

STATE ADAPTATION RESERVES CARDIORESPIRATORY SYSTEM FIRST-YEAR STUDENTS WITH VARYING DEGREES OF PHYSICAL FITNESS IN TERMS OF TREADMILL TEST

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Annotation. *Purpose:* to examine the state of the cardiorespiratory system in terms of the stress test in first-year students with different levels of fitness. *Material:* the study involved 43 students, of which 18 boys and 25 devushek basic medical group. The study used a treadmill, a pulse oximeter, spirometer. *Results:* more adjustment disorders were detected in students that are not involved in physical education at school. Decreased ability of the cardiorespiratory system to maintain proper oxygen supply of the organism in the stress test. This is not observed in students who were attending school in addition sports clubs. Found that students with low tolerance to physical exercise need a separate program of physical training, the dynamic control of the teachers and the need for additional medical examination. *Conclusions:* the treadmill test is an ideal way of revealing hidden maladjustment cardiorespiratory system in adolescence.

Keywords: adaptation, students, treadmill, cardiorespiratory, system, reserves.

Introduction

Recent years de-adaptation of young people has been becoming a subject of numerous medical-biological researches in connection with expansion of this phenomenon in many of developed countries of the world (Resolution of Supreme Council of Ukraine No. 2992-VI, dt. February 3, 2011 "Recommendations of parliamentary session about state of youth in Ukraine "Youth for healthy life style"/Bulletin of Supreme Council of Ukraine – 2011, vol.24, p. 173.) [1]. Analysis of students and pupils' state in schools and higher educational establishments (HEE) of Ukraine showed the signs of de-adaptation, deviations in health nearly of 90% of young people, among which more than half have insufficient physical fitness [2]. The so-called critical periods of life – endocrine reconstruction, heredity, change of conditions and locations of residence, peculiarities of study and work, diseases play great role in formation and increasing of de-adaptation state [3]. Besides, regular physical culture trainings have not become usual norm of life for most of young people. Using of alcohol, smoking hypo-dynamia are quickly expanding among young people. Only every fifth boy or girl of school age have sufficient level of health related motion functioning and it is the lowest in Europe indicator. 60% of Ukrainian pupils are not able to fulfill general European tests of physical fitness "Euro-fit". It was stated that in Ukraine, during studying at comprehensive schools, schoolchildren loose at least one third of their health (Resolution of Supreme Council of Ukraine No. 2992-VI, dt. February 3, 2011 "Recommendations of parliamentary session about state of youth in Ukraine "Youth for healthy life style"/Bulletin of Supreme Council of Ukraine – 2011, vol.24, p. 173.) De-adaptation in youth age is a result of influence of inadequate mechanisms of human adaptation to physical and emotional influence, which are accompanied by quick tiredness, reducing of workability and quality of life, formation of functional diseases against the background of neuro-endocrine dysfunction [4, 7].

In such conditions at physical culture trainings there appears a demand in dividing of pupils and students into groups as per their state of health- special health groups, preparatory groups and main groups. The latter is also non-uniform by state of adaptation. In most cases, the level of tolerance to physical load, state of oxygen-transportation system of these students is not examined sufficiently before beginning of physical culture trainings [3, 4].

That is why it is interesting to research tolerance to physical loads, cardio-respiratory system's indicators of first year students, who had physical training at schools only at physical culture classes in main group, or attended sport circles.

The presented results of our research is a fragment of complex work "Sex dimorphism in adaptation mechanisms to stress loads in young age during health related sport trainings", state registration No. 0113U002431.

Purpose, tasks of the work, material and methods

The purpose of the work is to analyze functional state of adaptation reserves of first year students with different stage of functional fitness by indicators of cardio-respiratory system in conditions of stress-test.

Methods and organization of the research. For solution of our tasks we tested 43 first year students, of 17-18 years old age (18 boys and the rest – girls). All tested were divided into groups: 1 and 2 groups – 12 girls and 8 boys accordingly, who, before entering HEE did not practice physical culture regularly; 3rd group – 13 girls, who attended basketball circle (n=4), aerobics (n=8), from 1 to 2 years; 4th group – 10 boys, who trained running; group of boys, who played football (n=4), from 1 to 3 years.

For fulfillment of stress-load we used treadmill test (Biomedical Systems), as per protocol of Bruce with increasing step-by-step power and duration of every stage 3 minutes; angle of bending changed every 3 minutes (rising by 5 cm in respect to median of track and corresponded to 5% (2.5) of sub maximal HBR. Tolerance to load was evaluated in MET (1 MET = 3,5 ml.per O₂/kg.p.min.). We determined maximal aerobic power during stress test (max VO₂, ml/kg/min). Also, we evaluated maximal indicators of haemo-dynamic: heart beats rate (HBR), systolic BP (max SBP), diastolic BP (max DBP) in conditions of load. Choice of treadmill test in comparison with cycloergometer is

connected with its higher physiological abilities and clear dozing of loads, where sub-maximal heart brats rate is achieved oftener [5].

In the process of treadmill test we controlled subjective students' response to physical load (heavy breathing, dizziness, general weakness, headache and etc.), haemo-dynamic response (heart beats rate, blood pressure), ECG changes. During stress test and in recreation period we determined content of oxy-hemaglobine in arterial blood with the help of pulse- oxy-meter (YUTASOKSI -201). Besides, at portable digital spirometer (Minitest), we determined forced vital capacity of lungs (FVCL), volume of forced exhale per 1 second (VFE).

For evaluation of results confidence we used variation-statistic method of results' analysis with the help of statistic program Statistica v.6.1 (USA) and recommendations of O. Yu. Rebrova (2002).

Results of the research

We determined reduction of tolerance to physical load of 1st and 2nd groups' boys and girls accordingly by 27.96±2.05 % and by 28.46±1.37 % (p<0.05), comparing with 3rd and 4th groups) see table 1). Increasing by intensity physical load is accompanied by increased demand of tissues in oxygen. However maximal VO₂ of students of 1st and 2nd groups was lower by 24.52±1.83 % and 34.62±2.66 % (p<0.05), in respect to results, received in 3rd and 4th groups. It witnesses that "oxygen deficit" appears quicker in group of boys and girls, who did not practice physical training earlier – at school and at home. The registered changes were accompanied by appropriate response of cardio-respiratory system.

Table 1

Haemo-dynamic and oxygen provision of dozed physical load of young people

Tested indicators	Not trained students		Trained students	
	1 group (girls)	2 group (boys)	3 group (girls)	4 group (boys)
Increment of HBR (%)	87.0±2.15	75.0±3.34	82.5±1.67	85.33±2.72
Final SBP, mm.merc.col	115.83±1.46	115.0±2.63	112.75±2.10	128.4±3.06
Final DBP, mm.merc.col	66.67±1.83	70.0±2.80	65.0±1.72	80.0±2.34
max SBP, mm.merc.col	146.67±2.05	140.0±3.11	155.0±2.23	137.0±3.12
max DBP, mm.merc.col	88.33±1.16	85.0±2.18	82.67±0.85	71.18±1.15
max METS, (ME)	8.45±0.52	7.92±0.60	11.73±0.63	11.07±0.69
max VO ₂ , (ml.kg.p.min)	29.65±1.19	24.3±1.56	39.28±2.04	37.17±2.38
Distance, (miles)	0.40±0.04	0.39±0.03	0.56±0.03	0.54±0.05
SpO ₂ , % (stress test)	94.5±1.10	97.8±1.42	95.2±0.88	98.3±1.36

So, it was stated that trained boys (4th group) had increment of HBR in conditions of stress test higher than (13.77±2.52)% - indicators of increment, received in group of boys, who trained physical culture only at physical education classes. Concerning girls, who attended sport circles (3rd group), HBR increment in conditions of stress test was by (15.17±2.34)% (p<0, 05) and was higher than the same of 1st group girls. HBR changes were accompanied by change of BP. For example, increment of SBP of not trained girls was (26.63±3.12)%, boys had increment a little lower – (21.72±2.65)%. SBP increment of trained girls was (37.47±3.36)%, and trained boys – (30.1±2.48)%. Thus, results of SBP increment of trained students were confidently better (p<0.05) than indicators of increment, received in 1st and 2nd groups.

Also we determined that DBP response of 3rd and 4th groups at load was by 6.41% (p<0.05) and 13.56% (p<0.05) less than results, obtained in 1st and 2nd groups accordingly.

Such dynamic of BP can witness that trained students have better condition of heart and periphery blood circulation under load [6].

Test of blood saturation with oxygen before load showed final low figures Sp O₂ (95.6±1.17)% and (96.3±1.53)%, accordingly, of 5 girls (41.67%) and 3 boys (37.5%) of 1st and 2nd groups. Among trained boys (n=13), only two of them (15,32%) showed reducing of basal level Sp O₂ up to 96.0%. 8 girls of 1st group showed reduction of Sp O₂ 5 girls. 4 boys from 2nd group during 4-7 minutes manifested transitory reduction of indicators Sp O₂ up to

(94.62±1.44)%. Concerning girls and boys, who attended sport circles, during treadmill test indicators Sp O₂, did not confidently change.

The carried out spirometry showed reduction of final FVCL (2.84±0.22) l of 6 girls (50%) of 1st group and of 3 boys (37.5 %) of 2nd group in respect to proper value of (3.47±0.31) l. The same changes (2.86±0.14) l were registered after stopping of physical load for 1-2 minutes among 8 girls (66.67%) of 1st group and among 4 boys (50 %) – of 2nd group. At the same time final FVCL indicators of 3rd and 4th groups' students were (3.46±0.28) l.; after 1-2 minutes after stopping of load it was in limits of expected norm (3.34±0.22) l. (p>0.5).

Indicators of VFE1 in 1st and 2nd groups were moderately reduced only among 4 students (2.86±0.19) l. Among girls and boys of 3rd and 4th groups, indicators of VFE1 did not confidently change.

Thus, in group of students, who were not trained in school, we registered changes of spirometry indicators, which witness about presence of respiratory disorders of restrictive type that can be connected with restriction of inhale depth reducing of breathing muscles' elasticity, disorders in vegetative regulation [7].

The conducted researches permitted to determine that cardio-respiratory system of students with reduced tolerance to physical load is not able to increase oxygen supply to skeleton and breathing muscles during long time for full ensuring of demand in ATF with the help of aerobic processes. It is known that not trained muscles have less quantity of mitochondrion that limits energy generation and, accordingly, level of tolerance to physical loads [8].

Reduced tolerance to physical load among first year students was accompanied by reduction of maximal aerobic power, insufficient haemo-dynamic provisioning of stress test [6, 7]. Besides, part of young people showed reduction of Sp O₂ in rest, under load and in first minutes after treadmill test, the obtained results were accompanied by reduction of indicators, mainly FVCL. At the same time among students, who, before entering HEE, regularly attended sport circles, besides academic physical culture classes there were found no significant deviations in cardio-respiratory system under load. It proves significance of systemic trainings in increasing of effectiveness of mitochondrion breathing, metabolic adaptation in formation of endurance in young age [9-15]. Just metabolic response to physical load is determined mainly by oxygen supply to working muscles, which in part of first year students of main group is in improper condition.

The conducted research proves existing idea about low effectiveness of school physical training program (Resolution of Supreme Council of Ukraine No. 2992-VI, dt. February 3, 2011 "Recommendations of parliamentary session about state of youth in Ukraine "Youth for healthy life style"/Bulletin of Supreme Council of Ukraine – 2011, vol.24, p. 173.) [2]. Thus, application of load tests, especially treadmill, changes homeostasis of cardio-vascular system in rest. It results in appearing of pathological-physiological mechanisms, latent or hardly diagnosed in young age pathological changes, de-adaptation and so on. Also treadmill test permits to determine fitness, compensatory potentials of cardio-vascular and respiratory systems in process of health related physical culture trainings.

Conclusions:

1. Treadmill test is an ideal method for evaluation of potentials of compensatory-adaptive organism's mechanisms in young age, especially of cardio-respiratory system.

2. Students of main group, by their adaptation to physical loads are rather heterogeneous group and it should be considered in health related physical trainings.

3. Reduction of adaptation reserves of a part of main group students is connected with cardio-respiratory system's inability to ensure oxygen supply to skeleton and breathing muscles during long period of time that, partially, is a result of insufficient physical training in domestic conditions and in school before entering HEE.

4. Students of main group with reduced tolerance to physical loads require separate program of physical training, dynamic control, to be ensured by instructors, and, if required, additional medical examination.

The prospects of further researches imply analyzing of influence of health related physical culture trainings on bio-chemical mechanisms of metabolic adaptation.

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