DATA SET 3 EXPLORE 1C LESSON 18



Study 1

Interstitial pH in human skeletal muscle during and after dynamic graded exercise

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Overview of the Study

In this study, scientists' aim was to determine the changes in interstitial pH in human skeletal muscle during and after exercise at different intensities. To study this, six healthy males with an average age of 31 and similar fitness levels, participated in the investigation.

Prior to the workouts, a probe was placed into the quadriceps muscle via a 25-gauge needle at the insertion site. The probe contained both inlet and outlet needles to allow for continuous perfusion of blood through the probe and into the data collection instrument called a microfluorometer. During exercise, pH-sensitive dye was perfused through the muscles. As this dye flowed through the muscles and into the microfluorometer, the pH of the blood could be measured.

pH is a measure of how acidic or basic (alkaline) a substance is. pH is reported as a number between 0 and 14. A pH of 7 is neutral (meaning there are equal amounts of acid and base present), anything below 7 is acidic, and anything above 7 is alkaline. pH is based on the concentration of hydrogen ions (H⁺) in a substance. The more H⁺ ions present, the more acidic something is, thus the lower the pH measurement. At rest, the typical pH of the interstitial fluid of skeletal muscle is about 7.4.

Subjects performed one-legged knee-extensor exercise in a supine position. The subjects completed three bouts of 5 minutes of knee extensions at power outputs of 30 W (low intensity), 50 W (moderate intensity), and 70 W (high intensity) in random order. Each bout was separated by 20 minutes of rest. Verbal encouragement was given to the subject at the higher intensities.

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Figure 1. Interstitial acidification during exercise. Individual recordings of interstitial pH during 5 minutes of knee-extensor exercise are shown. The six panels refer to the six different subjects. The power output was 30 W (green), 50 W (blue), and 70 W (red). Exercise was started 5 minutes after the onset of the recording (marked with a horizontal bar). One subject, marked *, became exhausted after 2 minutes of 70 W exercise.

Study 2

Lactate and H⁺ effluxes from human skeletal muscles during intense, dynamic exercise

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Overview of the Study

The aim of the study was to examine changes in blood H^+ concentration during varying intensities of exercise and during recovery. The concentration of hydrogen ions (H^+) in a substance determines how acidic or basic a substance is. The more H^+ ions present, the more acidic a substance is, and the less H^+ ions present, the more basic it is. At rest, the typical pH of blood is about 7.4.

To study these changes, scientists recruited six male subjects in their young to mid-20s with similar fitness levels. All the subjects consistently worked out, but none of them trained for competition.

A one-legged exercise that isolated the quadriceps muscle was used for all exercise trials. All participants were able to practice and were familiar with the exercise before any trials started. Catheters for blood samples and temperature readings were placed where arterial blood entered the muscle and where the venous blood exited the muscle.

Participants were randomly assigned which leg would be used for all movement throughout the trial and to either a passive (P) or active (A) recovery. Those assigned a passive recovery simply rested their leg during the recovery periods. Those assigned active recovery performed very light-intensity exercise with the same leg. After a light warmup, all participants completed the following exercise protocol: 10 minutes of moderate-intensity exercise with the active leg (Ex 1) and a 10-minute recovery period. Blood samples were collected every 2-10 minutes throughout the exercise protocol and during the recovery period. H⁺ levels in blood samples were measured using a chemical analysis.



Figure 2. The responses of H^+ to exercise and recovery. The femoral artery is represented by diamonds, and the venous artery is represented by squares. Blood H^+ concentration (*B*) for the P-leg (filled symbols) and the A-leg (open symbols). * Significant difference between P-leg and A-leg.