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# Physical Efficiency and Lipid Peroxidation in the Sportsmen in the Far North

**ABSTRACT**

The article presents results of studies of physical capacity and lipid peroxidation in the highly skilled sportsmen - single combat wrestlers in the Far North. It was shown that the level of physical capacity of sportsmen - single combat wrestlers was depended on the cardiorespiratory system indices, which was manifested in a significant predominance of the effects of the parasympathetic system on the cardiovascular system and the greater lability of regulatory mechanisms. The intensity of lipid peroxidation and antioxidant system state affect the physical capacity of the sportsmen - single combat wrestlers.

**Keywords:** physical capacity, Kerdo vegetative index, cardiorespiratory system, lipid peroxidation, antioxidant system.

## INTRODUCTION

The physical working capacity of sportsmen is an integral indicator of the final outcome of adaptive changes in the body of his physical abilities and the ability to withstand intense exercise and largely determines sporting achievements [2]. Physical activities increase level of consumption of oxygen that conducts to acceleration of oxidizing processes; therefore one of criteria of an objective assessment of level of special readiness of the athlete is studying of intensity of lipid peroxidation.

Physical activity increases the level of oxygen consumption, which leads to an acceleration of oxidation processes, in this regard, one of the criteria for an objective assessment of the level of special readiness of sportsman consider is the study of intensity of lipid peroxidation.

It is known that physical working capacity dependent on the morphological and functional condition of all systems of the organism and on the various factors, which role differs depending on sports specialization, age, etc.. The main functional system of limiting physical capacity of sportsmen is the cardiorespiratory system [7].

## MATERIAL AND METHODS

The study was conducted on 29 sportsmen-single combat wrestlers of high qualifications (candidates for the master of sports (cms) and the master of sports (ms)), aged 17-21 years.

For establishment of interrelation of physical working capacity with oxidative processes in an organism of athletes we determined intensity of lipid peroxidation (LPO) by accumulation of TBA - reactive product (TBA-AP) [9]. The condition of antioxidant system was determined by the total content of low molecular weight antioxidants (LMAO) in erythrocytes membranes by spectrophotometric methods prior to the test load [6].

To determine the vegetative support the adaptation process in sportsmen, we considered: frequency of heartbeat, arteriotony, the pressure pulse (PP), a Kerdo vegetative index (KerdoVI) not only at rest, but also under the influence the dosed physical load bicycle [3]. Measurement of cardiovascular held at rest in a sitting position after 5 minutes of taking this position. Heart rate per of minute measured by palpation in the projection of the radial artery. Measurement of systolic and diastolic blood pressure was carried out on the left hand on the standard method of S. V. Korotkov.

The general physical operability of PWC170 was defined, on the Neyrosoft stationary bicycle (Ivanovo), thus registered the maximum consumption of oxygen (MCO). Examinees carried out on the stationary bicycle two burdens of moderate intensity with a frequency of 60 rev / min shared 3 – a minute interval of rest. Each load lasted 5 minutes. As a result, all the sportsmen were divided into four groups: the first group consisted of sportsmen with a low capacity for work, the second - with the capacity below average, the third - with an average capacity for work and the fourth - with the capacity above average.

In the quiescent state (before loading) and in the first minutes of recovery (after to loading) for during 30 seconds measured the heart rate (HR) and arteriotony. After each of physical exercise was counted pulse recovery time (in minutes) [1].

The material for investigations heparinized blood. Blood sampling was perfomed in the morning on an empty stomach from the cubital vein.

The study was approved by the decision of the local Ethics Committee at FGBNU "Yakut Scientific Center of complex medical problems."

Statistical processing of received data was performed using statistical software application package STATISTICA 6.0. Applied standard methods of variation statics was used: Calculation of mean values, standard deviations, 95% of a trusting interval. The significance of differences between mean values was evaluated by nonparametric method «Kolmogorov-Smirnov». Data in tables are presented as M ± m, where M - average, m - an error average. Probability of the null hypothesis accepted at $p < 0.05$.

**RESULTS AND DISCUSSION**

Studies of the functional state of athletes have shown that 31% of those surveyed have a low physical working capacity, 26% – below an average, 26% – average and only 17% – above an average, results of PWC170 are presented in table 1. According to literary data, at healthy young men of the meaning PWC170 fluctuate ranging from 850 to 1100 mkg/min., and at the sportsmen who are engaged in single combats, the general physical working capacity fluctuates ranging from 1370 to 1594 кгм / mines (approximately on 30 - 40% surpass data not of coaching men) [1]. The research results show that the indicators of of the cardiorespiratory system in sportsmen are within of norms age, but there are some differences in the study groups (Table 1).

So, in the group of sportsmen with a low capacity the level of Pulse pressure is more high as compared to other groups, but the level of Maximal Consumption of oxygen is mionectic on 32%, what in the group of sportsmen with a good capacity (tabl.1), that testifies to the low aerobic productivity which isn't satisfying oxygen inquiry at intensive loadings.

Distinctive feature of sportsmen with low working capacity is that the blood circulatory system at them is under control of sympathetic system, KerdoVI – positive (table 1). It is known that excessive sympathetic influence leads to deterioration of a metabolism of skeletal muscles, in particular, to decrease of the activity of LDG in them, and, therefore, and to violation of processes of utilization of a lactate. Decrease in working capacity can be also a consequence of violations of a power exchange, first of all reduction of efficiency of aerobic oxidation, transition of power supply to more "expensive" anaerobic way, and, therefore, and increases in need for oxygen which were found.

**Table 1**

**Indicators of a functional condition of athletes with various working capacity to behavior of the testing load (M±m)**

| Indices | working capacity | | | |
|---|---|---|---|---|
| | low | Beneath low | medium | Higher than medium |
| PWC kgm/min | 870±41 | 1160±31 | 1305±22 | 1614,00±82** |
| HRF, beats / min | 76,24±2,89 | 79,66±6,80 | 67,62±2,98 | 66,00±4,08* |
| ADs, mmHg | 118,12±2,91 | 109,00±5,09 | 110,00±2,67 | 108±8,36* |
| ADd, mmHg | 76,56±3,17 | 74,00±4,00 | 73,75±2,63 | 74,00±5,09 |
| PD, mmHg | 41,56±3,70 | 35,00±2,23 | 36,25±1,82 | 34,00±2,44* |
| VIK, CU | 1,78 | -1,14 | -4,96 | -18,18 |
| Δ VIK, CU | +40,86 | +50,14 | +55,70 | +67,72 |
| MO**C,** l/min | 2,75±0,23 | 3,26±0,35 | 3,57±0,31 | 3,99±0,37* |
| t HRFR, min. | 4,31±0,69 | 2,83±0,60 | 2,62±0,49 | 1,8±0,20** |
| t ADR, min. | 3,86±0,41 | 3,33±0,55 | 3,00±0,50 | 2,88±0,66* |

Note: ** p<0.01 in comparison with the I group, * p<0.05 in comparison with the I group

In group of athletes with good working capacity, KerdoVI in an intact state was equal – 18.18 conventional units (table 1) that is characteristic for a "sports" vegetative profile of athletes of high qualification [8,4]. In athletes with a good capacity for work at intensive loads mechanisms of rapid mobilization of metabolism were developed due to significant activity of the sympathetic system, Kerdo ΔVI was on 40% higher than in the group of athletes with a low capacity for work.

In groups of athletes with average working capacity above average is noted reduction frequency of heartbeat at rest that is one of the most important effects of an ekonomization of hearted activity. The increase in duration of a phase of relaxation (diastole) provides a bigger blood-groove and the best supply of a cardiac muscle with oxygen. High physical performance is characterized by the greatest reduction of a myocardium. The athlete's myocardium with high physical performance spends the smaller effort to propulsive action of the heart, than the athlete's myocardium with low working capacity at similar loadings is considerable. At any average the HELL and the minute volume of blood, higher frequency of heartbeat is followed by big consumption of oxygen, and consequently, smaller efficiency of functioning of a myocardium.

After performance work of veloergometer in all groups of athletes the sharp increase in sympathetic influences which is possibly caused by activation of simpathicus adrenalovy system at physical activities was observed.

At athletes with low working capacity after performance of the submaximum veloergometric work, time of restoration of frequency of heartbeat and HELL passed more long in 2.4 ($p<0.01$) and 1.3 ($p<0.05$) time respectively, than in group of athletes with working capacity above average (tab. 2). Between physical working capacity and time of restoration of frequency of heartbeat negative correlation communication is noted ($p<0.01$). Between restoration time the HELL and a vegetative index of Kerdo positive correlation communication is revealed ($p<0.05$).

It is known that activation of LPO is a universal response to numerous factors. Intense physical activity, excessive activating PAUL, increase the permeability of the membrane of the nerve fibers and the sarcoplasmic reticulum myocytes, which hinders the transfer of motor nerve impulses and reduces the possibility of contractile muscle. Damaging effects on lipid peroxidation tanks containing calcium ions, inevitably leads to the dysfunction of the calcium pump and deterioration of muscle relaxation properties, moreover when damaged mitochondrial membranes decreases the efficiency of oxidative phosphorylation, which leads to a reduction in energy supply aerobic muscular work. These data indicate that our results are consistent with the literature data [5].

A comparative analysis of the level of lipid peroxidation products alone, prior to the test load showed that the first group of athletes with low performance of athletes, and the second - with the performance below the average concentration of TBA - AP was 1.87 times higher ($p<0.01$) and 1.96 times ($p<0.01$) compared with the fourth group of athletes with the performance above average (Figure 1).

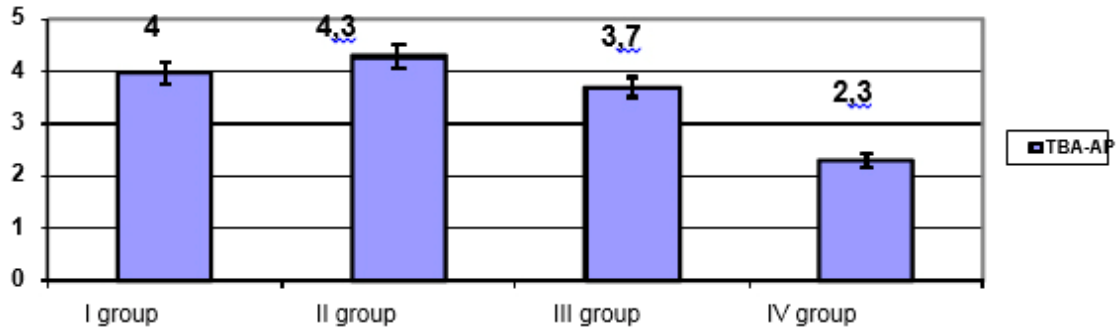


Fig. 1. TBA-AP level (mkmol/ml) in the erythrocytes membranes in the sportsmen with various physical capacity

In turn speed the lipid peroxidation depends on a condition of AOS. Determination of Lmao in erythrocyte membranes revealed that the athletes first, second and third groups Lmao content was reduced, compared with the athletes of the fourth group (Figure 2).

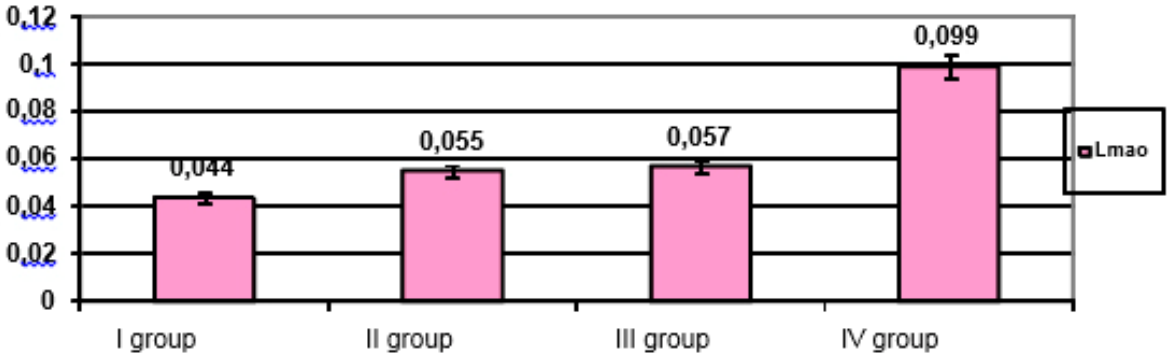


Fig. 2. The sum content Lmao (mgequ/ml*er) of the low-molecular oxidants in the erythrocytes membranes in the sportsmen with various physical capacity

Athletes first group by 56% in the second group of athletes by 45% and the third group of athletes by 43%.

Correlation analysis showed that the concentration of TBA-AP has a negative correlation with RWC170 ($p < 0.05$). Content Lmao has a positive correlation with RWC170 $r = 0,645$ ($p < 0.05$). The highest rates were observed physical performance in athletes with low tiobarbiturat-active products and high content of low molecular weight antioxidants.

**CONCLUSIONS**

1. The level of physical performance of athletes, martial artists and their adaptive potential depends on the parameters of the cardiorespiratory system, which manifests significant prevalence of parasympathetic influences on the cardio vascular system and the greater stability of regulatory mechanisms.
2. The intensity of lipid peroxidation and condition of antionsidant system affects the physical performance of athletes, martial artists.

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