

ON ASSESSMENT OF PHYSICAL DEVELOPMENT OF UNIVERSITY STUDENTS

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Health of the younger generation determines the prospects of social and economic development of Russia. So, concern for healthcare of the youth is displayed in fundamental state documents (including the 'Fundamentals of the state youth policy of the Russian Federation for the period up to 2025') [1]. In accordance with its relevance, we conducted research aimed at examination of physical development of 1,820 students of the first and fourth years from four Universities of the Republic of Bashkortostan. Based on the past experience, standards of physical development for students from the Republic of Bashkortostan were developed and registered. A retrospective analysis was done comparing data related to modern students from the Republic of Bashkortostan and the ones related to the standard of physical development of students from the Republic of Bashkortostan obtained 25 years ago. The results reveal a tendency (during the last quarter of a century) to asthenization of modern youth from the Republic of Bashkortostan. The functional reserves of the cardiovascular and respiratory systems of students were assessed using the circulatory and respiratory Skibinski's index. It is established that in students, the mean Skibinski's index was 24.8 ± 0.3 , which corresponds to the 'satisfactory' range only. The program called 'Software to assess physical development and adaptation capabilities of the body' was developed and registered at the Federal Institute of Industrial Property aimed at determination of a risk group of diseases among students depending on their physical development, functional condition and adaptive capabilities of the body.

Keywords: students, universities, physical development standards, computer program

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Compliance with ethical standards: report of the local ethics committee 'Bashkir State Medical University' of the Ministry of Health of Russia as of Jan. 20, 2021 (protocol No. 1) was submitted. The participants signed the informed consent.

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ОБ ОЦЕНКЕ ФИЗИЧЕСКОГО РАЗВИТИЯ СТУДЕНТОВ ВУЗОВ

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Здоровье подрастающего поколения определяет перспективы социально-экономического развития России, поэтому забота о здоровьесбережении молодежи отражена в основополагающих государственных документах (в том числе в «Основах государственной молодежной политики Российской Федерации на период до 2025 года» [1]). В соответствии с актуальностью нами было проведено исследование, направленное на изучение физического развития 1820 студентов I и IV курсов четырех вузов Республики Башкортостан (РБ). По результатам работы разработаны и зарегистрированы стандарты физического развития студентов РБ. Проведен ретроспективный сравнительный анализ современных студентов РБ с данными стандарта физического развития обучающихся Республики Башкортостан 25 лет назад. Полученные результаты свидетельствуют о тенденции (за последние четверть века) к астенизации современной студенческой молодежи Республики Башкортостан. Проведена оценка функциональных резервов сердечно-сосудистой и дыхательной систем студентов с помощью циркуляторно-респираторного индекса Скибинской. Установлено, что средний показатель индекса Скибинской у студентов составил $24,8 \pm 0,3$, что соответствует лишь диапазону «удовлетворительно». Разработана и зарегистрирована в ФИПС программа для ЭВМ «Программное обеспечение для оценки физического развития и адаптационных возможностей организма», целью которой являлось определение группы риска развития заболеваний у студентов в зависимости от физического развития, функционального состояния и адаптационных возможностей организма.

Ключевые слова: студенты, вузы, стандарты физического развития, программа для ЭВМ

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The Law 'On Education in the Russian Federation' as of December 29, 2012 No. 273-FZ [2] pays great attention to health protection of students and includes health promotion and education.

Considering relevance of health preserving and promotion of the youth, we analyzed physical development of 1,820 students of the 1st and 4th years from four universities of the Republic of Bashkortostan (Ufa State Aviation Technical University, Bashkir State Agrarian University, Financial University under the Government of the Russian Federation, Bashkir State Pedagogical University named after Akmylla M.).

MATERIALS AND METHODS

Physical development of students was estimated at higher educational institutions using certified appliances. 22 indicators were analyzed with some of them (height, body mass, thoracic region, pulmonary capacity, timed inspiratory capacity, pulse during 1 min, spine flexibility) being described in this article.

The functional reserves of the cardiovascular and respiratory systems in students were assessed based on the circulatory and respiratory Skibinski's index. It was calculated as follows:

$$[(VLC \text{ (in ml)} / 100) \cdot A] / B,$$

where VLC is vital lung capacity in ml, A is breath holding after respiration (c), B is pulse rate (beats per min.).

Normal indicators: <5 for very bad, 6–10 for unsatisfactory, 11–30 for satisfactory, 31–60 for good, and >60 for very good [3, 4].

Portable spirometer (УСПЦ-01. Technical specification 9442–001–188596072007. Marketing authorization No. ФСП 2007/00694. Compliance certificate No. 11/0272016) was used to measure VLC.

Statistical methods of data processing such as r (correlation coefficient), R (regression coefficient), V (variation coefficient), σ (mean square deviation), t (Student t -test), M (weighted arithmetic mean), m (mean error of weighted arithmetic mean) were used while working with standards of physical development of students from the Republic of Bashkortostan.

The following results were obtained during this work:

- Incorporation certificate of database at the Federal Institute for Industrial Property No. 2018621629 'Tables evaluating physical development of students from Ufa, Republic of Bashkortostan' [5].
- Standards to assess physical development of students from the Republic of Bashkortostan (approved by the acting Minister of Healthcare from the Republic of Bashkortostan Zabelin MV No. 133 as of July 20, 2019; approved by the Chief Public Health Officer of the Republic of Bashkortostan Stepanov EG No. 158–19 as of May 05, 2019).
- Incorporation certificate of database at the Federal Institute for Industrial Property No. 2022620676 as of March 30, 2022 'Physical development of children, adolescents and youth in the Russian Federation in 2000–2001 (et al.)' [6].

RESEARCH RESULTS

The following mean indicators were obtained while working with **standards of physical development obtained from the students of the Republic of Bashkortostan who are 17 to 22 years old**: body length is 164.0 ± 0.3 and 176.8 ± 0.3 cm

and body mass is 56.8 ± 0.3 kg and 70.0 ± 0.2 kg in young women and young men, respectively.

Of those examined, 13.3% of male students and 13.1% of female students had the below-average level of physical development; whereas 1.9% of male students and 3.3% of female students had low physical development.

Retrospective comparative analysis was conducted based on the obtained results. 17-year-old students of today were compared with those studied in the Republic of Bashkortostan in 1996 [7]. 25 years later, young men were 2.3 cm higher (174.2 ± 0.39 and 171.9 ± 0.6 cm, $p < 0.05$), however, their body mass insignificantly increased by 0.2 kg (62.9 ± 0.5 kg in modern students and 63.1 ± 0.4 kg in those studying in the end of 1990s). Young women of today were only 0.5 cm higher as compared to those in 1996 (162.9 ± 0.5 and 162.5 ± 0.6 cm respectively). However, in young women of today, body mass was significantly lower (2.1 kg) than in those studying in 1990s (54.5 ± 0.5 and 56.6 ± 0.6 kg respectively, $p < 0.05$).

In relation to thoracic organs, a decrease in values was noted among students of both genders as compared to those studying in 1990s ($p < 0.05$). In young men, the indicator was 3.2 cm lower (85.2 ± 0.3 and 88.4 ± 0.7 cm), in young women, it was 4.6 cm lower (80.8 ± 0.4 and 85.4 ± 0.6 cm).

The results determined the tendency (within a quarter of a century) to asthenization of young students in Bashkiria.

1. When assessing the functional reserves of the cardiovascular and respiratory systems of students using the **Skibinski's circulatory and respiratory index** it has been established that the mean value was 24.8 ± 0.2 (within the 'satisfactory' range).

56% had a 'satisfactory' indicator, 12% results were 'very bad' and 'not satisfactory'. Only in 32% of young people the indicator ranged within 'good' and 'very good'.

2. Analysis of **flexibility indicators in the lumbosacral area of the spine** [8] has shown that in 61.6% of female students and 57.9% of male students the indicator was 'good' and 'excellent'. Meanwhile, 22% of women and almost every third young man (29.2% of all male students) had 'bad', 'very bad' and 'critical' indicators.

It has been established that the mean value of the indicator estimating the spinal flexibility constitutes 8.8 ± 0.2 cm in young women and 7.1 ± 0.1 cm in young men.

Gender-based differences were taken into account at this stage of the trial (fig.). As a whole, (all students) had a mean indicator of 8.1 ± 0.1 cm ('good').

During analysis of indicators of flexibility of the spine, the 'critical indicators' were observed in 7.9% of young men and 4.8% of young women.

3. As a result, we developed 'Software to estimate physical development and adaptive capabilities of the body' **computer program** (certificate No. 2020618022 as of July 16, 2020) [9]. The program is aimed at determination of risk of diseases in students depending on their physical development, functional condition and adaptive capabilities of the body.

Primary processing of data obtained while examining physical development and adaptive capabilities of students was done through the indicator aggregation method and using a generalized Harrington function during assessment of 11 clusters. Each cluster contains a number of indicators that characterize these or those qualitative attributes of students' health. The indicators were aggregated using the generalized Harrington function. Linguistic values of the indicator and quantitative intervals were compared using the desirability scale (table 2).

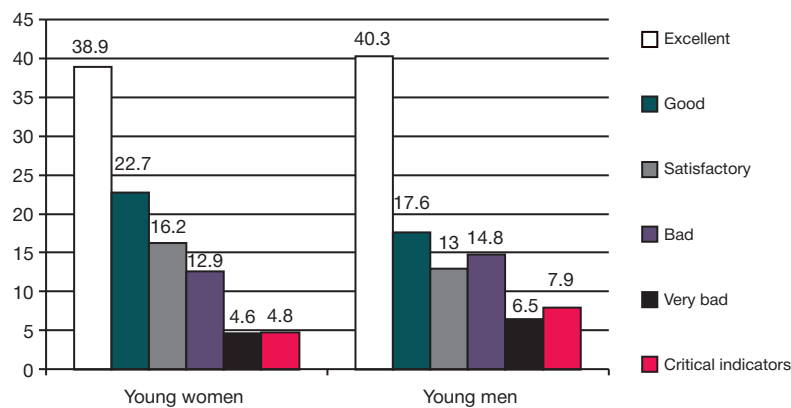


Fig. Distribution of students depending on flexibility in the lumbosacral area of the spine (young women and young men,%)

Table 1. Comparative analysis of flexibility in the lumbosacral area of the spine considering difference in gender-based criteria (%)

Evaluation criteria	Evaluation criteria for young females (cm)	Results (young females, %)	Evaluation criteria for young males (cm)	Results (young males, %)
Excellent	12 and more	38.9	10 and more	40.3
Good	8–11	22.7	7–9	17.6
Satisfactory	5–7	16.2	4–6	13.0
Bad	1–4	12.8	1–3	14.8
Very bad	-3–0	4.6	-5–0	6.5
Critical indicators	-4 and more	4.8	-6 and more	7.9

Table 2. Harrington's desirability scale

Desirability	Desirability marks
Very good	1.00–0.80
Good	0.80–0.63
Satisfactory	0.63–0.37
Bad	0.37–0.20
Very bad	0.20–0.00

The advantage of the function is that during aggregation and generation of the Harrington's desirability function the mutual effect of indicators is recorded in a non-linear way. In other words, compression by indicators or non-linear compression occurs. Numerical intervals of the generalized Harrington's desirability function were compared with linguistic estimates traditionally formulated in hygiene, which enables to identify health risk groups.

However, translation of a linguistic value of every indicator and quantitative interval using the desirability scale is very time-consuming. Thus, we developed software aimed at optimization of this process. It is necessary to differentiate between risk groups. It allows timely conduction of medical and pedagogical and social activities among students.

DISCUSSION OF RESULTS

Some authors also note an increased number of asthenic students. Galkina TN, a researcher, reported that 37% of students from Penza had an asthenic body type [10]. According to Kubieva SS et al. [11], a similar number of young women and men with normosthenic constitutional type (60% each) predominate among students from Tyumen. It means that there are 15% more of asthenic young men than young women, corresponding to a more significant number of asthenic male students as compared to female students.

A marked weight deficit was established in 22% of young men and 22.4% of young women from Ulyanovsk [12].

With age, the body weight gain occurs mainly due to fat deposit [13].

In women from Saratov, hygienic development was seen in 68% of cases [14]. In those educated in Vladivostok, weight deficit was found in 22% of young women and 10% of young men. 75% of young women and 71% of young men have balanced development [15]. According to Bokareva NA, it has been established that only 68% of young examined women from the Moscow Medical University had balanced physical development [16].

Considering high intensification of the educational process and hypodynamia of students, their physical upbringing becomes relevant [17].

According to Polish investigators, refusal from old control criteria makes it necessary to search for new forms of assessing physical condition of students [18].

CONCLUSIONS

The research results testify that it is necessary to conduct a preventive activity aimed at detecting students from the risk group and formation of positive hygienic behavior among young people.

Prenosological diagnostics that estimates physical development, functional condition and adaptive capabilities of the body enables to detect unfavorable tendencies in population health and timely conduct preventive activities.

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