the tissues, improves the mechanisms (more relevant for the first year students), leads to an increase in physical performance. The desire to find the most effective means of improving the health of young people requires professionals working in the field of health-saving technologies to apply a more individualized approach in the educational process [15, 16].

As defined by Professor V.Yu. Lebedinsky (2018, p. 603), physical health is "initial genetically determined human motor capacity (physical fitness), undergoing marked changes in the process of morphofunctional adaptation (physical development) to changing environmental conditions and standards of living" [17]. Therefore, for the prevention and correction of existing diseases of students, first of all, it is extremely important to evaluate this two-component health system.

The indicator values of physical development and physical fitness of students allow us to speak with confidence about the level of students' physical health, which is the main prerequisite for the future self-realization of young people in their professional activities. They help to identify problems associated with the development of specific physical qualities necessary for the high qualification and performance of future specialists. For this reason, the information need of an annual monitoring survey of students is unavoidably obvious.

**II. MATERIALS AND METHODS**

In INRTU in the Scientific Research Laboratory (SRL) "Monitoring of physical health" in the Center of Health Saving Technologies (CHST) the problems of the state, preservation and promotion of students' health are studied since 2007. The Center of Health Saving Technologies carries out preventive medical, educational, research activities in the development and implementation of innovative technologies aimed at improving the system of protecting the health of students with a view to improving their quality of life and level of social success.

The Laboratory conducts monitoring of the physical development and physical fitness of young people, searches for ways to improve the management of the pedagogical process on the basis of its planning and an expert system of dynamic control, forecasting and evaluation of its effectiveness.

For the moment (2019), the database contains more than 28,400 survey results about students assigned for health reasons to the III functional group of health, and more than 22,300 data on students of the main and preparatory departments. The laboratory develops and implements innovative technologies aimed at improving the basic characteristics of the physical, mental and social components of their health, makes management decisions to coordinate and correct the educational process, the main element of which is the link - teacher-student. Moreover, with the coordinating role of the teacher who embodies the social policy of the higher education institute and sets the vector for a healthy lifestyle, an equivalent responsibility for the health rests with the student, who is assisted in the formation of the target setting for a healthy lifestyle by the laboratory department of educational programs.

The system of pedagogical actions of the Scientific Research Laboratory includes a range of events, including competitions, quizzes, organization of sports and dance marathons, festivals and flash mobs. Educational programs use new, popular among young people, formats that promote a healthy lifestyle, form the level of literacy in the system of health-saving competence and motivational and value orientations both to organized classes in the educational system and to independent systematic physical education classes.

The anthropometric (weight, chest circumference (Thoracic organs), height) and physiometric (Stange's and Gench's functional tests) characteristics of students' physical development that form the basis of monitoring studies, as well as the values of the screening studies indicators of their motor skills that assess strength abilities, speed, flexibility, dexterity and endurance, are processed using a software electronic product "Health Passport". The structure of the program includes nine blocks containing student personal information and encryption to protect the right to medical confidentiality. The main advantage of the program is the information base formation of the general, social, physical and mental components of students' health and the ability to identify risk factors for their main diseases.

By the means of another innovative, specially developed in the laboratory of the Center of Health Saving

Technologies and integrated into the database of monitoring studies program "Automation of determining indices of human physical development" the basic indices of students' physical health are calculated automatically, the level of their physical fitness and state of health are determined.

The data obtained are automatically compared with the standards of students' physical development and physical fitness (2014) developed by the initiative group of INRTU scientists [18], which have five levels ("low", "below average", "average", "above average", "high"). Standards are developed for each age and gender category and provide an opportunity to compare the absolute and calculate the relative values of the studied parameters.

**III. RESULTS AND DISCUSSION**

Studies during the last decade show, against the background of a decrease in the number of healthy students, their quantitative redistribution within each department according to levels of physical development and physical fitness has occurred. It was revealed that the most evident changes appeared among students with deviations in their health status and referred to the department of the third functional group (Table 1).

**TABLE I. COMPARATIVE CHARACTERISTICS OF THE STUDENTS DISTRIBUTION OF THE III FUNCTIONAL GROUP ON THEIR PHYSICAL DEVELOPMENT CLUSTERS (ON A PERCENTAGE BASE)**

<b>Indices</b>		<b>L</b>	<b>BA</b>	<b>A</b>	<b>AA</b>	<b>H</b>
<i>Physical development</i>						
<i>female</i>						
Height (cm)	*	7.28	15.62	50.58	17.94	8.58
	**	8.16	21.73	47.15	15.47	7.49
Weight (kg)	*	2.94	16.1	61.38	9.94	9.64
	**	2.07	13.15	58.17	16.31	10.3
Chest circumference (cm)	*	4.22	16.5	60.96	10.2	8.12
	**	4.97	18.9	58.21	9.92	8.0
Stange's test (sec)	*	10.3	19.9	47.8	12.88	9.12
	**	12.2	21.3	47.62	11.2	7.68
Gench's test (sec)	*	3.0	16.86	51.66	15.98	12.5
	**	4.97	19.01	50.42	13.7	11.9
<i>male</i>						
Height (cm)	*	7.04	8.62	61.4	17.06	5.88
	**	8.91	12.51	57.9	15.12	5.56
Weight (kg)	*	5.58	18.96	49.8	15.94	9.72
	**	5.99	13.5	49.56	18.95	12.0
Chest circumference (cm)	*	3.8	10.04	65.84	13.7	5.9
	**	4.92	13.99	63.99	12.17	4.93
Stange's test (sec)	*	4.42	18.14	53.48	12.26	11.7
	**	4.99	23.17	51.9	11.16	8.78
Gench's test (sec)	*	3.58	18.22	52.4	15.3	10.5
	**	5.12	21.97	50.4	12.7	9.81
Commentary: L - «low», BA - «below average», A - «average», AA - «above average», H - «high»; * - data obtained from the monitoring studies in 2009, ** - data obtained in 2019						

Analysis of the students' distribution of the third functional group showed that both male and female students demonstrate a tendency to decrease in height: there is a declining number of students with "average" height and an increasing number of students in clusters "below average" and "low". Notably, male students aged 17 and younger (31.1%) contribute more to such redistribution. If in 2009, the "average" cluster of this age category, according to the standards developed for the Pribaikalsky region, met the height of male students in the range from 175.0 to 183.6 cm, then in 2019 it corresponds to the interval from 171.1 to 176.3 cm. The group of male students aged 18 years (29.7%) made a smaller contribution. The "average" range of this group in 2009 corresponded to 166.1-187.9 cm, in 2019 - 166.0 - 174.5 cm.

Among female students, 19-year-old female students made the largest contribution to the group of "average" indices (25.9%). If in 2009 their "average" range corresponded to 161.6-169.6 cm, then in 2019 it is limited to an interval from 159 to 168 cm.

It is known that the human body length is one of the factors of its general health with a fairly high genetic determination coefficient (95%) [19], a predictor of its viability and the health condition of the cardiovascular system. Therefore, a decrease in the values of this index denotes a decrease of their innate vitality potential and the health of the basic life support system among the students of the third functional group.

Larger representation of the "above average" and "high" groups suggests the increase in the proportion of these clusters among students of both gender groups in terms of "weight" index. The "above average" cluster was mostly increased due to the number of female students of 18 (29.4%). If in 2009 girls with a weight of 63.0 - 69.3 kg were assigned to this group, then in 2019 - 65.6 - 71.2 kg. The proportion of female students aged 19 years (24.4%), 20 years (23.7%) and 21 years (21.6%) increased, whose weight also corresponds to the "above average" level. For 19-year-old female students, it corresponded to the range from 62.9 to 68.8 kg in 2009 (in 2019 - 63.3-69.7 kg). In 2009, female students aged 20 years made up the contingent of this cluster, provided that their weight ranged from 61 to 65 kg, and in 2019 its range correlated with the interval of 65.2 - 74.1 kg.

Among male students, the increase in the share of "above average" and "high" clusters was due to their redistribution from the "below average" cluster, and with male students aged 21 years (in 2009, according to the standards, this cluster corresponded to 75.4-81.3 kg, but in 2019 it corresponds to the range from 78.8 to 84.1 kg).

As for the cluster of "average" values, the female students have a quantitative decrease in this group due to their redistribution into "problem" clusters, while practically no changes are observed among the male students within this indicator.

In the comparison of physical fitness clusters of students of the third functional group (Table 2), an increase in the number of female students is observed, whose results correlate with the levels of "average", "above average" and "high" in the values of strength indicators according to the

"push-up" test. The greatest improvement in the values of this test indicators is observed among female students aged 18 (in 2009 - 16-28 times, in 2019 - 27-41), 19 (in 2009 - 16-27 times, in 2019 - 31-44) and 20 years (in 2009 - 15-24 times, in 2019 - 27-40) of the "average" cluster.

However, monitoring studies of the physical fitness of female students showed a decrease in values of the endurance test indices (in the 1000 m race) among female students.

Female students aged 17 years and younger made a significant contribution to the "low" cluster (in 2009 this level corresponded to the range from 3.38 to 5.26 minutes, in 2019 - 4.48 to 5.54 minutes), to the "below average" cluster - female students aged 21 years (in 2009 - from 5.0 to 5.45 minutes, in 2019 - 5.02 - 6.59 minutes).

TABLE II. COMPARATIVE CHARACTERISTICS OF THE STUDENTS DISTRIBUTION OF THE III FUNCTIONAL GROUP ON THEIR PHYSICAL DEVELOPMENT CLUSTERS (ON A PERCENTAGE BASE)

Indices		L	BA	A	AA	H
<i>Physical development</i>						
<i>female</i>						
1000 m race (sec)	*	4.9	18.9	48.3	13.1	14.8
	**	7.7	22.3	47.1	10.0	12.9
Hang position (sec)	*	14.6	27.7	37.9	10.2	9.6
	**	14.5	29.1	37.7	9.8	8.9
Sit-up per 30 sec (times)	*	11.2	13.1	50.7	13.1	11.9
	**	11.6	15.9	49.9	12.7	9.9
Standing long jump (cm)	*	9.0	19.28	49.8	17.6	4.32
	**	10.4	21.56	48.5	15.1	4.44
Press-up (times)	*	14.6	24.56	45.7	9.1	6.04
	**	9.58	15.6	53.22	11.2	10.4
<i>male</i>						
1000 m race	*	6.06	9.62	59.4	16.04	8.88
	**	7.99	10.7	57.01	15.56	8.74
Pull-up (s)	*	9.82	17.97	48.8	16.93	6.48
	**	14.0	25.5	42.56	12.95	4.99
Sit-up per 30 sec (times)	*	5.82	10.7	63.9	13.04	6.54
	**	5.92	13.99	61.99	12.17	5.93
Standing long jump (cm)	*	5.52	17.04	53.58	12.06	11.8
	**	6.97	24.18	49.9	10.17	8.78
Press-up (times)	*	5.13	19.66	50.5	14.8	9.91
	**	4.58	15.22	53.4	16.4	10.4
Standing forward bend	*	8.1	12.8	55.8	12.8	10.5
	**	7.81	10.6	57.99	13.5	10.1
Commentary: L - «low», BA - «below average», A - «average», AA - «above average», H - «high»; * - data obtained from the monitoring studies in 2009, ** - data obtained in 2019						

The most significant decrease in results is observed in the "pulling up" test at the "average", "below average" and "low" levels among male students. The largest contribution to the "low" (according to the standards of 2009 - <2 times; in 2019 - <3 times), and to the cluster "below average" (2-4 times in 2009 and 5-8 times in 2019) was made by the male

students aged 21 years (29.9% and 27.4% respectively), i.e. students who are unable to engage in physical culture due to the lack of practical training for this age category (3-4 courses). Moreover, the main contribution to the reduction in the number of students in the “average” cluster within pull-ups tests was also made by students aged 21 years and older (39.4%). However, it is important to note their improvement in the indices values for the flexibility test “forward bend while standing on the gymnastic bench”: there was a redistribution of the number of students into clusters of “average” (27.7%) and “above average” (29.5%) values (the “average” cluster in 2009 corresponded to the range of 3–15 cm, “above average” - 16–22; in 2019 - 8–17 and 18–24 cm, respectively).

#### IV. CONCLUSION

Thus, monitoring studies allow to obtain complete information about the physical development and physical fitness of each student, group, course, training program (technical, humanitarian, creative), track gender and age characteristics of the student audience and make informed decisions on the correction of the educational process. This information helps teachers, working with students of the third functional group, to place them into separate subgroups and to find effective means of influencing a targeted, prenosological correction of their physical health.

Analysis of the physical development and physical fitness of INRTU students showed that over the past decade there was a decrease in the value of height index and an increase in weight of the students. Moreover, the vector of change is the same for both gender groups.

According to the results of monitoring studies, there is an increase in the strength endurance of the arm muscles among female students, but a decrease in the shoulder strength among male students. At the same time, there is a decrease in total endurance of female students. The male students have improved the values of flexibility index.

To assess the motor fitness of the third functional group students, it is important to focus on individual values and their growth rates in terms of their physical development and physical fitness. Taking into account the initial characteristics of the parameters under monitoring studies at the beginning of the academic year, it is necessary to compare them with the final values obtained at the end of the next stage (course) of study at the higher education institute.

Monitoring technologies are designed to improve the quality of life of domestic universities students, to ensure such a quality it is important, first of all, to form competences in the field of health-saving technologies on the basis of modern scientific achievements and the ability to apply them in everyday life [20], it is necessary to form positive motivations of students to systematic physical exercises and a healthy lifestyle. It is necessary to find new opportunities for increasing the physical activity of young people, ensuring the enrollment of student groups taking into account their health status, level of physical fitness, preferences in the choice of physical exercises and sports specialization.

Study and analysis of the physical development and physical fitness characteristics of students who regularly attend classes, with a certain degree of caution, makes it possible to evaluate the work of a teacher of Physical Culture department, motivating everyone to increase their level of professionalism, find ways to improve the pedagogical process, and form an appropriate educational and methodical technical base.

Monitoring as an integral part of the Russian public health care system, innovative technologies for the study and analysis of students’ physical development and physical fitness, allow you to plan and effectively organize the educational process in the disciplines "Physical culture" and "Elective courses in physical culture and sports." Additionally, the introduction of effective health-saving and health-forming technologies contributes to the health improvement of students, and therefore, to the economic well-being of the state in perspective.

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