

## The Effects of Exercise on the Respiration Rates of Mice

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### ABSTRACT

Physical fitness is known to lower respiration rates. For this study 12 mice were exercised by swimming each one for 30 minutes. The mice were to be exercised and monitored for eight weeks. Six mice served as the control group and were not exercised after an initial conditioning period of four weeks. The other six mice were also conditioned and then were exercised regularly for two weeks after that. Before and after each session of exercise, the mouse's respiration rate was recorded using the LI-6200 Portable Photosynthesis system. The hypothesis stated that the resting and recovery respiration rates would be lower in the mice that were exercised the extra two weeks. The results of the experiment showed no significant evidence in favor of the hypothesis. One major factor contributing to the insignificance may have been that 10 out of the 12 mice died after a total of six weeks, cutting the experiment short by two weeks. Significant results may have been achieved if larger sample sizes were used, more consistency with the equipment, or if the duration of the experiment was longer.

Key Words: exercise, resting respiration rate, recovery rate, post-exercise respiration rate

### INTRODUCTION

The maximum respiration rate, the maximum rate of oxygen uptake or carbon dioxide release, is one of the most important indicators of one's ability to perform sustained exercise. Respiration rate does not instantaneously return to resting rates following exercise. According to Witten (1995), recovery respiration, or the period of respiration after each interval of exercise during which the rate of respiration returns to normal levels, decreases exponentially while returning to resting levels. During the recovery period, the body adapts to the stress produced by the work it has just done (Deschriver, 1998). Also known as oxygen debt, the recovery respiration is actually when the levels of respiration are kept high in order to metabolize by-products of exercise, such as lactic acid (Witten, 1995).

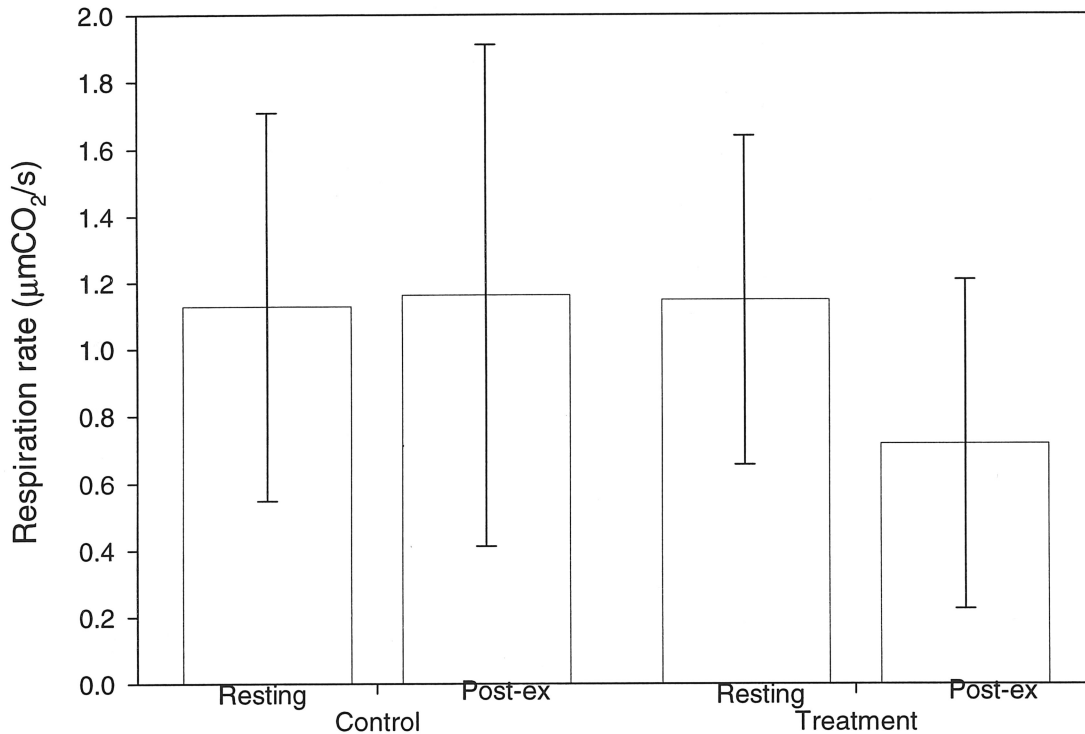
It is known that the amount of time it takes to return to normal resting respiration rate after exercise is directly proportional to the fitness level (Witten, 1995). Prolonged exercise, resulting in an increase in physical fitness, will cause a gradual decrease in both resting respiration and the amount of time it takes for recovery after each period of exercise, or the recovery rate. The recovery respiration reflects the metabolic changes caused by the preceding exercise, as well as the physiological alterations caused by that exercise (Katch et al., 1995).

The above facts have led me to perform my own research on the relationship between exercise and respiration rates. My experiment consists of taking the resting rate of carbon dioxide release of mice and the rate of respiration after swimming for thirty minutes and after five minutes rest. Comparing the results of an exercised group with those of a control group will test my hypothesis that physical fitness lowers resting and recovery respiration rates.

### MATERIALS AND METHODS

For this experiment, 12, young adult mice were used. These mice were randomly divided into four groups of three. The first step was to condition the mice to ensure they were all at approximately the same level of physical fitness before I began testing. To ensure the mice all got the same amount of exercise, they were each put into a pipette cleaner full of water, deep enough to keep them from reaching the bottom or getting out the top. In water, the fur of the mouse would hold air suspending them in the water. To guarantee this wouldn't happen, a small drop of soap was placed on back of the mouse and rubbed in to keep the air from building up in the fur. The trial and error method was used to determine how long the mice should swim. The first group swam for 10 minutes, and seemed not to be effected afterward. The next group swam for 30 minutes and could still keep their heads above the surface, yet seemed exhausted; therefore, a standard exercise time of 30 minutes was set. All twelve mice were exercised three times a week for four weeks. Groups two and four were then determined to be the exercised group throughout the treatment period, while groups one and three would be the control group.

After the conditioning period, the mice were ready to be tested. To monitor the rate of carbon dioxide released, the LI-6200 Portable Photosynthesis system was used. The LI-6200 measures the rate of photosynthesis in plants, however for this purpose, it was used to monitor the rate of respiration from the mice. The tubes from the console of the machine were led through a stopper and into an 18.8-liter glass jug. The page parameters were set as follows: LAB: MANDI; Vt (cc): 18,800 (cubic centimeters, since the jug is 18.8 L); Vg (cc): 154; P (mb): 979.99; BC (mol): 0.0; STOMAT: 0.0; Fx (umol): 999.99; Kabs: 1.0; A8:



**Figure 1.** Average Resting and Post Exercise Rates.

0; A9: 0; pr1 to pr6 were left blank. The operating parameters were set as follows: LAB: MANDIOP; Change: 60; Channel: 10; Obs/page: 1; Steps: 1; Beep log: Y; Keep SMP: Y; PRN FMT: S; Area Mult: 1.0. When the machine is set to monitor the rate of carbon dioxide release, it should start by being at about the same concentration as the carbon dioxide in the air. This is about 350 ppm (parts per million). If this number is higher than 350 ppm, it can be lowered by using the scrub switch, or a quicker way is to use a vacuum and pressure pump to suck the carbon dioxide out of the jug until it reaches around 350 ppm. Once everything was set, the mice were ready to be tested. Each mouse was put in the jug to test the resting respiration rate. The mouse was then removed from

the jug, exercised 30 minutes, given a five-minute rest, and then put back in the jar for a post-exercise reading.

An initial test was done all on all twelve mice. Groups two and four were then exercised for two weeks. The post-exercise results of these two groups were then compared with the results of the initial test, as well as the resting rates of each mouse in the treatment groups before it was exercised.

## RESULTS

The results of the initial test showed that after the four week initial treatment on all the mice, the resting rates of all 12 were approximately the same, and the post-exercise rates of the treatment group were slightly

lower (Fig. 1). During the first week of the exercise treatment, the average resting rate was 1.4966  $\mu\text{mCO}_2/\text{s}$  (s.d.=0.6550), and the average post-exercise rate was 1.3457  $\mu\text{mCO}_2/\text{s}$  (s.d.=0.5175). A t-test for paired samples showed the difference was not significant. A test to determine how large a sample was needed to obtain a significant value for the results of week one showed that a sample size of 13 would have resulted in significant values. The average resting rate of the testing done during the second week of exercise was 1.3197  $\mu\text{molCO}_2/\text{s}$  (s.d.=0.4047), while the average post-exercise rate was 1.2945  $\mu\text{molCO}_2/\text{s}$  (s.d.=0.4525). A paired sample t-test for these results also showed that the numbers were not significant. A sample size of 44 would have given a significant conclusion.

## DISCUSSION

The results of comparing a conditioned group versus an unconditioned group of mice, did not confirm the hypothesis that over time, exercise reduces the respiration rate, since my findings were not significant. My results do not reinforce the findings by Katch, (1991), and Witten, (1995) that state that respiration rate is directly proportional to fitness level and that increased physical fitness will result in a decrease in resting and recovery rates. Some of the reasons the data may not have been significant include inconsistency with operating the monitoring device and physical condition of each mouse (some were pregnant or had recently had babies). Another possible source of error could have come from differences in temperature of the water the mice swam in. According to Katch, 1995, swimming in water below 77 degrees Fahrenheit or 25 degrees Celsius, puts the body in thermal stress, where it has to work to maintain a consistent core temperature.

In order to achieve significant results the experiment could have been administered longer, obtaining more data. This was the original plan, however due to unknown reasons, 10 of the 12 mice died, cutting the experiment short by two weeks. This also presented a problem in that the mice of the control group died before they had a chance to be tested a final time after not exercising for four weeks. Due to time constraints, the information already obtained was used. The rates of post-exercise respiration for the exercised group were compared to the resting rates of the exercised group and the initial results of all the mice. Other methods that could have been used to achieve significant results include using larger sample sizes, as previously stated, and more practice using the respiration monitor, resulting in more consistent data. Regardless of the significance of the data found in this experiment, the emphasis of exercising for respiratory health is of obvious importance. The findings reported in this study simply confirm what many experts have known for years.

## ACKNOWLEDGEMENTS

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## LITERATURE CITED

- Deschriver, Richard. Recovery in Interval Training.  
[www.sports.ussa.edu/pubs/sportsup/RECOVERY.HTM](http://www.sports.ussa.edu/pubs/sportsup/RECOVERY.HTM)
- Katch, Frank I., Katch, Victor L., and McArdle, William D. Exercise Physiology: Energy, Nutrition, and Human Performance.  
 Philadelphia/London: Lea and Febiger, 1991.
- Witten, Mark L. Respiration and Exercise.  
[www.physiol.arizona.edu/CELL/Instruct/95BWRS-2/95BWRS-2.html](http://www.physiol.arizona.edu/CELL/Instruct/95BWRS-2/95BWRS-2.html)