O. V. Gromova, A. Y. Nadtochy, A. V. Kulemzin, S. V. Yakhontov

**FUNCTIONAL RESERVES AS A FACTOR OF OPTIMALITY OF LOADS IN HIGH SCHOOL PHYSICAL EDUCATION**

The results of our research show the necessity of differentiation of the variable parts of high school educational program in compliance with the results of complex evaluation of functional reserves of students engaged in physical culture.

**Key words:** physical education in high school, the efficiency, functional capabilities of the organism, adaptability, physical development, and monitoring.

**Introduction.** Physical education is an important part of a university educational process. The scope and content of compulsory physical training is established by the State Education Standard, which includes a complex of measures aimed at harmonizing of the individual, enhancing and supporting one’s mental and physical capacity for work (B. K. Zamarenov, M. R. Jacks, V. G. Nikonov).

Recent year research shows the importance (urgency) of improving physical education of high schools students. The crisis in the sphere of physical education and the need for innovations in this area have been also indicated in a number of studies (R. A. Abzalov, M. J. Vilinsky, Y. D. Zheleznyak, A. J. Nine, R. A. Piloyan etc.). The main reason of the high school physical education problems lies in the entrenched habitual standardized approach to the organization of physical culture educational process. In most cases, this approach is based on the primacy of physical fitness of students who are involved in this process and insufficient attention to the features of the organism (V. P. Gladenkova, I. V. Merkulov). Meanwhile, the discrepancy between the level and nature of physical activity and a real level of functional features of the body reduces the efficiency of educational process and makes the improvement of physical education at high school an urgent problem [1].

**Methods.** The main group consisted of 164 students of the first- fourth grades of Tomsk universities. The physical development testing of this group included the estimation of parameters of physical fitness and functional reserves within the common high school program scope. The dynamics of the parameters of the physical development was being monitored for 8 semesters of physical training at high school (Table 1).

The syllabus of physical education of this group satisfied the requirements of the normative documents for physical education at high school institutions. Together with the monitoring of physical development of the core group (164 persons), engaged in the standard program, a group of 65 people was organized, which in its turn was divided into three experimental (“A”, “B” and “D”) and one control (“C”) sub-type according to the type of their vegetative stability. While the control group consisted of students with vegetative stability, the experimental groups represented different kinds of vegetative instability (Table 2). The syllabus of all three groups was absolutely identical to that of the main group. At the end of the training testing of physical fitness and functional features of the experimental subgroups was carried out and compared with the testing results of the main group.

**Results.** During the 8 semesters of monitoring of physical development parameters either constancy or a negative trend of almost all indicators of physical fitness and functional reserves of students were observed (Table 1).

The absence of significant changes and the negative trend of the most part of the parameters of physical development proved low efficiency of physical training. In our opinion the reason of this is the fact that the content of the standard syllabus for physical education is not fully consistent with the functional features of the organism [2, 3]. The real reason for the low efficiency of training was the lack of conditions which could make possible individually different
entiated approach to students which could provide the best accordance between the syllabus content and the functional features of physical education students. Supposition was confirmed by the survey results of the experimental and control subgroups (Table 2).

Subgroup C had the lowest power quality (flexion-extension hand-ups). Similar results were obtained during dynamometer testing. At the same time, the results of the subgroup in arm’s length (strength endurance) were also the smallest. Physical efficiency (IGST) in subgroups A and D compared to the control group was almost identical, while IGST was the largest in the group with gipoadrenergetic syndrome (“B”). However, differences in the IGST were insignificant. Thus, the differentiation of the students according to the selected functional characteristics may be useful to achieve maximum compliance of the level and kind of exercise that make up the content of training programs with the functional capabilities of students.

**Discussion of results.** The concept of “functionality of the body” includes the possibility of not only blood circulation and respiratory system, but virtually all anatomical and functional systems. At the same time both in the Federal Law “On Physical Culture in Russia” and in the practice of physical culture, the attention in evaluating of the functionality of the body’s maximum has been given only to the resources of cardiovascular and respiratory systems [4]. Nevertheless, recent years more attention has been paid to the “hidden” features of the organism, which are determined by the regulatory systems of the body (nervous and endocrine). It is a generally accepted fact nowadays that the state of these systems determines the adaptive resources of the human organism, whereas the cardiovascular and respiratory systems are not totally independent and depend on regulatory mechanisms at all levels [5, 6].

Numerous research works point to the urgent necessity of a more expanded interpretation of “human capabilities”. It is obvious, though, that it is difficult to highlight some basic parameters, reflecting the effectiveness of physical development of students.

The matter is that the concept of “natural development” requires some explanation and clarification. Despite the existence of some differences in views on the essence of this concept, physical development includes not only indicators of anthropometry and physical qualities (strength, speed, agility, endurance and flexibility), physical fitness (complex index of development of physical qualities), but also the parameters of the functional features of the body.

However, the current practice of physical training scores such an important indicator as the functionality of the body is limited to only a minimal estimate of the autonomic component of the reaction of the cardiovascular and, partly, the respiratory system to exercise (this fact highlighted by an oval of gray in Fig. 1). Nevertheless, recent data in the field of physical culture indicates that the evaluation of functional abilities of the body will be adequate only if you use a set of interrelated parameters of at least three of its components – the neuro-muscular, emotional and vegetative (Fig. 1).

Recently this question has been paid much attention to. It has been shown that the maximum effect of physical training can be gained only under the condition of the most total conformity of the program content to the functional features of the body, while the latter must be evaluated as a set of morphological, physical and functional parameters.

### Table 2

<table>
<thead>
<tr>
<th>Name of measure</th>
<th>“C” n=33</th>
<th>“A” n=15</th>
<th>“B” n=12</th>
<th>“D” n=5</th>
</tr>
</thead>
<tbody>
<tr>
<td>un 30 meters:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>a) Arterial pressure, systolic, mm of mercury</td>
<td>126±1.1</td>
<td>126.7±3.4</td>
<td>148±2</td>
<td>132±4.8</td>
</tr>
<tr>
<td>b) Arterial pressure, diastolic, mm of mercury</td>
<td>72.8±2.7</td>
<td>74.1±2.4</td>
<td>76.6±3.3</td>
<td>68±3.7</td>
</tr>
<tr>
<td>c) Arterial pressure, pulse, mm of mercury</td>
<td>53.2±1.4</td>
<td>52.6±1.1</td>
<td>71.4±1.2</td>
<td>64±1.1</td>
</tr>
<tr>
<td>d) Pulse Rate, beats/minute</td>
<td>128±3.2</td>
<td>131±6.4</td>
<td>108±2.2</td>
<td>118.8±2.2</td>
</tr>
<tr>
<td>e) VIK, %</td>
<td>43±0.4</td>
<td>43.4±2.3</td>
<td>29±1.1</td>
<td>42.8±2.7</td>
</tr>
<tr>
<td>f) CEC, standard unit</td>
<td>683±6.1</td>
<td>689±8.7</td>
<td>771±10</td>
<td>760±5.9</td>
</tr>
<tr>
<td>Length of standing broad jump (sm)</td>
<td>193±3.4</td>
<td>191.1±6.6</td>
<td>165±1.9</td>
<td>200±5.6</td>
</tr>
<tr>
<td>Index of Harvard step-test: (standard unit)</td>
<td>42.4±0.8</td>
<td>42±0.6</td>
<td>51.4±2.5</td>
<td>42.7±2.4</td>
</tr>
<tr>
<td>Bending and extension of arms in lying support (times)</td>
<td>24±1.7</td>
<td>24.2±1.6</td>
<td>18.3±1.5</td>
<td>25.8±0.9</td>
</tr>
<tr>
<td>Dynamometry: Right hand (kg) Left hand (kg)</td>
<td>20.7±2</td>
<td>21.6±1.7</td>
<td>10±1.7</td>
<td>24.2±1.3</td>
</tr>
<tr>
<td>Weight holding 4 kg (sec)</td>
<td>39.5±2.8</td>
<td>40±3.2</td>
<td>25.6±2.7</td>
<td>48.4±9.7</td>
</tr>
</tbody>
</table>

Note: “C” is a control group; “A” is a group with giperadrenergetic syndrome, “B” is a group with gipoadrenergetic syndrome, “D” is a group with the dissociative changes in blood pressure and pulse rate. VIK is vegetative index Kerdо, IGST is index Harvard step test, CEC is coefficient of economization of blood circulation. * Indicates significant difference with respect to the subgroup “C”. 

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In our opinion, the concept of an extended evaluation of functional features, affecting the parameters of physical fitness, makes it possible to optimize the conditions of physical education in high school with the elective components of working programs in accordance with the results of the monitoring functional features of students (Fig. 2).

Achievement of maximum compliance of the intensity and nature of physical activity with the level of the functional abilities of the body will ensure implementation of the objectives of youth physical education.

Thus, it can be possible to achieve a high level of physical development of the involved in physical activity only under the condition of when the technology of physical training is aimed at improving the quality of the factors determining the physical development of the organism. Providing these technologies is the primary objective condition of modern physical education of the students at universities with the regard to their specificity.

References

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Received 03.05.2011.
На основе результатов собственных исследований показана необходимость дифференцировки вариабельной части программ по физической культуре в вузе в соответствии с результатами комплексной оценки функциональных резервов занимающихся физической культурой.

Ключевые слова: физическая культура в вузе, эффективность, функциональные возможности организма, адаптивность, физическое развитие, мониторинг.

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