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EDITORIAL

Factors defining oxygen uptake at peak exercise in aged people

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Maximum oxygen uptake (VO_{2max}) is defined as the highest rates at which oxygen can be taken up and utilized by the body during severe exercise indicating the cardiopulmonary fitness of the individual. It is one of the main variables in the field of exercise physiology and is frequently used to indicate the cardio-respiratory fitness of an individual [1]. Consequently, there has been great interest in identifying the physiological factors that limit VO_{2max} and determining the role of this variable in endurance and anaerobic performances. Today, it is universally accepted that there is a physiological upper limit to the body's ability to consume oxygen. In the scientific literature, an increase in VO_{2max} is the most common method of demonstrating a training effect. In addition, VO_{2max} is frequently used in the development of an exercise prescription in health and disease. Given these applications of VO_{2max}, there has been great interest in identifying the physiological factors that limit VO_{2max} and determining the role of this variable in endurance performance.

Aging-related changes occur mainly in the cardiopulmonary and skeletal muscles, bringing about a reduction in physical performance [7]. Such myocardial and peripheral functional changes include a decline in the maximum heart rate, stroke volume, and contractility, and an increase in peripheral vascular resistance. Consequently, the maximal VO_{2max} decreases.

The primary aging process, itself genetically associated, occurs both independently of lifestyle and in the absence of disease [4]. Accordingly, one may expect maximal cardiac output to decrease with aging irrespective of lifestyle because of genetic factors. Reduced arteriovenous oxygen difference at maximal effort [6] is the second factor associated with decrease with aging of VO_{2max}.

Incremental exercise is characterized by exposing the subjects to a high degree of load which may alter the left ventricular contractility and function [5]. This has the effect of placing a large load on the left ventricular which might have significant effects on oxygen delivery to the working muscles. Thus, oxygen delivery to the working muscle may be reduced, and since metabolic demand during incremental exercise is increased over time to maximum, elderly subjects may maintain the energy supply due to the balance between O_2 delivery and extraction.

Untrained and trained elderly can increase the response of the central factors i.e., cardiopulmonary without a significant reduction in peripheral ability to extract oxygen at the muscle level. It was found that in elderly subjects, skeletal muscle mitochondrial capacity, tissue blood flow capacity, and oxygen exchange capacity appear to be well-matched. It seems that intrinsic mitochondrial function and regulation are not altered significantly.

Values for cardiac output at peak aerobic exercise are low in the untrained compared to the trained at maximal aerobic exercise. The lower cardiac output in the untrained elderly at peak exercise is related to the limited heart rate reserve, stroke volume, contractility, and to the inappropriate adjustment of the circulation [3, 5]. The augmentation in maximal oxygen uptake in the trained elderly in response to

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exercise training is mainly due to the adaptive increases in cardiac output and to the lesser extent to the arteriovenous oxygen content difference at maximal exercise [2].

This suggests that the differences between the trained and untrained elderly in absolute oxygen uptake of the working muscles and peak power output at peak exercise are due to physical inactivity or physical activity. Although maximal oxygen uptake is lower in the untrained elderly, it seems that intrinsic mitochondrial function and regulation are not altered significantly due to physical inactivity. Thus, untrained subjects can partially compensate for the lower cardiac output by increasing oxygen extraction as the trained elderly.

The higher aerobic capacity in the trained elderly is related to increases in the abilities of cardiovascular factors and to the lesser extent to increases in muscle mitochondria concentration and capillarity.

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