



# Online calculator in diagnostics of functional state and body mass index

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## Abstract

**Objective of the study** was to develop a digital tool for the rapid implementation of functional diagnostics and further recommendations on physical culture.

**Methods and structure of the study.** A mobile application in the form of an online calculator made it possible to digitize the following existing formulas: the coefficient of endurance of the cardiovascular system, the level of regulation of the cardiovascular system, the vital index, the Skibinski circulatory-respiratory coefficient, the body mass index, the vegetative Kerdo index, the index of functional changes circulatory systems. And also to assess the level of motor activity of students of the Plekhanov Russian University of Economics (279 people, February 2022).

**Results and conclusions.** Diagnostics with the help of a digital tool revealed the optimal indicators of body mass index, physical activity of students below the physiological norm. At the same time, low values of VC, the level of regulation of the cardiovascular system, the vital index and the index of the functional capabilities of the circulatory system in young men were determined. Almost none of the index revealed high, above average and average values, except for the coefficient of endurance of the cardiovascular system in young men. In this regard, the importance of regular physical activity, "informal participation" in sports, organization of competitions "For all" (General physical training, billiards, tug of war), master classes using digital technologies are noted. Thanks to the developed application, efficiency, interactivity, personality-oriented orientation of teaching in physical culture and sports at the university was achieved. Undoubtedly, this digital service aroused high interest among the target student audience, it meets the requirements of the digital educational ecosystem for Physical Culture and Sports at the university.

**Keywords:** *online calculator, express assessment of the functional state, digital support of physical education, physical education of students.*

**Introduction.** The presentation of the concept of development in modern society is largely identified with digital transformation and global information challenges [6]. The strategy of working with the digital generation should be based on traditional educational processes that integrate modern technological capabilities of both the teacher himself and the student living in a perfect digital reality. In this regard, its significant transformation is in demand, the result of which is the formation of a new digital educational process [5].

Digital technologies in the new information society act as a mechanism for achieving educational goals

and objectives. Such technologies in the educational process in physical culture and sports at the university are aimed at increasing the means of informatization and communication, developing educational platforms, new ways of independent physical education and sports, means of operational control of the physical and functional state, rethinking the type and presentation of information, creating a new system knowledge [2,7]. It is necessary to integrate information, both on conventional and modern media, computer technologies, information systems, work technologies and databases [3,4,8]. However, at present, there are not enough modern digital tools, services (mechanisms)

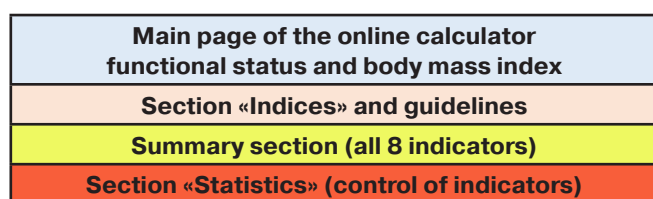


to solve educational, health-improving, organizational and managerial tasks according to physical culture and sports in a mobile, remote, operative, automated way.

**Objective of the study** was to develop a digital tool for the rapid implementation of functional diagnostics and further recommendations on physical culture.

**Methods and structure of the study.** The content of the mobile application “Online calculator of the functional state and body mass index” contains not only the revealed result for eight indicators and the norm values, but also methodological recommendations for each index, as well as the “Statistics” section for monitoring the dynamics of the functional state and body mass index. The Summary section displays all eight values, summarizing the diagnosis. The online calculator is distinguished by its complex nature, ease of use, concise interface and promptness of diagnostics (Figure 1, 2).

[https://play.google.com/store/apps/details?id=com.vendetta.online\\_calculator](https://play.google.com/store/apps/details?id=com.vendetta.online_calculator)



**Figure 1.** Structure of the online calculator



**Figure 2.** Interface, “icon” and QR code (Android, Apple) of the mobile application

Resource support for assessing the functional state is minimal, in the form of a tonometer, scales, stadiometer and spirometer. To build an online calculator program, the Dart programming language, Android Studio computer programs, Flutter Framework, the program size is 19.9 MB. The mobile application is designed in such a way that all the results of the functional state, body mass index and level of physical activity are stored on the server, which will allow you to create a database of the studied indices,

taking into account the gender and age of users.

With the help of the developed online calculator, the level of motor activity of students of the Russian University of Economics was assessed. G.V. Plekhanov (279 people, February 2022).

**Results of the study and their discussion.** The study showed (279 people, February 2022) that the body mass index for both boys (22.7 c.u.) and girls (20.9 c.u.) is within the normal range (Table 1).

The level of physical activity in boys was 9035 steps, in girls - 7542 - “a somewhat active lifestyle or a somewhat active work.” The applied classification of the level of motor activity (E. Masi, James E. Peterman, Leonard A. Kaminsky, 2019) [8], where motor activity is <5 thousand steps per day - the so-called “Sedentary work”; 7.5-9.9 thousand steps per day - “Somewhat active work”; 10-12 thousand steps - “Active lifestyle”; over 12.5 thousand steps - “Very active lifestyle.” At the same time, the physiological norm of 10 thousand steps is not realized by young men and especially girls.

The coefficient of endurance of the cardiovascular system (the norm is 16 c.u.), determined by the formula  $CE = \frac{HR \cdot 10}{PP}$ , where HR - heart rate (bpm), PP - pulse pressure (mm Hg), showed an increase in the cardiovascular system in young men, the result was 13.8 conventional and the weakening of the activity of girls - 20.5 conventional units. The most common result (Mo) in girls was 24.1 conventional units, for young men - 9.5 conventional units. (Table 1). The revealed level of regulation of the cardiovascular system causes concern. So, in boys the result was 100.5 conventional units, for girls - 93.3 conventional units, while 81-90 is the “average” level of regulation, 91-100 is “below average”, and 101 and above conventional units – “low” value. The value of the “double product” correlates with the value of the maximum oxygen consumption, so the lower the value, the higher the physical performance. The values for young men are on the border of the level of “below average” and “low”, while a high standard deviation was revealed.

It should be noted that the most common result of blood pressure in young men is 134/66 mm Hg, the average heart rate is 80.2±17.5 beats/min. In girls, the level of CVS regulation is “below average”, while the most common result of blood pressure is 115/74 mm Hg, the average heart rate is 84.2±13.7 beats/min (Table 2).

The norm of the vital index is 53-61 ml / kg, if the indicator is less, then this may indicate a lack of vital capacity of the lungs, or overweight. In the study, the life index in boys was 37.8±14.7 ml/kg, in girls it



**Table 1.** Online calculator in the study of functional status and body mass index (February 2022)

Indicators	Youths (n=136)		Girls (n=143)	
	(X±σ)	M <sub>o</sub> (fashion)	(X±σ)	M <sub>o</sub> (fashion)
Body mass index (norm 18.5-24.9 c.u.)	22,74,2	23,1	20,93,6	19,0
The level of physical activity (number of steps)	9035,25 2710	10 000	7542,52 2313	10 000
Endurance coefficient of the cardiovascular system (c.u.) (norm 16 c.u., less than 16 - strengthening, more than 16 - weakening of the cardiovascular system)	13,8 5,9	9,5	20,59,7	24,1
Level of CVS regulation (c.u., «double product») 81-90 - medium; 91-100 - below average; 101 and above - low value	100,533,0	132,0	93,321,7	83,9
Life index (ml/kg) (norm 53-61 ml/kg)	37,8 14,7	40,0	36,115,9	36,6
Circular-respiratory Skibinski coefficient (<5 c.u. - very bad, 5-10 - unsatisfactory, 10-30 - satisfactory, 30-60 - good, > 60 - very good)	25,213,0	26,0	16,98,3	23,5
Kerdo vegetative index (c.u.) (norm 0 conventional units, from -15 to +15 balance of sympathetic and parasympathetic influences)	- 10,542,6	15,7	7,3922,5	1,33
Index of functional capabilities of the circulatory system (c.u.) (2.6-3.09 - sufficient functional indicators, more than 3.09 - insufficient opportunities)	3,649,2	2,38	2,10,26	2,24

was 36.1±15.9 ml/kg. low values of the vital index are due to insufficient level of VC (Table 2), which in boys is only 3171.19± 594.5 ml, in girls - only 2370.8± 397.2 ml. The Stange’s test of the male group of the studied - only 69.5 s., in the female group - only 53.8 s. In this regard, the importance of regular physical activity, including low-intensity physical activity, “informal participation” in sports, organization of “For All” competitions (general physical training, billiards, tug of war), master classes using digital technologies is noted.

Circular-respiratory coefficient Skibinski (c.u.), which determines the reserves and endurance of the respiratory and cardiovascular systems, was found to be at a satisfactory level in young men - 25.2 ± 13.0

conventional units, in girls - 16.9 ± 8,3 – “satisfactory”. The result “excellent” was not revealed in any of the subjects.

Let us analyze the result of the index of functional capabilities of the circulatory system. With an indicator of 3.09 conventional units insufficient capabilities of the circulatory system are observed, the result indicates the presence of pronounced deviations in the adaptation processes. In the studied group of boys, the value was 3.64 conventional units, in girls the result was better - 2.1 conventional units– sufficient functionality of the circulatory system.

Diagnostics revealed optimal body mass index, physical activity below the physiological norm. At the same time, low values of VC, the level of regulation

**Table 2.** Indicators of physical development and functional state of the cardiovascular system

Indicators	Youths (n=136)		Girls (n=143)	
	(X±σ)	M <sub>o</sub> (fashion)	(X±σ)	M <sub>o</sub> (fashion)
Body length (cm)	181,42 6,6	180	167,345,3	165
Body weight (kg)	75,19 12,1	74,5	57,64 7,2	50,0
Vital capacity of the lungs (VC) (ml)	3171,19594,5	3000	2370,8397,2	2500
Stange test (s.)	69,52 25,1	90,0	53,81 15,2	45,0
Heart rate beats/min	80,24 17,5	81,0	84,27 13,7	83,0
BP (mm Hg)	124,9 18,1/ 70,2 9,9	134/66	111,6 14,3 / 72,7 8,6	115/74



of the cardiovascular system, the vital index and the index of the functional capabilities of the circulatory system in young men were determined. Virtually none of the index revealed high, above average and average values, except for the CVS endurance coefficient in young men.

**Conclusions.** All subjects were given individual recommendations, it was also recommended to increase physical activity up to 10-12.5 thousand steps, increase aerobic load, while monitoring heart rate and blood pressure, as well as training in the gym two to three times a week with low-intensity loads. Along with this, connect applications in the “fitness and health” category, online calculators for nutrition and water consumption.

Thanks to the developed mobile application in the form of an online calculator, efficiency, interactivity, and a personality-oriented orientation of training in physical culture and sports at the university were achieved.

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