ASSESSMENT OF THE ADAPTING ABILITIES OF THE CARDIOVASCULAR SYSTEM OF STUDENTS TO PHYSICAL LOAD

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ABSTRACT

In this article the current adaptation abilities of the cardiovascular system (CVS) of 227 students from two faculties of NSA Vassil Levski – Pedagogy and Kinesiotherapy is studied. The research methodology is complex and involves the study of literary sources, testing, mathematical-statistical processing and analysis. For the purpose of the study, a 3-minute standard YMCA load test was conducted. Test results are processed by: variation analysis, frequency analysis and 7-point scale method.

Key words: *students, adaptation, cardiovascular system, cardiac rhythm.*

INTRODUCTION

In the life of a certain part of the students' sport, which to some extent is an anti-stress factor, takes an important place. Physical activity plays an important role in the formation of body's functional reserves. At the same time in Universities training and competitive activity alongside with the academic load places high demands on the functionality of the body and the health of students. Any discrepancy between the volume as well as intensity of physical activity and adaptive capabilities of the organism can cause a number of changes in functional systems on homeostatic level, change the regulatory-adaptive status of the body, predetermining the further course of adaptation (Bersenev, 2008; Ignatova, 2017).

Sports training loads, in their turn, have a significant impact on the morphofunctional development of the circulatory apparatus and, in particular, of the heart, as well as the usefulness of the mechanisms of its regulation (Tihvinskij, 1991).

According to Phillip B. Sparling (2007), Professor of Applied Physiology, college education is a time during which students develop habits that will be useful to them for life. Some of these habits should include physical activity and sports. This is not only a university task, but it should also be a public policy given the enormous scale of the problem of obesity globally, including America, any assistance in this regard would be helpful, especially when it comes to students. The same author finds that people who are used to exercising as young people are much less likely to suffer from illnesses associated with lack of physical activity as adults. The pres-

ence of physical education and sports in university programs is not only important for maintaining a good BMI. Research shows that regular physical activity improves cognitive and decision-making processes, as well as increases overall happiness. (<https://greatist.com/fitness/colleges-drop-gym-class-011012>).

One of the main mechanisms by which physical activity influences the cardiovascular system during regular exercise is related to its adaptation. In a trained body, the adaptation processes to the workload are much faster and one can work longer without feeling tired. As a result of physical activity, cardiac activity, metabolism, and overall blood circulation are generally improved. The effects that occur in the cardiovascular system, under the influence of physical activity, depend on the intensity, duration and systematic load. The cardiovascular system is most influenced by physical activity, and tests for registering adaptation processes carry objective information about both the adaptive capacity and the physical capacity and health status of the person.

To determine the ability to adapt the cardiovascular system to the physical exertion applied, so-called standard-load tests are used. Functional samples with standard loads are usually for mass application. They are easily applicable in practice due to the availability of physical activity and the lack of special equipment, and the main criterion for functional work capacity is the response of the cardiovascular system, evaluated by the pulse rate

(HR). The reaction is evaluated by quantitative and qualitative characteristics of reactivity and recovery (Slanchev, 1998, 2014; Petkov, Toteva, Maznev, Dimitrova, 2012).

Functional study of the cardiovascular system for adaptation to physical activity is also done (Pirova, Belova 2001).

In the article "The Functional State of the Cardiovascular System of Students with Different Levels of Physical Fitness" A Konkabaeva and M Rasol, 2016 are researching the current functional state of the cardiovascular system of the body of students that regularly go in for sport and those that are not involved in sports. The cardiovascular system was estimated by recording the heart rate variability, and by defining a work capacity of a man by Ruffier method. A complex estimation of heart rate variability by index of activity of the regulatory systems of the body was carried out. It was found that students involved in sports had a moderate and expressed stress on regulatory systems observed in 55% of cases that composed more than half of the surveyed students. It may be due to inadequate physical load placed on the current functional state of the body.

A similar study, but with the 3-minute standard test of the YMCA's standard workload with students from TU, Sofia, was made by A. Tsarova (2013), who found that training in physical education and sports in higher schools does not lead to increasing the possibilities for adaptation of the cardiovascular system to physical activity, regardless of the nature of the applied motor activities, as well as P. Mavrudiev 2018 with students from the University of National and World Economy.

METHODOLOGY

The aim of this study is to identify the possibilities for adaptation of the cardiovascular system to the physical loads of students.

The subject of the study is the influence of physical activity on the adaptive capacity of the cardio-

vascular system.

The object of the study is the adaptation of the cardiovascular system to physical exertion by students. A total of 227 students, 148 men and 79 women from the NSA from two professional fields, a teacher - 118 men and 59 women and kinesitherapy 30 men and 21 women were included in the study. The research methodology is complex and involves the study of literary sources, testing, mathematical-statistical processing and analysis (Mackenzie, 2011; Gigova, 2002).

For the purpose of the study, a 3-minute standard YMCA load test was conducted with students from two NSA faculties during the 2017/18 academic year.

Test results are processed by:

- ✓ variation analysis;
- ✓ frequency analysis;
- ✓ 7-point scale method.

The evaluation of the test results was made on the basis of the achieved heart rate values during the applied standard load conducted a 3-minute standard step test with a metronome by a 30 cm high step. The logic in determining the estimate is based on the value of the pulse immediately after loading, i.e. the lower the attained heart rate, the better the adaptive capacity of the cardiovascular system and the functional state of the subject to be examined.

In assessing the results of our studies, a 7-point scale was used, consistent with the gender of the subjects studied (Petkov, Toteva, Maznev, Dimitrova, 2012).

RESULTS

The analysis of Table 1 shows that just before the functional test was performed, the average resting heart rate of the studied population of NSA Pedagogy faculty (PF) students was 68.57 b./pm. for men and 67.55 b./pm for women. These are the heart rate values that are within the normal range of the tested population.

Table 1. Average results of a 3-minute step test to determine the adaptive capacity of the cardiovascular system to physical activity - PF of NSA

№	Indicators	Men	Women
1.	P_{rest}	68,57 b./pm	67,55 b./pm
2.	P_{after}	81,63 b./pm	81,89 b./pm
3.	Change – %	19,04 %	21,23 %
4.	Average grade	<i>High</i>	<i>Very high</i>

The table shows that, after applying the standard load, the average heart rate for the first minute of recovery reaches 81.63 b/p.m. for men, up to 81.89 b/p.m for women. This allows, according to the norms of sports medicine (Petkov, Toteva, Maznev, Dimitrova, 2012), the ability of the cardiovascular system of the studied set of men to adapt to physical activity to be evaluated as high and for women as very high.

The calculated relative share of the observed changes shows that after the loading, the pulse rate for men from the Pedagogy faculty of the National Sports Academy is on average 19.04% higher than

the initial one, and for women - on average by 21.23%.

It is noteworthy that the measured mean pulse rates for men and women at the beginning and end of the step test are very close. This suggests that the ability of future physical education teachers to adapt to physical activity does not depend on their gender.

The analysis of the results presented in fig. 1, reveals the relative proportions of individual assessments of the capacity of the cardiovascular adaptation system for students of the Pedagogy faculty of the National Sports Academy.

Figure 1. Relative proportions of individual assessments of the cardiovascular system's capacity for adaptation of students from the Faculty of Pedagogy of NSA (men)

The figure shows that the highest (51.43%) for men is the relative share of high individual scores, and for 34.29% of them the score is even very high. Only 2.86% of future physical education teachers have average grades, and below average grades are seen for 1.43% of the total population.

For the purposes of the study, the relative propor-

tions of the changes in the pulse rate by zones were also revealed.

The analysis of Figure 2 shows that, as a result of the applied standard load, an increase in the pulse rate within 20% of the initial one occurred for 55.71% of the students at the NSA Pedagogy faculty.

Figure 2. Relative proportions of the changes in heart rate (in %) by the students from the Faculty of Pedagogy of NSA (men)

Much lower (42.86%) is the relative share of those with change between 20 and 40%. Only for 1.43% of the prospective physical education teachers the applied load caused a pulse rate increase between 40 and 60%.

The relative proportions of individual assessments of cardiovascular adaptation capacity in female students of the Pedagogy faculty of the National Sports Academy are presented on Figure 3.

Figure 3. Relative proportions of individual assessments of the cardiovascular system's capacity for adaptation of students from the Faculty of Pedagogy of the NSA (women)

The analysis of the figure shows that over 63% of the female students of the NSA's PF (women) have very high adaptive capacity. They can easily be added to about 24% who have high individual grades. This is a good sign and it is reasonable to say that, as a whole, the group of future physical education teachers has a high level of functional readiness, which is a guarantee for good professional realization in the future.

The pattern of changes in heart rate by zone in female students from this population is very different from the one already commented in the men at the NSA Pedagogy faculty Figure 4.

As can be seen from the figure, an increase in the pulse rate within 20% was observed in 63.16% of the studied population, which is a sign of a high level of adaptation of the cardiovascular system to the applied functional load.

Figure 4. Relative proportions of the changes in heart rate (in %) by the students from the Faculty of Pedagogy of NSA (women)

Much smaller (23.68%) is the relative share of female students with an increase in heart rate between 20 and 40%. Only 5.26% of them have an increase within the next two zones (between 40 and 60% and between 60 and 80%). It is noteworthy that in this group there are female students (2.63%), in whom the response of the applied standard load is

extremely strong - the pulse rate reaches over 80% of the initial one. This is evidence of a low level of endurance development for these girls and is likely to create problems in the future in the performance of their professional duties as physical education teachers.

The results of the conducted step-test with the students from the Kinesitherapy faculty of NSA “V. Levski” are presented on Table 2.

Table 2. Averages of a 3-minute step test to determine the adaptive capacity of the cardiovascular system to physical activity - NSA Kinesitherapy faculty

№	Indicators	Men	Women
1.	P _{rest}	71,90 b./pm	74,48 b./pm
2.	P _{after}	86,67 b./pm	92,86 b./pm
3.	Change – %	20,54 %	24,68 %
4.	Average grade	High	High

The analysis of Table 2 shows that just before the step-test, the average resting heart rate of students with specialty kinesitherapy was 71.90 b./pm. for men and 74.48 b./pm for women. Following standard loading, the average heart rate for the first minute of recovery reaches 86.67 b./pm for men and 92.86 b./pm for women. This gives grounds for assessing the cardiovascular system's ability for these studied populations (men and women) to adapt to physical exertion as high.

The table also shows that the relative proportions of the observed changes in the average heart rate, as a

result of the applied standard load, are respectively 20.54% for men and 24.68% for women.

The presented results on Figure 5 allows to reveal the relative proportions of the individual assessments of the possibilities of the cardiovascular adaptation system for the students with specialty kinesitherapy.

The analysis of the results presented in the figure shows that the highest (33.33%) for men is the relative share of very high individual grades.

Figure 5. Relative proportions of individual assessments of the cardiovascular system's capacity for adaptation of students from the Kinesitherapy faculty of NSA (men)

Adding to them the high scores of 30.00%, it can be concluded that over 63% of kinesitherapy students have a high level of adaptation of the cardiovascular system to standard physical activities, lasting within 3 minutes.

From Figure 5 it is also seen that 16.67% have grades above the average and the relative share of students with grades between low and average is equal to 6.67%. It should be noted here that low individual scores are not observed in both male and

female students from NSA Pedagogy faculty.

The revealed relative proportions of the changes in the pulse rate of the kinesitherapy students by zone are presented on Figure 6.

The analysis of the figure shows that as a result of the applied standard load, for 63.16% of the students studied in this population, a change in the pulse rate occurred at the end of the impact, with an increase of up to 20%.

Figure 6. *Relative proportions of the changes in heart rate (in %) by the students from the Kinesiotherapy faculty of NSA (men)*

Much lower (23.68%) is the relative share of those with an increase in heart rate within the range of 20 to 40%. In contrast to men from Pedagogy faculty, in those from Kinesiotherapy faculty, the relative proportion of pulse rates reaching between 40 and 60% at the end of the load is almost 4 times higher (5.26%). At the same time, 5.26% of them reach a heart rate that is 60-80% higher, and at 2.63% - even higher than 80%. This is a alarming finding. The fact that the body of about 13% of future kinesitherapists reacts strongly to the applied 3-minute

load is evidence of the low level of development in these students of general endurance and the low adaptive capacity of their cardiovascular system.

The results of the kinesitherapists are presented on Figure 7. From the figure it is clear that with high and very high individual grades here are in total over 70% of the students studied (respectively 38.10% - high and 33.33% - very high), which is a sign of a high level of development of functional capabilities for these girls.

Figure 7. *Relative proportions of individual assessments of the cardiovascular system's capacity for adaptation of students from the Kinesiotherapy faculty of NSA (women)*

At the same time, however, 9.52% of the female students in this population have below-average individual grades, and 4.76% have low grades. In comparative terms, it should be remembered that low scores are not observed in NSA Pedagogy faculty girls. Moreover, the relative share of low grades in future kinesitherapists is higher (6.67%). This gives the right to be considered that the girls from the

NSA Kinesiotherapy faculty showed a higher level of functional adaptation than the boys from the same faculty.

From Figure 8 it is seen that an increase in the pulse rate within 20% is observed in almost half of the girls included in this group (47.62%), which is evidence of the high level of cardiovascular ad-

aptation abilities to the applied functional load. A little lower (38.10%) is the relative share of female students, with an increase in heart rate between 20 and 40%. Only 4.76% of the increase is in the range

of 40-60%, but at the same time at 9.52% the pulse rate increases, as a result of the applied effect, by 60-80%.

Figure 8. Relative proportions of the changes in heart rate (in %) by the students from the Kinesitherapy faculty of NSA (women)

CONCLUSIONS

We can summarize that the response of the cardiovascular system to the applied standard load is adequate to the level of training of all students, regardless of their gender. Proof of this are the individual estimates of heart rate measured within the first minute of recovery.

For students with a teacher qualification after applying the standard load, the average heart rate for the first minute of recovery reaches 81.63 b/p.m. for men, up to 81.89 b/p.m. for women, which determines the ability of the cardiovascular system to adapt to the physical exertion of the study population, men are rated as high and those of women as very high.

By men, 51.43% is the relative share of high individual scores, and 34.29% of them is even very high. Only 2.86% of future physical education teachers have average grades, and below average grades are seen for 1.43% of the total population.

More than 63% of female students at the NSA Pedagogy faculty (women) have very high adaptation skills, and about 24% have high individual grades.

For students with kinesitherapy qualification after the standard load applied, the average heart rate

for the first minute of recovery reaches 86.67 b/p.m. for men and 92.86 b/p.m. for women. This gives grounds for evaluating the ability of the cardiovascular system of these study groups (men and women) to adapt to physical activity as high.

By men, 33.33% is the relative share of very high individual grades, and 30.00% high marks, it can be concluded that over 63% of kinesitherapy students have a high level of adaptation of the cardiovascular system to standard physical activities, 16.67% have grades above the average, and the relative share of students with grades between low and average is equal - 6.67%.

For women with high and very high individual grades, a total of over 70% of female students (respectively 38.10% - high and 33.33% - very high), 9.52% of female students in this group have individual grades below average, and 4.76% have low grades.

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