

## METABOLIC ENDURANCE AND ITS COMPLIANCE WITH INTERNATIONAL STANDARDS IN ELITE CYCLISTS

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**Abstract:** The article is devoting to assess the compliance of average values of key metabolic endurance indicators (anaerobic threshold, lactate tolerance, relative power) with international standards in elite cyclists.

### Introduction

The functional state and metabolic endurance of athletes in cyclic sports are key factors determining their competitive success [1, 2]. The most informative indicators reflecting the level of special performance are considered to be the anaerobic threshold (AT), lactate tolerance and specific power (W/kg) [3, 4]. A number of studies have established that in elite cyclists these parameters reach values that ensure resistance to high training and competitive loads, which indicates their high physiological adaptation [5, 6].

### Materials and methods.

The study included 43 elite cyclists (mean age  $22.4 \pm 3.1$  years) with training experience corresponding to the international level of training. For a comprehensive assessment of the functional state of the athletes, a stepwise bicycle ergometric test was used, which involved performing successive load steps with a gradual increase in power. Each step lasted a fixed period of time, after which heart rate indicators were recorded and capillary blood samples were taken to determine the lactate concentration.

This protocol made it possible to identify individual values of the anaerobic threshold, reflecting the transition of the body from a predominantly aerobic to anaerobic energy supply pathway. Lactate levels were analyzed using enzymatic analysis, which ensured high sensitivity and reproducibility of measurements. Based

on the data obtained, lactate tolerance was calculated, as well as relative power (W / kg), defined as the ratio of the achieved power to the athlete's body weight. This indicator was considered as a key criterion of metabolic endurance, allowing an objective assessment of the functional capabilities of the body under specific competitive loads. To ensure the correctness and scientific validity of the interpretation, the results were compared with international standards established by the Union of Cyclists (UCI) and the European College of Sports Science (ECSS). This allowed not only to assess the compliance of the studied sample with the reference indicators, but also to determine the degree of physiological adaptation of cyclists to high loads typical of modern cycling.

### **Results.**

The average values of the key indices of metabolic endurance in the examined cyclists were: anaerobic threshold —  $4.3 \pm 0.2$  mmol/l, lactate tolerance —  $9.8 \pm 0.6$  mmol/l and relative power —  $6.4 \pm 0.4$  W/kg. The obtained data indicate that the studied sample fully complies with the international standards established for elite athletes (UCI, ECSS). The anaerobic threshold value of 4.3 mmol/l reflects the body's ability to effectively utilize lactate and maintain stable work on the border between aerobic and anaerobic energy supply. This indicator is considered characteristic of world-class athletes and indicates a high level of metabolic stability. Lactate tolerance (9.8 mmol/l) demonstrates the pronounced ability of the body to tolerate significant concentrations of the metabolite without a sharp decrease in work power. This indicator is directly related to the potential for long-term high-intensity load, which is critical for competitive activity in cycling, especially when passing the finishing sections or mountain stages.

The relative power calculated based on the bicycle ergometry data averaged 6.4 W/kg. This value not only confirms compliance with international standards, but also reflects the optimal ratio between absolute power performance and body weight, which is crucial for achieving high sports results, in particular, in mountain races and on stages with a pronounced difference in terrain. The totality of these data confirms that the examined athletes have a high degree of physiological adaptation

to the specific requirements of cycling. Their metabolic endurance indicators demonstrate the effectiveness of the implemented training process and the compliance of their preparedness with the international level, which is an objective criterion for the quality of the training system.

**Conclusion:** The average values of anaerobic threshold, lactate tolerance and relative power in the examined cyclists correspond to international standards for athletes of this level. The results obtained confirm the high efficiency of the training preparation and adaptation to the specific requirements of cycling. The use of these indicators can serve as an objective criterion of functional readiness for the individualization of training programs.

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