Maximal Aerobic Capacity (VO_{2max})

Fick Equation

$VO_2 = HR \times SV \times a\text{-}vO_{2diff}$

Absolute VO_2

- The total volume of oxygen consumed.
- Expressed as L/min

Relative VO_2

- The total volume of oxygen consumed related to body weight
- Allows comparison of aerobic fitness among individuals of various body size
- Expressed as mL/kg/min

An Example

If you are 70kg and have an absolute VO_2 of 3.5 L/min, what is your relative O_2 consumption?

VO_2 (mL/min) = 3.5 L/min x 1000 mL/1L = 3500
VO_2 (mL/kg/min) = 3500 mL/min ÷ 70 kg = 50

What are normal values for relative (mL/kg/min) VO_2 for various groups of individuals?

Untrained College-aged Females 30-35 mL/kg/min
Untrained College-aged Males 35-45 mL/kg/min

Active College-aged Females 40-45 mL/kg/min
Active College-aged Males 45-50 mL/kg/min

Trained College-aged Females 50-60 mL/kg/min
Trained College-aged Males 55-65 mL/kg/min

Competitive College-aged Males 65-85 mL/kg/min

Highest measured VO_{2max} ~95 mL/kg/min

Why does aerobic exercise training increase VO_{2max}?

Let's focus on the Fick Equation

$$VO_2 = HR \times SV \times a\text{-}vO_{2diff}$$

Factors to consider are how does training affect:

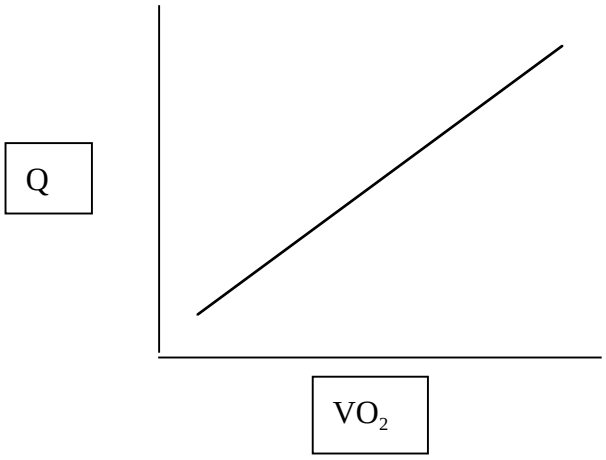
HR

SV

$a\text{-}vO_{2diff}$

Also, consider this relationship:

1 L/min VO_2 = 6 L/min Q



Therefore if…..:

VO_2 is 2 L/min, what must Q be?

3 L/min?, 4 L/min?, 5 L/min?

Fick Equation

$VO_2 = HR \times SV \times a\text{-}vO_{2diff}$

Now that we have seen the Fick equation how should I relate this to training adaptations? Here are some thoughts and questions to focus your thinking…..

1) What are the training adaptations to resting HR, submax HR and max HR?

Be able to describe why training changes these. How do changes in HR relate to Q? (Be able to talk about Q = HR x SV)

2) How does training affect SV?

Be able to describe changes in EDV and ESV. What causes these to change and how do they contribute to increasing SV. Use the relationship SV = EDV – ESV to discuss these training adaptations.

3) What role does changes in blood volume play in altering Q?

4) Why is a change in Q_{max} important for increasing VO_{2max}?

5) What is the limit for VO_{2max}? Does it have anything to do with blood volume and changes in Q_{max}?

6) Look over Table 9.4 to fully understand the differences between a trained and untrained cardiovascular system.

7) Blood delivery (i.e., O_2 delivery) and O_2 utilization. How is this limiting to VO_{2max} and how does training change the limits to VO_{2max}? Use this Fick equation as part of your explanation (Think about Q and a-vO_{2diff}).