

## APPLICATION OF BIOLOGICAL FEEDBACK FOR ESTIMATION OF ANAEROBIC PERFORMANCE IN JUMPING TEST

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**Annotation.** *Purpose:* - To determine the effect of biofeedback to determine the level of anaerobic performance of healthy young men. *Material:* The characteristics of physical performance in 60-seconds jumping test without and with visual and audible biofeedback (BFB) are determined at 23 healthy young men. *Results:* Significant individual peculiarities are found in performance features of 60-seconds jumping test both without and with BFB. The groups of performance indexes are maximum jumping height; jumping frequency and achieved performance level; correlation of jumping phases and achieved capacity of a separate jump; jumping dynamics during the test. The positive effect mostly on performance in BFB regime is found in the group of persons with low level of physical performance. *Conclusion:* The application of BFB in 60-seconds jumping test is proved to increase the objective character of measuring anaerobic performance.

**Keywords:** biofeedback, physical performance, aerobic, jump.

### Introduction

Modern professional sports require from sportsmen to have high level of fitness, achievement of which is possible only with the help of physical loads, close to extreme physiological potentials of human organism. Such loads result in overloading, which, in its turn, results in traumas of muscles, ligaments, joints and nervous structures of sportsman. That is why, recent time application of biological feedback (BF) in sportsmen's rehabilitation and training has become so popular.

Biological feedback is a technology, in the base of which there is complex of research, medical and prophylaxis procedures, which permits to receive information about status and changes of human physiological processes with the help of external feedback circuit with application of micro-processor and computer apparatuses.

To day method of biological feedback, which appeared on the base of medicine, biology and technique, is successfully developing as separate branch of science and is widely practically used. BF is a modern method of therapy, which permits to improve or correct functioning of organism by activation of human reserve potentials.

Conception of BF includes receiving of information about status or change of own functional state that permits for a patient or sportsman to master self-regulation of tested organism's function. It, in its turn, is rather valuable mean of activation of organism's functional systems.

BF in sport training, fitness and rehabilitation is fulfilled on the base of different characteristics of variability of heart rhythm, electric myogram, strain data, biochemical parameters in the form of analysis of both visual and verbal information.

It was proved that application of intensive BF with of video and verbal analysis can reduce strength of landing in jumps [Onate J.A. e.a., 2001].

At the same time, there is lack of researches, devoted to BF for determination of physical workability and its training.

The present research is a component of combined plans of scientific-research works of Cherkassy national university, named after Bogdan Khmelnytskyi.

### Purpose, tasks of the work, material and methods

*The purpose of the work:* determination of biological feedback's influence on anaerobic workability of healthy young people.

*The tasks of the research:* 1. Determination of content and sense of conception "biological feedback"; 2. Analysis of criteria for evaluation of anaerobic workability in 60 seconds' jump test; 3. Determination of BF's influence on different characteristics of anaerobic workability in jump test for persons with different workability.

*The methods:* we carried out measurements of 23 healthy young men of 20-28 years old age, observing main bio-ethical principles of EC human rights' and bio-medicine's Convention (dt. 04.04.1997), Khelsinky Declaration of World medical association about ethic principles of scientific medical researches, which involve human beings (1964-2008). We fulfilled 60 seconds jump tests by methodic of Bosco C. e.a. After 40 minutes' rest we again fulfilled the same test with application of biological feedback and visual control of flight time dynamic on monitor screen and hearing control of flight phase of jumps (frequency of sound signal – 400 Hz). We evaluated power of mechanical work of the whole test, frequency of jumps, value of maximal jump, correlation of their supported and unsupported phases, their dynamic during all test. Calculations and statistical analysis of data was carried out in electronic tables Excel

### Results of the research

At first stage we fulfilled visual analysis of dynamic of physical workability indicators of certain persons during all test. Dynamic and structure of supported and unsupported (flight) phases significantly differ by following characteristics:

1. Chaotic character or stability of indicators of one tested person during whole test.
2. Dynamic of changes of different indicators from the beginning to the end of the test.
3. Frequency of jumps, correlation of supported-un supported phases of compared persons significantly differ.

That is why we analyzed specific features of distribution of physical workability's characteristics in sample of 23 healthy young men both with their determination in ordinary mode and in feedback mode (see table 1).

Table 1

*Distribution of physical workability's characteristics, determined in 60 seconds' jump test of healthy young men*

Indicators	Statistical data				
	Min.	Max.	M	$\sigma$	cV
Ordinary mode					
Frequency, cycles/min.	45.99	85.12	62.4	10.2	16.38
Power, m/min.	24.47	51.37	34.98	7.74	22.13
Correlation, conv.un.	0.51	2.38	1.01	0.48	47.01
Power of jump, m/min	37.53	174.75	74.56	35.04	47.00
Maximal jump, m	0.56	0.74	0.67	0.05	7.20
Feedback					
Frequency, cycles/min.	47.82	82.91	69.22	8.89	12.85
Power, m/min.	26.71	51.31	39.08	7.33	18.76
Correlation, conv.un.	0.57	2.39	1.26	0.53	41.80
Power of jump, m/min	42.07	175.39	92.44	38.64	41.98
Maximal jump, m	0.56	0.82	0.66	0.06	9.80

For example minimal scatter of maximal jump height was in ordinary mode (cV = 7.20%), and in feedback mode (cV = 7,20%). Frequency of jumps and power of test fulfillment had a little bit higher inter-individual variability (12,85-22,13%). The highest distinctions belonged to correlation of jump phases and achieved power in separate jumps (41,80-47,01%). Thus, there are substantial inter-individual distinctions in characteristics of physical workability, achieved in 60 seconds' jump test, which are the base for system of automatic evaluation. By scatters all these indicators can be divided in three groups: maximal height of jump; frequency of jumps and achieved level of workability; correlation of jump phases and achieved power of every separate jump.

During test all analyzed indicators had both positive and negative dynamic. To the largest extent, height of maximal jump reduced by the end of test. The trend to reducing of jump power was also rather expressive. Thus, indicators of workability's dynamic during test also can be used in automatic system of its evaluation.

The measurements were carried out with registration of indicators of anaerobic workability of 23 healthy young men in compliance with standard protocol by Bosco C. e.a. (I) and with BF (II) (see table 2).

So, in 60 seconds' test in conditions of biological feedback frequency of jumps, power of work confidently increase as well as correlation of flight and supported phases and power of pushing off. It permits to make conclusion about higher mobilization of the tested during testing and detecting of actual anaerobic workability in BF mode. The height of maximal jump in I and II did not differ.

Table 2

Indicators of physical workability in 60 seconds' test with and without (I) and with biological feedback (II) (n = 23)

Indicators	I	II	P
Frequency, cycles/min.	62.42±2.13	69.20±1.85	<0.001
Power, m/min.	34.98±1.61	39.08±1.53	<0.01
Correlation, conv.un.	74.56±7.31	92.44±8.06	<0.05
Power of jump, m/min	1.01±0.10	1.26±0.11	<0.05
Maximal jump, m	0.67±0.01	0.66±0.01	>0.05

Frequency of jumps both in I and II was increasing during test and its dynamic in both modes did not differ. In period from 25 to 35 seconds from the beginning of test and further dynamic of change of power of work, of power during jump was less in BF mode and this reduction was not so significant as with standard protocol. So, changes of anaerobic workability in BF mode permit to maintain relatively uniform level during the whole test, mainly in period from 25 second after beginning and further.

We compared indicators of anaerobic workability of persons with relatively low level of it (less than

36 m·min<sup>-1</sup>, N = 12) and relatively high level (more than 36 m·min<sup>-1</sup>, N = 11, from them 7 – were sportsmen of high class). The persons of first group improved workability in BF mode, while in the second group increment was not confident. For example, power in first group was accordingly 28.58±0.90 m·min<sup>-1</sup> and 34.60±1.98 m·min<sup>-1</sup> (p <0.001), and in second group 41.95±1.30 m·min<sup>-1</sup> and 43.97±1.21 m·min<sup>-1</sup> (p > 0.05).

Dynamic of change of workability during test also depended on achieved its level (see fig.1). Only persons with relatively low workability in period from 25 to 35 seconds had lower level of its reduction in BF mode than in mode I.

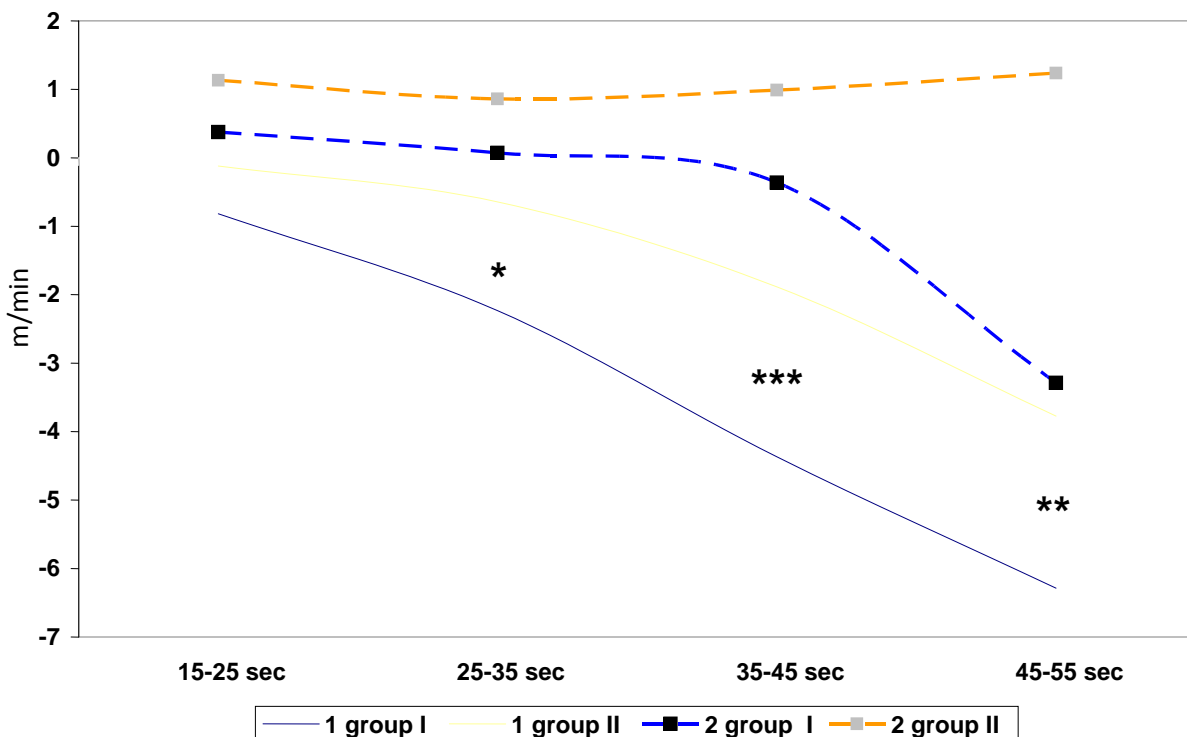


Fig.1 Changes of workability during test in ordinary mode and in feedback mode (persons with different workability's level). \* - p<0.05; \*\* - p<0.01; \*\*\* - p<0.001.

**Conclusions:**

1. Healthy young men have substantial individual features in characteristics of fulfillment of 60 seconds' jump test in BF mode and in ordinary mode.

2. We can mark out the following groups of characteristics: maximal height of jump; frequency of jumps and achieved level of workability; correlation of jump's phases and achieved power of every separate jump.

3. Dynamic of changes of physical workability during 60 seconds' jump test also has substantial individual peculiarities that permit to include these indicators in system of evaluation of human functional state.

4. In mode of biological feedback, its positive influence is the most expressive in group of persons with relatively low level of physical workability.

5. Application of biological feedback in jump tests can be recommended for optimization of training of human anaerobic potentials.

The prospects of further researches imply their fulfillment with different contingents of persons, practicing physical culture and sports.

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**Cite this article as:** Kovalenko S.O., Nechyporenko D.L. Application of biological feedback for estimation of anaerobic performance in jumping test. *Physical education of students*, 2014, vol.5, pp. 20-24. doi:10.15561/20755279.2014.0504

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Received: 20.06.2014  
Published: 30.06.2014