BIOMECHANICAL REGULATION OF SPORTSMEN EXTERNAL BREATH CHARACTERISTICS WITH USE OF PNEUMO-VIBRATION EFFECT

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Its known strength development and «stamina» of respiratory muscles improve at their training or exercising. When this happens, almost all vital functional systems of a person (cardiovascular, neuromuscular, immune, blood circulatory, etc.) improve, and respiratory muscles develop without changes in kinematical and dynamic structures of the movement performed. Sporting practice shows that low frequency (12 – 30 Hz) muscles "vibrostimulation" increases their (muscles) efficiency. The exerciser using of pneuma-vibration load for respiratory muscles in exhalation of breathing is offered. We underline that «combined» exerciser's effect is very important for sport so that it wouldn't interfere with your technique. In this case training effect significantly increase. The purpose of this study was an experimental research was carried out for the exerciser's effect to sportsmen external respiration.

KEY WORDS: pneuma-vibration, exerciser, exhalation, characteristics of external respiration.

INTRODUCTION:

Sporting practice shows that low frequency (12 – 30 Hz) respiratory muscles vibrostimulation increases their (muscles) efficiency (Lindemann, 1992; Dychko, Kochergin, 2005) and to reach the following positive results:

1. Increase load to respiratory muscle to develop their strength and stamina.
2. Keep respiratory channels opened at the exhalation phase preventing bronchial collapse.
3. Enrich inhale and exhalation.
4. Improve sputum transportation and pulmonary ventilation.
5. Involve respiratory channels fragments with insufficient aeration into respiratory process.
6. Increase air flow at the end of exhalation phase (increase vital capacity).
7. Suppress tussive reaction.

The Exerciser is executed as a handset for breathing in water and on earth. The device for breathing in water (Fig.1) fastens in front on a head of swimmer with the help of special strengthening and mouth-piece. Load knot is into structure of device too.

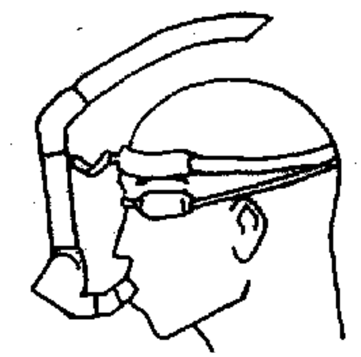

Figure 1. On-position of the offered exerciser (general view)

The load knot contains the channel of an inhalation with the valve and the channel of an exhalation with the generator of low frequency. The generator's construction allows to adjust frequency of vibration of exhaled air stream with allowance for individual features of a

swimmer respiratory system and technique of float. The expense of modification of a position of a load knot rather mouth-piece and own individual frequency of vibration is selected by practical consideration expense of a modification of a position of a load knot rather mouth-piece and own sensations of sportsman.
The exerciser using of pneuma-vibration load for respiratory muscles in exhalation of breathing is offered. We underline that «combined» exerciser's effect is very important for sport so that it wouldn't interfere with your technique. In this case training effect significantly increase.

METHOD:
An experimental research was carried out for the exerciser's effect to sportsmen external respiration. The research was aimed at sportsmen respiration process comparative analysis conduction in circumstances where exercises are performed at normal respiration with the Exerciser.
One group of sportsmen took part in the research. Group consisted of 5 sportsmen (age - 19-22, weight 69+/-3.6 kg) specialized in lawn tennis (advanced degree, candidate master).
The second group contained nonprofessional participants who were involved in fitness and jogging with 10 – 15 year experience, average age - 30-38, and weight 76 +/- 5.9 kg.
Participants external respiration peculiarities research in circumstances where exercises load increase with the Exerciser ("Exerciser" line)and under normal conditions ("Mask" line - an exercise with a gas mask put on without additional expiratory air flow resistance) was performed at limited muscle activity of incrementally increasing character «till refusal» of the participant.
The idea was that the participants should perform two limited character exercises on mechanical exerciser «Monarch» under normal conditions and with the Exerciser. Initial load was 240 kgm/min (40 Wt; 0, 5 кP) and it increase each two minutes on the same value. Cycling tempo was constant during the whole exercise performance – 80 rotations per minute. It could be recorded by speed counter.
Cardiac rate (CDR) and was recorded by means of specialized sport tester S 725 (Finland).
Gases concentration analysis in expiratory air was carried out in gasometrical analyzer «Beckman» (USA), expiratory air volume was detected by means of dry type Spiro meter «Oxymer» (Germany).
During each exercise performance («Mask» and «Exerciser») the following external respiration and work parameters were analyzed:Tp - exercise work time, min; MOC - maximum oxygen consumption, l/min; MLV - maximum lungs ventilation, l/min; OUC2 - oxygen utilization coefficient, %; CO2% - carbon dioxide percentage in expiratory air, %; RC - respiratory coefficient; CDR - cardiac rate, b/min and so on.

RESULTS:
In order to correctly realize external respiration peculiarities using the Exerciser we remind that the Exerciser's base is a special work load device which produces low frequency vibration at exhalation in combination with adjustable resistance.
It was underlined that the Exerciser application reduces pulmonary ventilation volume at the power increase due to the Exerciser's design features (fig.1).
Pulmonary ventilation differences were recorded at the 4-th minute (2-nd load stage) which was equal to 5.55 l/min (-14.2%). Pulmonary ventilation differences between breathing with and without resistance increase after the 4-th minute and were 45, 6% or 52, 0 l/min on the moment of «refusal».The 12-th minute of the exercise corresponded to the moment. At that pulmonary ventilation parameter working with the Exerciser was 62.0 l/min and breathing in mask – 141.0 l/min (Figure 2). Figure 3 shows that differences in OUC2 with the Exerciser can be seen since the 3-rd minute (2-nd load stage). Then you may see a fast OUC2 growth till the 5-th minute of the exercise (3-rd load stage) where the parameter difference may reach 16.3 % (at OUC2 - 5.2% and 4.3% for «Exerciser» and «Mask» respectively). OUC2 slow growth proceeds up to 10-th minute (end of the 5-th load stage) when differences reach 33% (OUC2 parameters 5.6% and 4.2% for «Exerciser» and «Mask» respectively). Then

OUC2 parameters for «Exerciser» variant reduce till the moment of «refusal» (the 12-th minute, 6-the load stage). Differences in this parameter at the moment of «refusal» equal 51.2% (OUC2 parameters 5.3% and 3.5% for «Exerciser» and «Mask» respectively). Figure 4 shows that carbon dioxide percentage in expiratory air CO2% in “Exerciser” variant increase by the 7-th – 8-th minute (the 4-th load level) what corresponds to introduction into anaerobic limit zone when the Exerciser prevent a sportsman from pulmonary ventilation volume increase

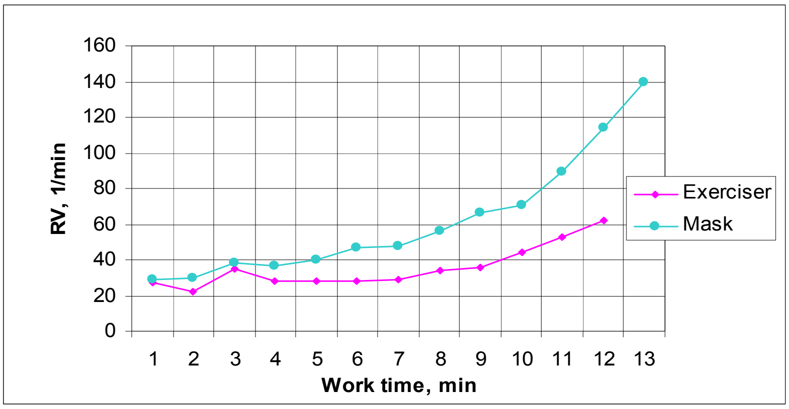

Figure 2. Pulmonary ventilation dynamics. Average group parameters.

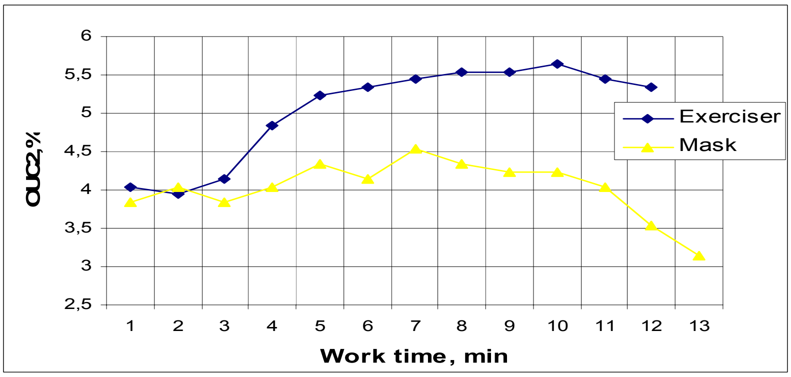

Figure.3. Oxygen utilization coefficient OUC2 % dynamics. Average group parameters.

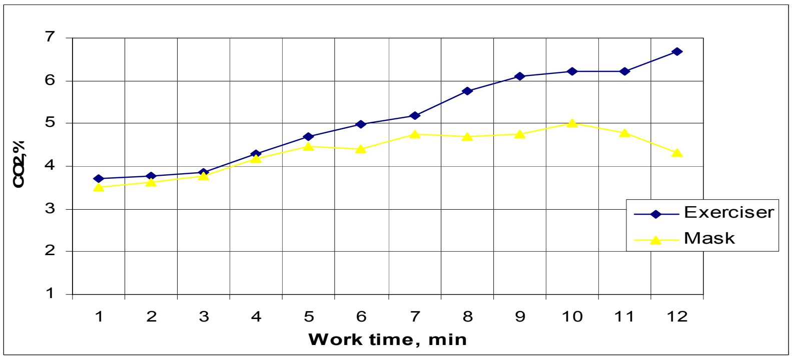

Figure.4. Carbon dioxide percentage in expiratory air CO2% dynamics. Average group parameters.

Figure 5 shows that cardiac rate till the 5-th minute (beginning of the 3-rd load stage – 60 Wt) almost the same for both variants – «Mask» and «Exerciser». Later on if work load increase CDR is higher when working with the Exerciser than under normal conditions («Mask» variant) till «refusal» moment. Different is about 9 -12 b/min. According to the results we may suggest that trainings with the Exerciser gives higher activation to cardiovascular system functioning at a standard load.

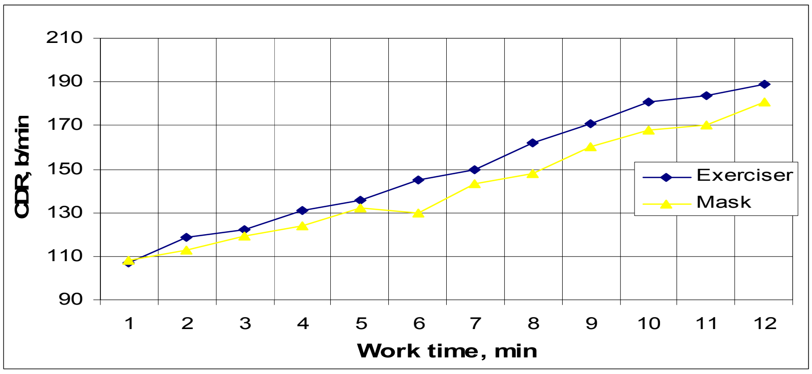

Figure 5. Cardiac rate CDR dynamics. Average group parameters.

DISCUSSION:

The experiment findings testify that the Exerciser application in relation to a normal respiration process results in maximum anaerobic performance reduction and in a high accumulation speed on standard load levels (below and on anaerobic limit level). It means that the Exerciser application contributes to earlier creation of hypoxia (artificial controlled hypoxic environment). Take notice that a lack of free oxygen during muscle work under standard load stages prevents current lactic acid from oxidation to carbon dioxide and water as far as its supply is limited by ingoing air volumes (pulmonary minute volume) and this lack can't be replenished by oxygen utilization coefficient and cardiac rate growth.

CONCLUSION:

It is revealed, that vibrating loading on respiratory muscles with growth of power of carried out exercise strongly influences characteristics of sportsmen external breath. This position creates preconditions for further use of the revealed phenomenon in training sportsmen.
The research results show that in comparison with the normal respiratory process the Exerciser application results in significant limitation of expiratory air flow from the beginning of till the very end of load training. It is testified by statistically significant difference in pulmonary ventilation parameters in spite of sportsmen qualification.
Insufficient volume of ingoing air into the sportsman body (as a result of pulmonary ventilation limitation) with the Exerciser contributes to significant increase in carbon dioxide concentration and in oxygen utilization coefficient
Oxygen consumption dynamic research results testify that respiration with the Exerciser application results in oxygen consumption reduction (due to insufficient volume of pulmonary ventilation and oxygen utilization coefficient growth).
It was found out that respiratory process with the Exerciser contributes to higher activation of cardiovascular system functioning to a standard work load. But it prevents the sportsman from reaching of maximum possible level.

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