PHYSICAL PERFORMANCE OF STUDENTS IN TRANSPORT VOCATIONAL EDUCATION

Kosareva, Irina A., *Russian University of Transport, Moscow, Russia.*
Romanov, Alexey A., *Russian University of Transport, Moscow, Russia.*
Nigay, Ruslan M., *Russian University of Transport, Moscow, Russia.*

ABSTRACT

The article is devoted to the study of physical performance in the railway college. The authors propose a computer program written by them for this purpose, the novelty of which is that it determines, through control measurements and test checks, physical performance of a student in relation to his future specialization. Moreover, during the entire training period (3–4 years), it is possible to make adjustments to the plan of physical education with the student depending on his indicators and thereby contribute both to overall professional training and development of those individual qualities that will help to strengthen the physical potential of the graduate of the industry educational institution.

Keywords: railway transport, college, physical performance, students, physical efficiency, fitness, medical groups, computer program, tests.

Background. *The well-known English historian of 19th century Macaulay quite rightly remarked that with the exception of invention of letters and printing presses, the discoveries and inventions that are aimed at shortening distances were most conducive to and will contribute to the successes of civilization. Ways of communication play an important role in the history of human development. And it is very important that professionals who are trained to work in transport meet this role.*

Objective. *The objective of the authors is to consider physical performance of students in transport vocational education.*

Methods. *The authors use general scientific methods, comparative analysis, mathematical apparatus, graph construction.*

Results.

1.

At the present stage, the educational institutions of the railway branch assume tasks of preparing a highly qualified specialist with an initiative, creative independence, the ability to solve job problems of any complexity, to orient themselves in related fields of knowledge, ready for cooperation and interactive interaction in the information society. At the same time, one of the guidelines and, also the condition for development of vocational education remains provision of the physical capacity of students to assume future tasks.

The experience of Moscow College of Railway Transport shows that working with complex equipment requires attention of the specialist, speed, endurance, emotional and mental stability. In colleges and technical schools this, as a rule, is promoted by physical culture and mass student sport.

The introduction of physical culture and sports into the everyday life of students, the increase in the number of sports sections suggest the search for forms and methods of muscle training aimed at solving health problems, increasing physical and professional performance, developing motor qualities and preventing diseases.

Railway transport carries great losses from diseases caused by a number of unfavorable production factors, including lack of motor activity, neuro-emotional stresses, overloading of the neuromuscular and musculoskeletal system [1]. From this it follows that prevention of diseases by means of physical culture must begin already in a profile educational institution and continue successively in on-job conditions [2].

In this context, the definition of the physical performance of students is of particular importance for future railway workers.

The concept of «physical performance» takes its rightful place in the physiology of sports, theory and methods of sports training [3]. At the same time, there are still no clear and generally accepted definitions of this and similar terms [4].*

In the most general sense, physical performance means the ability to perform work [5]. In the dictionary of physiological terms, physical performance is the potential ability of a person to perform a maximum amount of work within a given time due to significant activation of the neuromuscular system.

In the field of sports physiology, scientists [6, 7, 8] characterize physical performance as the ability of an athlete to perform a specific job for him: to raise the maximum gravity, to develop the maximum speed, to keep a high tempo in martial arts, to overcome fatigue over a long distance.

2.

To study the physical performance of students of the railway college, we first of all divided numerous industry specialties according to their professional affiliation into four main groups, depending on severity and intensity of labor.

1 group – professions of light physical labor associated with performance of simple monotonous operations. Small movements with stress of attention and vision with limited mobility quickly weary people with their monotony. Working sitting posture causes static tension of many muscle groups, disrupts blood circulation in the legs and lower body, creates a deficit of motor activity.

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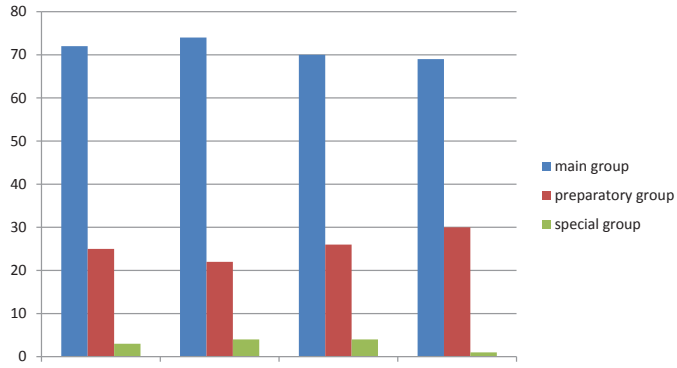
* – As the authors focus the study on practical aspects of measuring physical performance of students with regard to their future employment in transport sector, and see that Russian term describing it in general is common and quite unambiguous, the authors did not meet problems while using it. But as we can see, English terms describing divers aspects of the phenomenon under the study are more nuanced and comprise e.g. «physical performance», «physical efficiency», «physical capacity», «physical fitness», so the choice of the term «physical performance» for translation is inspired merely by the desire to use the most general term without insisting on its singularity. – ***Ed. note.***



Pic. 1. Results of the study of physical performance (Ruffier's test) of students of Moscow College of Railway Transport.

2 group – people engaged in manual labor of medium gravity. Their work in a posture standing or standing and moving equally includes elements of mental and physical labor, requires the stress of attention. Movements are diverse, dynamic, with moderate physical effort. And yet they cause fatigue.

3 group – professions of heavy physical labor, which involves expenditure of great physical effort, usually performed while standing in motion with participation of virtually all muscle groups, causes considerable physical fatigue.

4 group – professions focused mainly on mental work, requiring intellectual, nervous, emotional stress. The work is inactive, without physical effort.

At the second stage of the study, we used various tests. For example, a computer program was developed that allows calculating the physical performance of students in two ways: with the submaximal PWC-170 test and the Harvard step test [2].

The PWC-170 test is used to determine the degree of health of the body at a pulse rate of 170 beats per minute. The choice of this frequency is predetermined by the fact that the zone of optimal functioning of the cardiovascular system during the performance of the muscular load is in the range of 170–190 beats per minute and the relationship between the heart rate and exercise capacity remains linear up to 170 beats; at higher indices, the linear character of the dependence is disturbed as a result of activation of anaerobic mechanisms of muscular activity.

Evaluation of the PWC-170 test can be conducted in two ways: graphical and mathematical. The program uses a mathematical method of calculation. The performance is determined by substituting in the formula the heart rate value for 1 minute (f1 and f2) and the power of the first (W1) and second (W2) load:

$$PWC_{170} = W1 + \frac{(W2 - W1) \cdot (170 - f1)}{f2 \quad f1}.$$

The Harvard step test is convenient for determining the adaptive capacity of the organism to physical loads. It is based on registration of heart rate after the measured physical load and makes it possible to determine the course of recovery processes.

Suppose that the data on the time of ascent to a step is recorded in the program. At the end of the test, the examinee sits down and rests. He is counting the heart rate for the first 30 seconds of 2, 3, 4 minutes of the recovery period. The test results are substituted into the equation:

$$IHST = \frac{t \cdot 100}{2 \cdot (f1 + f2 + f3)},$$

where: IHST – Harvard step-test index; t – time of ascent to a step at a given rate in seconds (with a fully executed 5-minute load, this is 300 s); f1, f2, f3 – pulse rate for the first 30 seconds of 2, 3, 4 minutes of the recovery period.

Control tests should be skillfully included by the teacher in the training process, be as accurately measurable as possible. In order for the results to be used and evaluated, they must be statistically reliable [2].

3.

In addition to two described test variants, a computer program was written and prepared for use, which allows calculating the physical performance of students with the help of Ruffier's test.

The choice of this particular test is determined by the following reasons.

Ruffier's test is a simple physical test, according to which you can judge the work of the heart during exercise [8]. The test shows what level of work a person can sustain without a risk to his health, which is especially important when it comes to researching the resource of young people.

Previously, this test has been used only in sports schools and before sports competitions. But after several pupils died in physical education classes from heart failure, doctors obligatory check all students before the beginning of the school year and after each sick leave.

The main principle of tests for assessing the fitness of the heart muscle is to perform simple but intensive physical exercises. During the first few minutes, the frequency of cardiac contractions is measured and compared with generally accepted standards or defined scales. When carrying out the Ruffier's test, squats are usually used at a rather intensive rate, the increase in the heart rate is subject to linear dependence – the more adapted is the heart to the load, the less is the tachycardia after it and vice versa. That is, a trained heart tends to have a normal or even a slow rhythm, rather than a quickened one.

To obtain the Ruffier's index, according to which the heart's fitness is evaluated, the formula is used IR = (4 • (P1 + P2 + P3) – 200)/100. The index is evaluated according to the scale: unsatisfactory result – more than 15; bad – 10–15; satisfactory – 6–9; good – 3–5 (normal), and an excellent result – 0–3 (normal).

Calculation example. Adult man, more than 28 years. P1 at rest before load = 20, P2 in the first 15

seconds after 30 sit-ups = 25, P3 in 15 seconds after a half-minute from the beginning of rest = 23. IR = {4•(20 + 25 + 23) – 200}/100 = 0,72. Excellent work of the heart.

Physical education teachers say that young people who are successfully engaged in sports sections often enough, according to the results of Ruffier's test, are not in the main, but in the preparatory, and often even in special groups. Therefore, they are examined by a sports doctor in a polyclinic – where the survey is more extensive. This is essential for those who need a good physical education score for admission to the relevant higher education institutions (as a rule, training staff of security agencies).

In general, if a child does not get into the main group, the average score of the certificate will not be reflected – when counting the list of subjects, physical education is simply excluded.

Now the mentors have to deal with three groups simultaneously, using three types of physical activity. The approach to evaluation has also changed: previously the results of standards were the dominant factor, now the standards for evaluation do not influence. «If a student is engaged in good faith, follows instructions, improves his results, he deserves a good score», the teachers of physical culture say.

In practice, in college, the Ruffier's test shows in which group in physical education should and can be a student for the state of health. Based on the results of the test, he is given recommendations which group to visit:

A. The main group: absolutely healthy students – they have no problems with the cardiovascular system and there are no complaints about the heart.

B. The preparatory group consists of students at the stage of rehabilitation and with minor deviations in physical development, which, for example, are engaged in the main program, but do not pass the cross-country standards.

C. The special group includes students with chronic pathologies that require an individual approach when performing the exercises.

From the study carried out by us, it follows (Pic. 1):

1. The main group, according to the results of Ruffier's test, comprises 72 % of the students of the 1st year of study, 74 % – of the 2nd, 70 % – of the 3rd, and 69 % – of the 4th.

2. The preparatory group – respectively, 25 %, 22 %, 70 %, 30 %.

3. The special group – 3 %, 4 %, 4 %, 1 %.

General conclusion. *According to the results of testing the physical performance of college students, it is legitimate to assume that, on the whole, its level is rather high for the main group, special attention should be paid to the number of students belonging to the special group, while the indicators of the preparatory group are within the permissible norm.*

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Information about the authors:
Kosareva, Irina A. – First Deputy Director of the Institute of Applied Technologies, Director of Moscow College of Railway Transport of Russian University of Transport, Moscow, Russia, +7(495) 687–64–31.
Romanov, Alexey A. – Ph.D. (Pedagogics), associate professor of the Institute of Applied Technologies of Russian University of Transport, Moscow, Russia, romanov74.00@mail.ru.
Nigay, Ruslan M. – Ph.D. (Eng), associate professor of the Institute of Applied Technologies of Russian University of Transport, Moscow, Russia, ruslan1010@mail.ru.

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