Metabolic rate varies with exercise p210-212

As a vertebrate begins exercise, its energy use sharply rises. However, it does not increase breathing immediately as it’s respiratory and circulatory system cannot increase flow instantly. This can be though of as the blood having a sort of inertia. Breathing increases gradually and the energy deficit is produced anaerobically. This is experienced as a gradual increase in breathing rate when beginning exercise there exists a state of equilibrium between oxygen demand and consumption, the text refers to this as the “Pay-as-you-go-phase” (Hill et al. 2022, p. 211). After exercise, the rate of oxygen consumption does not drop immediately, experienced as heavy breathing.

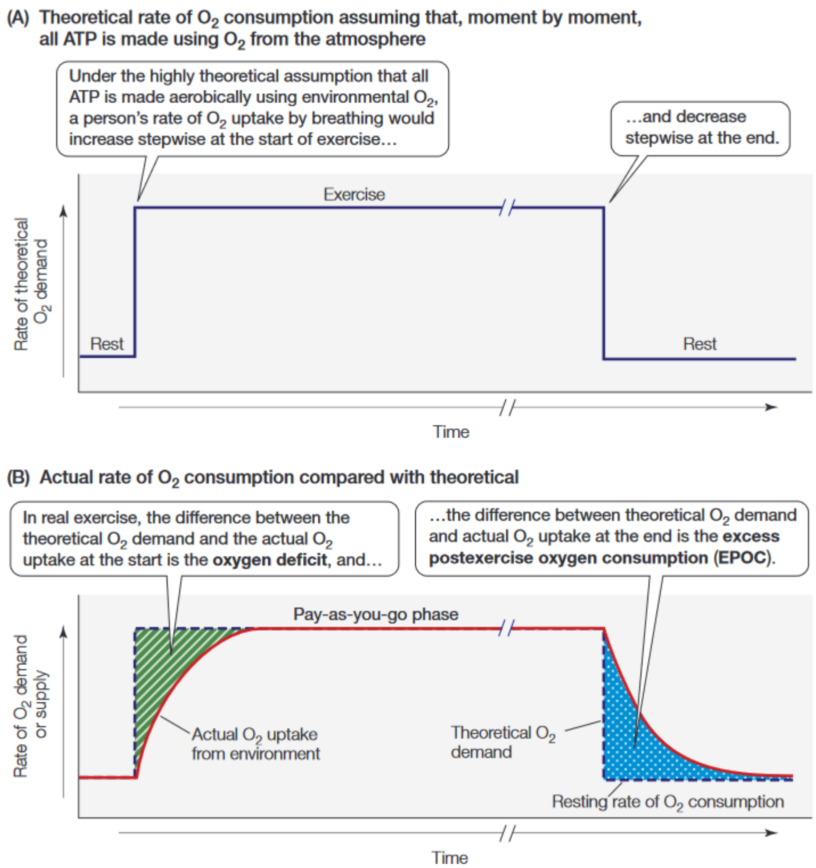


Figure 8.10 p. 211 shows the general form of exercise oxygen consumption. Although the actual physical work increases and decreases stepwise, the oxygen consumption of the organism increases and decreases gradually.

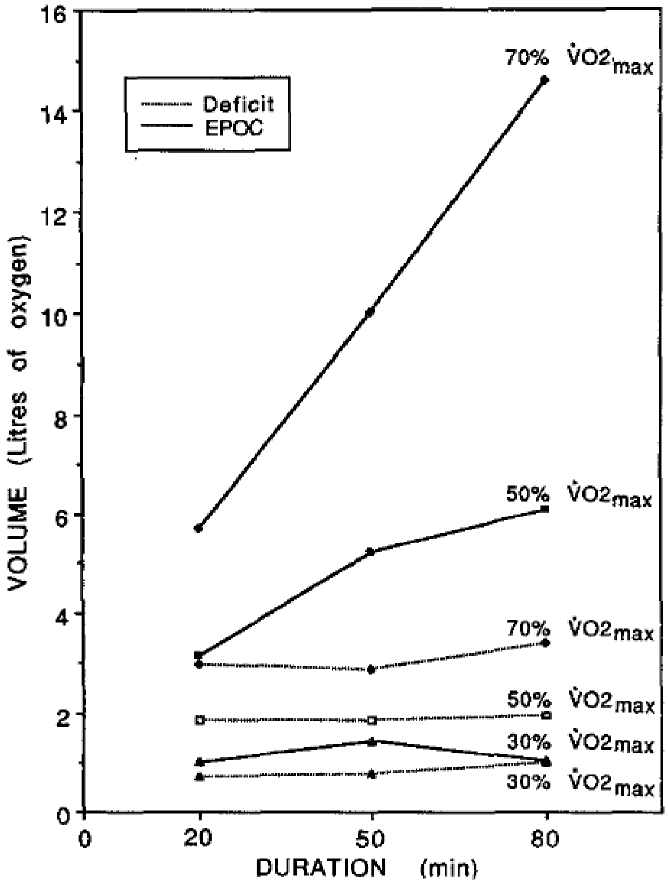
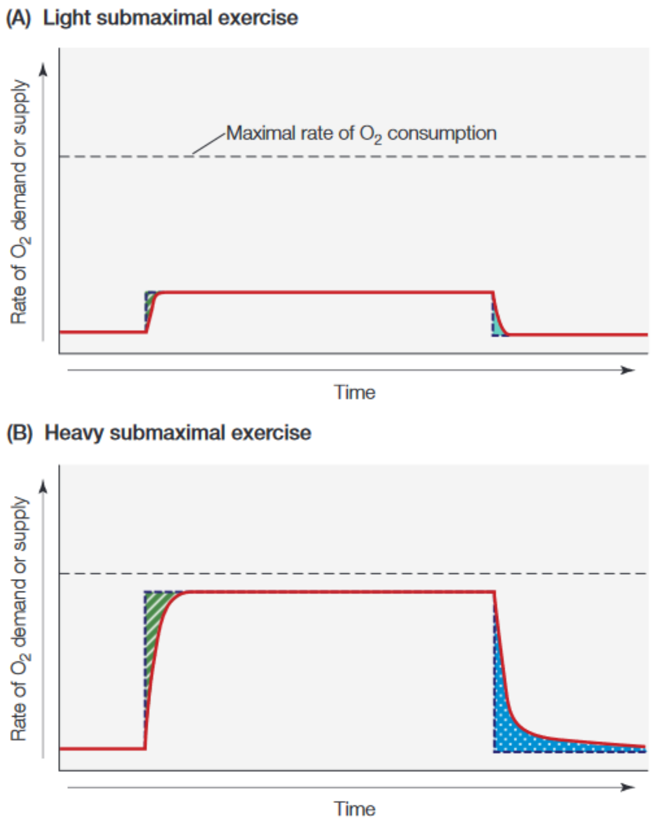


Fig. 1. The mean O_2 deficit and excess post-exercise oxygen consumption (EPOC) of the nine subjects resulting from 20, 50 and 80 min of treadmill exercise at 30, 50 and 70% maximal O_2 consumption ($\dot{V}_{O_{2\,max}}$)

Interestingly, the total oxygen consumed during EPOC is often greater than the deficit at the start of exercise likely due to oxidation of lactic acid, and re-oxygenation of myoglobin and hemoglobin along with other disturbances due to exercise (Gore and Withers 1990).



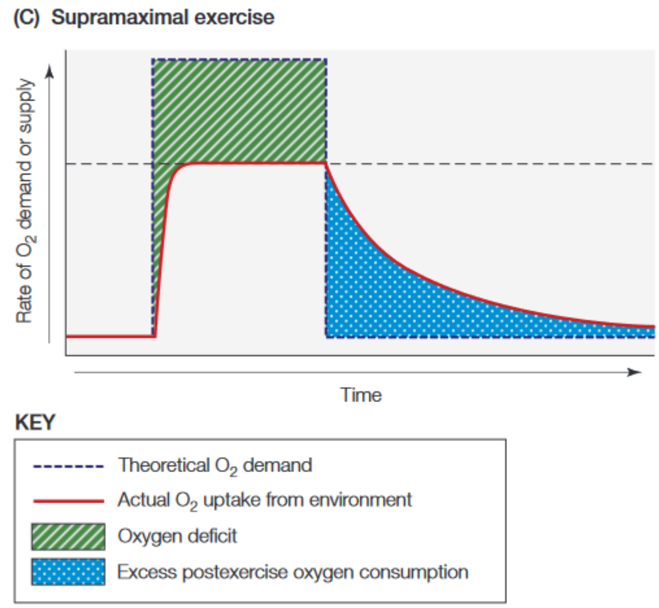


FIGURE 8.11 Stylized O_2 supply–demand diagrams for light submaximal, heavy submaximal, and supramaximal exercise The format is as in Figure 8.10. The patterns illustrated are those observed in mammals. Two important determinants of exercise performance are an individual's maximum rate of O_2 consumption and maximum oxygen deficit. Both are increased by training (repeated exercise), thereby increasing performance. A person, for example, might increase his or her maximum rate of O_2 consumption by 10%–30% through appropriate training.

An individual can only sustain a certain maximum rate of oxygen consumption due to lung capacity, diffusion rates blood flow and number of mitochondria in cells, this leads to individuals having specific maximal exercise capacity. Below this or at this threshold, submaximal and maximal exercise, oxygen is not the limiting factor for energy production. Above this threshold, supramaximal exercise, oxygen is the limiting factor in the amount of work an individual's muscles can perform. The excess energy again is provided anaerobically (Hill et al. 2022, p. 212).

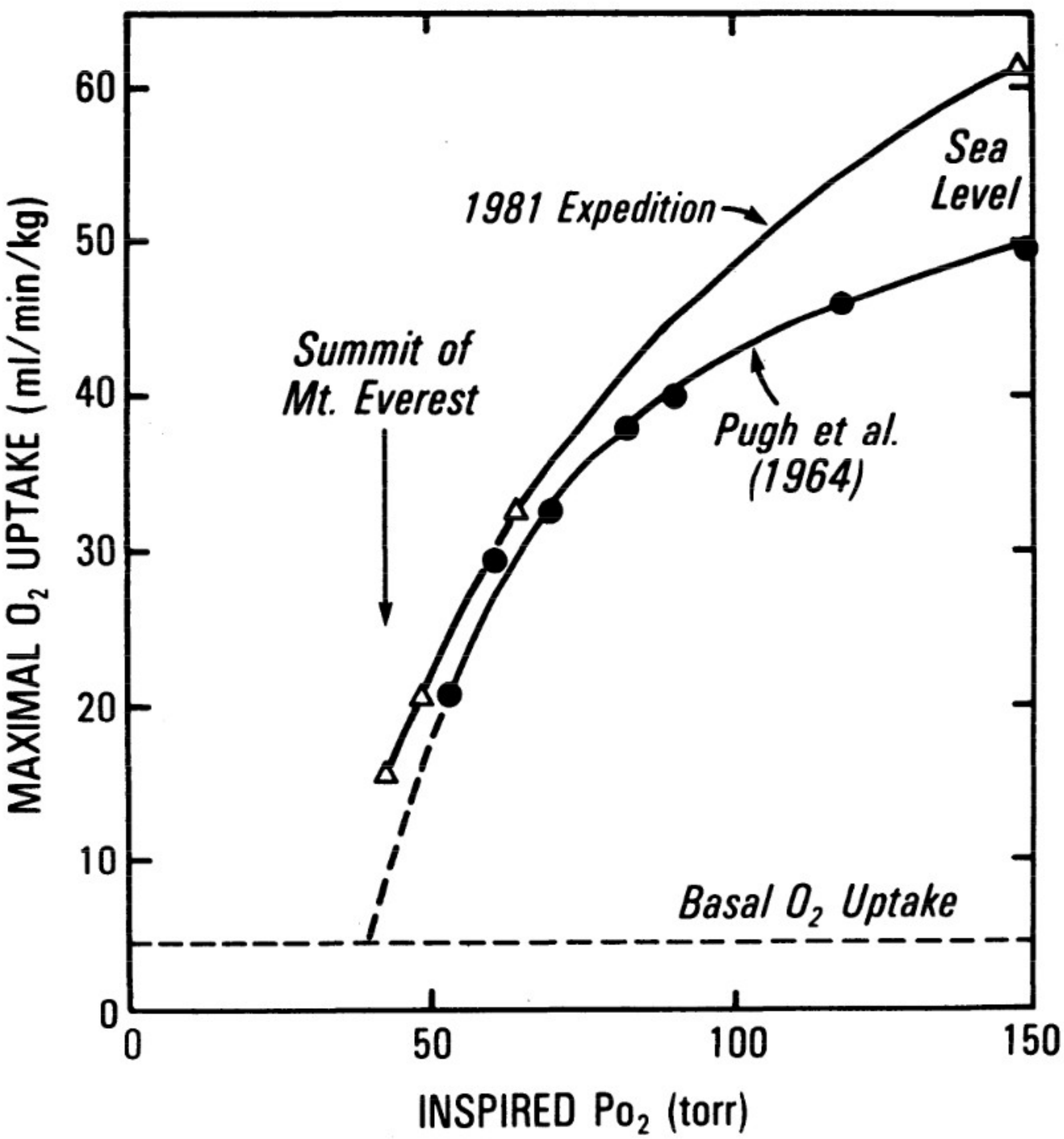


FIG. 4. Maximal O_2 uptake against inspired Po_2. The present data (*triangles*) are contrasted with measurements (*circles*) made previously by Pugh et al. (21). Note that although curve derived from data in present study is only slightly shifted to left, because of steepness of slope, gain in maximal O_2 uptake at extreme altitudes is substantial.

Maximal exercise is related to the amount of oxygen available to an individual, in lower oxygen concentrations such as in high elevation, the maximum amount of work possible decreases. In this case, high altitudes have the same percentage of oxygen as sea level air, but the rate at which oxygen diffuses into blood is decreased because the partial pressure of O_2 (X-axis) is lower (West et al. 1983).

Works Cited:

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