An Exploration of the Differences Between Diaphragmatic Respiration and Normal Respiration on Post-Exercise Recovery Heart-Rates

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Abstract

This paper explores the relationship between recovery time after anaerobic exercise when using diaphragmatic breathing versus traditional chest breathing. The experiment tracked heart rate before, during, and three minutes after participants had completed a minute of planking. Then, looked for a correlation between the length of time required to reach a recovery heart rate and the use of chest and then, diaphragmatic breathing after exercise. Results of this experiment show that there is a benefit to using diaphragmatic breathing during recovery after exercise in order to reduce recovery time.

Introduction

The group's decision to do the POPs Project on the respiratory system began by looking into studies about different types of breathing. Many articles were found discussing the benefits of diaphragmatic breathing, it was decided that the project would be based upon the changes it could have on post-exercise recovery times. However, difficulties were faced when trying to find articles that directly correlated between aerobic/anaerobic exercise and diaphragmatic breathing. Past studies examining diaphragmatic breathing only address topics such as chronic obstructive pulmonary disease (Vitacca, 1998), stress (Consolo, 2007), and rumination syndrome (Halland, 2015). This study was designed to better understand the relationship between diaphragmatic breathing and exercise recovery time.

The experiment's hypothesis predicted that individuals who perform diaphragmatic breathing exercises after light exercise would see a greater percentage decrease in heart-rate per minute than when they use regular chest breathing exercises. UC Berkeley says, "Your heart rate drops most sharply in the first minute after you stop exercising; it should then fall about 20 beats per minute—a drop of less than 12 beats a minute is considered abnormal. This "recovery heart rate" is measured as part of an exercise stress test." (Wellness, 2019). It was predicted that there would be a sharper drop in heart rate during the first minute of post-exercise recovery using diaphragmatic breathing, than while using regular chest breathing principles.

Materials

Stopwatch, time in seconds/minutes

People of all ages

A way to obtain pulse rate, either electronic or manual.

Flat space, preferably on carpet, used for planking

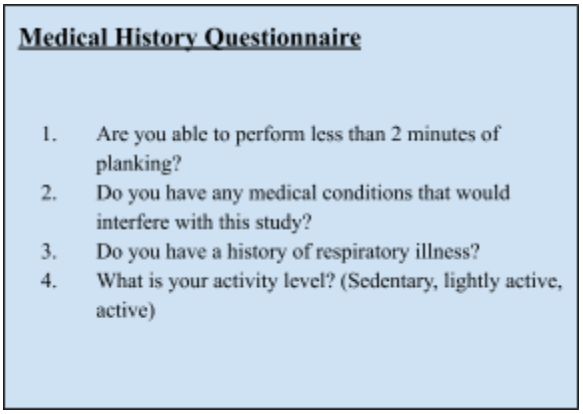


Figure 1.1

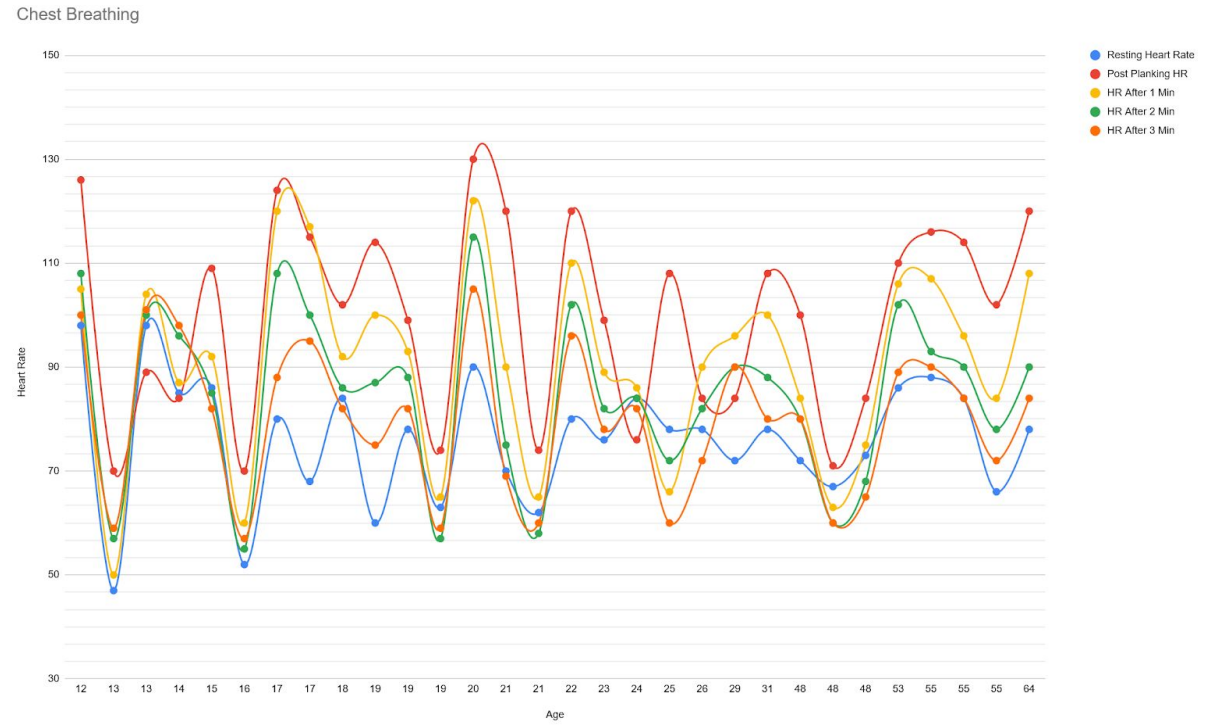
Methods

For this experiment, heart rates of individuals at different stages of recovery were measured and contrasted with the type of breathing done directly after completing exercise. Each

conductor of the study started with one person. The subjects were given the study questionnaire listed in Figure 1.1 to make sure that they were medically capable of completing the experiment and to get an idea of their health. To establish a baseline, the resting pulse was taken before the activity was started. This was done both manually, by taking a radial pulse, and through the use of Apple watches or fit-bits. Then, the subject was instructed to plank for one-minute. Immediately, thereafter, the heart rate was taken again in order to establish how it had changed with exercise and the subject was instructed to breathe normally. Their pulse was then monitored at one-minute intervals for three consecutive minutes. After the subject had returned to baseline, they were instructed in how to breathe using the diaphragmatic method, and a baseline pulse was established. They completed another minute of planking, followed by noting their pulse, and, then, their heart rate was monitored at minute intervals through another three-minute recovery period. The experiment was repeated on a total of thirty-participants in order to collect a wide variety of results and have data that was statistically significant.

Data

Fig 1.2


Chest Breathing
Resting Heart Rate
Post Planking HR
HR After 1 Min
HR After 2 Min
HR After 3 Min
Heart Rate
150
130
110
90
70
50
30
12 13 13 14 15 16 17 17 18 19 19 19 20 21 21 22 23 24 25 26 29 31 48 48 48 53 55 55 55 64
Age

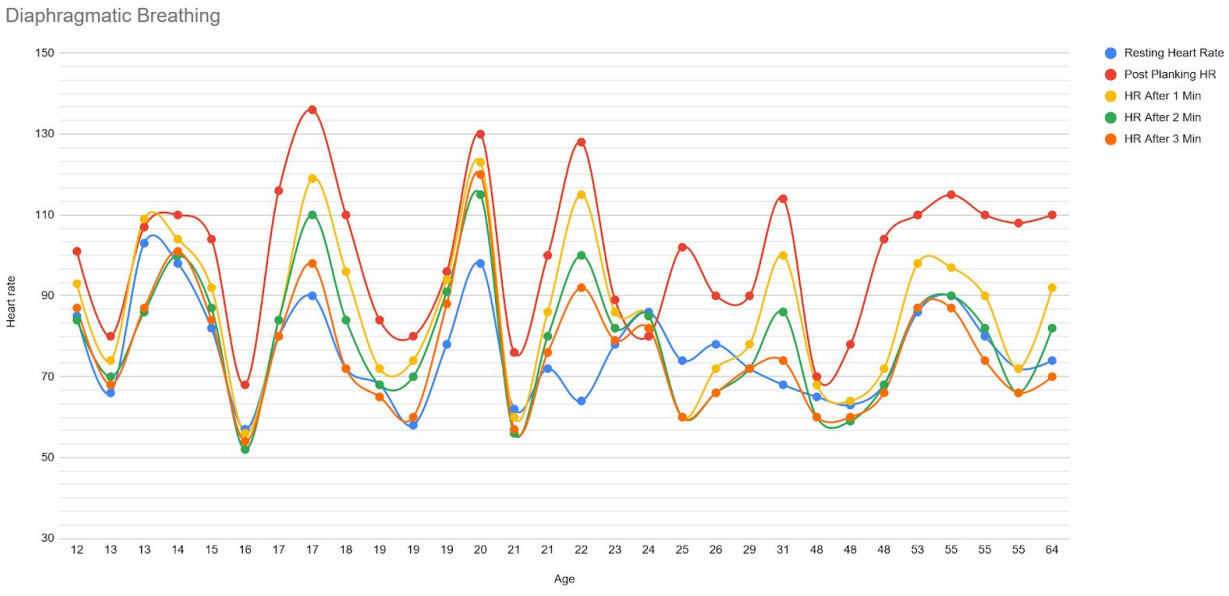

Diaphragmatic Breathing
Resting Heart Rate
Post Planking HR
HR After 1 Min
HR After 2 Min
HR After 3 Min
Heart rate
150
130
110
90
70
50
30
12 13 13 14 15 16 17 17 18 19 19 19 20 21 21 22 23 24 25 26 29 31 48 48 48 53 55 55 55 64
Age

Fig 1.3

Results

On average for diaphragmatic breathing, there was an overall 23% decrease in heart rate between when heart rate was taken immediately after planking and when it was taken after three minutes. Subjects who used normal chest breathing had a decrease of 19% between the time their heart rate was taken immediately after planking and at the end of three minutes.

For diaphragmatic breathing there was a 14% decrease in heart rate during the first minute after planking, an 8% decrease during the second minute after planking, and a 4% decrease during the third minute after planking. For chest breathing there was a 9% average decrease in heart rate during the first minute of recovery time, a 6% decrease during the second minute, and a 5% decrease during the third minute. very cool!

In figure 1.2, one can observe the decrease in heart rate as the minute intervals go by. In figure 1.3, the results show similarity to the chest breathing however, it is a higher decrease in beats per minute and a larger difference between the resting to 3 minutes after exercise is completed.

Discussion and Conclusion

This study was able to conclude that there is a significant decrease in heart during recovery time when using diaphragmatic breathing versus regular chest breathing. This conclusion supports our hypothesis that individuals who perform diaphragmatic breathing exercises after light exercise would see a greater percentage decrease in heart-rate per minute than when they use regular chest breathing exercises.

Subjects overall saw a 23% decrease in heart rate over the entire 3 minutes post exercise when using diaphragmatic breathing, which is 4% more than when subjects used regular chest breathing. This suggests that diaphragmatic breathing can help individuals reach their resting heart rate in less time than regular chest breathing. There was also a sharper decrease in heart rate during the first minute after subjects exercised than the additional two and three minutes. During the first minute, subjects who used diaphragmatic breathing had a decrease in heart rate of 14% while those who used chest breathing only saw a decrease of 9%. This supports our prediction that there would be a larger decrease in heart rate during the first minute post-exercise for those that practiced diaphragmatic breathing principles than those who just used regular chest breathing.

Errors that may have impacted this study are the range in ages among participants, the range of activity levels, and the way some of the data was collected (over the phone). The ages in this study ranged from 12-64. Children under the age of 18 have vastly different recovery times than adults over the age of 50, so the percentage decrease between chest and diaphragmatic breathing could be dramatically different because of age. While the experiment calculated the percent decrease for each individual, the sample size of individuals between those age ranges was not large enough to take statistically significant data from.

The activity levels of those tested were also dramatically different, which could have also had an affect on the recovery time. Those who regularly exercise would have a shorter recovery time which was not taken into consideration when completing the study. This study also presented some limitations, one including the fact that some of our participants were unable to be present and had to collect their own data results. This may cause some possible result errors,

however, they were given a thorough explanation of how to effectively take their own pulse, and the correct form for the exercises performed. We also had some of our subjects collect the data themselves over the phone, so we were not present for some of the data collected. There could be an error in how their pulse was taken or how well they performed the exercise. Some of these discrepancies could be corrected in the future through using a more randomized sampling method, a larger sample size, checking pulses manually, and collecting data in person.

Future studies could exclusively look at professional athletes or sedentary individuals exercise recovery times to see if athletes would benefit more from breathing with their diaphragm after exercise or if there is a type of breathing that is better for an individual based on their regular activity levels. Scientists could also look into whether there is a difference between switching between diaphragmatic breathing and chest breathing after exercising, or if the differences have a physiological or mental explanation.

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Group Credit:

All: Collected data and conducted the study. Edited final draft for midterm and final. Edited final PowerPoint.

Erin Robison: Formulated medical history questionnaire, researched past studies, wrote the introduction, wrote the discussion and conclusion, calculated percentage decrease data points and made associated bar graphs for the powerpoint, reviewed and edited final draft.

Kimberly Juarez: Formulated the works cited, made graphs for data, reviewed and edited for final draft.

Adrianna Haight: Wrote the abstract, created the outline for the paper.

Katie Keiser: Made graphs for data, wrote materials and methods,

Colee Kammerman: Made graphs for data, created the powerpoint, and created bar graph in powerpoint.