

The Physiological Effects of Recreational Kayaking

Heidi Pederson, Molly Samuelson

University of Wisconsin at Eau Claire, WI

ABSTRACT

Abstract. Pederson, H., Samuelson, M. The Physiological Effects of Recreational Kayaking. *J. Undergrad. Kin. Res.* 2005;1(1):30-38. The purpose of this study was to examine the physiological effects of recreational kayaking. Two female subjects, ages 21 and 22 participated in this study, along with one male, age 33. Their kayaking experience ranged from beginner to intermediate. All of the subjects were determined to be in good physical condition. Heart rate, blood pressure, and RPE were recorded during a 2 hour kayak trip. After analyzing the data, it was found that recreational kayaking does produce positive physiological benefits.

Key Words: Exercise, kayak, RPE, heart rate, blood pressure

Introduction

It is recommended that the average person should include at least thirty minutes of moderate intensity physical activity in their day to achieve positive health benefits.¹ In accordance with this, there has been a recent nationwide movement to get America into shape. This movement is backed by several nonprofit organizations; one of the larger groups, called Shape Up America, is dedicated to achieving healthy weight for a lifetime. These organizations educate individuals to the endless number of health gains that come with exercise. These include, but are not limited to: lower blood pressure, decreased body fat, lower resting heart rate, improved cardiovascular health, reduced risk of diabetes, reduced risk of colon cancer, reduces feelings of depression and anxiety, helps promote strong bones and healthy joints, and increased levels of “good” cholesterol (HDL). According to the Surgeon General, healthy lifestyles are more influential than genetic factors in avoiding deterioration traditionally associated with aging. Heart rate and blood pressure are often used as a convenient and accurate tool to measure a person’s exertion. In a study comparing open water kayaking to a kayak ergometry, both showed a rapid increase in heart rate that is followed by a steady increase. Additional studies have been done to show the positive health benefits that come from traditional forms of exercise (i.e. treadmill, bike, stair climber, etc.), however, nontraditional forms have been overlooked. Non-traditional exercises range from rock climbing to yoga and have gained popularity in recent years. Although many people have personally experienced the positive benefits of these activities, there is little scientific data to back their claims.

The purpose of this study is not to discredit the already proven benefits of traditional exercise, but rather to shed light on one of the many alternative forms of physical exertion. Views on exercise need to be shifted from an expensive chore to an energizing and fun activity to get more people on board. There are numerous studies that have focused on the physiological effects of *elite* kayakers.^{2,3,4,5,6} Elite kayakers are

characterized by exhibiting great strength, anaerobic capacity, and endurance.⁷ Therefore it is known that high intensity kayaking elicits many physiological responses that benefit overall health, however, not many studies have been done to link these health effects with recreational kayaking.

We would like to further examine this subject area and demonstrate, through a case study, that recreational kayaking elicits positive physiological effects that have been proven to be beneficial in a person's health. It was hypothesized that recreational kayaking mimics the healthy benefits that more traditional forms of recreational exercise produces.

Methods

Subjects

Two female and one male subject were selected from a convenience sample (Table 1). Before collecting data, the study was approved by the University's Human Subjects Institutional Review Board. They also read, understood, and signed an informed consent form. Because there is not any published research regarding the recreational kayaker, selection criteria was very broad. All three subjects were in good health and were categorized as having an active level of training. Their kayaking skills ranged from beginner to intermediate, but all of them were familiar with the biomechanics of kayaking.

Subject	Height (inches)	Weight (lbs)	BMI (kg/m²)
Female 1	68	150	22.8
Female 2	69	152	22.4
Male 1	75	188	23.5

Table 1. Mean Subject demographics.

Instruments

Kayaking session

Each of the subjects completed the kayaking data collection phase in an Acadia 12.5 Perception kayak. Other tools that were used included a Bending Branches- Whisper Dream paddles and Stearns Challenger lifejackets. To obtain an ongoing recording of the subjects heart rate, researchers provided each subject a Polar T31-coded heart monitor and the accompanying wrist watch. Blood pressure was measured and recorded using a Mabis cuff. RPE was determined by using the Likert type scale that ranged from 8-22.

Sub-maximal session

To obtain results, researchers relied on the Rockport test. This test has been proven in multiple studies to produce a reliable estimate of VO₂ max. Researchers had a working knowledge of all of the equipment used and selected the specific instruments based on this knowledge and availability of equipment. At several points one of the heart rate monitors stopped beeping, causing researchers to believe that it had shut off, however, the data offers no support for this concern. Environmental conditions (wind) made hearing the heart beat difficult during several of the scheduled

blood pressure stops. This might have reduced the reliability of the blood pressure readings by a small amount, but the data appears to be very reliable.

Procedures

Data was collected in two separate sessions. The first included a two-hour kayak trip on October 2nd, 2005, and the second was a sub-maximal test done on October 21st, 2005. The route chosen for kayaking is one that is very accessible to University of Wisconsin-Eau Claire (UWEC) students. UWEC's Recreational office rents kayaks and recommends this six-mile route along the Chippewa River to its clients.

Pre-kayaking

Subjects were instructed to refrain from physical activity for the twenty-four hours leading up to kayaking. They were also told to eat and drink normal amounts beforehand. After collecting the signed informed consent forms, subjects were given an introduction to the study. They were told that their heart rate and blood pressure would be monitored to evaluate how their body responded to kayaking. Subjects were told that if at any point they did not feel comfortable or wanted to stop the experiment, that they could. RPE's table was explained thoroughly to them. Subjects were told to keep up a moderate/recreational activity level and that they should be able to carry on a conversation at all times while kayaking.

Kayaking

Subjects were individually asked their estimated RPE every fifteen minutes. These were immediately recorded by the researchers. The subjects were asked to pull over to various sand bars every thirty minutes so researchers could perform a blood pressure reading.

Post-kayaking

Once arriving at the destination point, subjects exited the kayaks and remained still for five minutes to allow their heart rate to drop down to a resting level. The subjects were then instructed on the date of the sub-maximal data collection and allowed to go.

Rockport Walk Test

Subjects were instructed to refrain from physical activity for the twenty-four hours leading up to the testing and to eat/drink what they normally would. Once arriving to the indoor walking track they were given instructions on what would be expected of them. Each subject would be expected to complete a one mile walk at a moderate/recreational level. They would then have their heart rate recorded immediately upon completing the walk. Subjects were staggered to eliminate the possibility of influencing each others speed. Positive verbal encouragement was given to each subject throughout the process. Immediately upon crossing the finish line, subjects had their heart rate taken for fifteen seconds by the researchers. After this data was recorded, subjects were free to go.

Statistical Analysis:

There were no independent variables in this study. The Dependent variables were heart rate, blood pressure, RPE and VO₂ max.

RPE:	Female 1	Female 2	Male 1
Baseline	8	8	8
15 min	11	11	10
30 min	12	12	10
45 min	13	12	10
60 min	15	14	11
75 min	16	17	12
90 min	17	16	12
105 min	16	15	12
Mean	13.5	13.1	10.6

Measurement	Female 1	Female 2	Male 1
Baseline	106/68	112/78	118/76
30 min	114/72	130/84	122/82
60 min	116/68	120/72	124/82
90 min	112/76	130/74	122/76
120 min	112/72	124/78	120/68

Table 2 and 3. RPE and BP measurements for subjects during Kayaking.

Results

Table 2 shows the results from the RPE values given by each subject. These RPE values go up from the initial as the subjects began kayaking. Figure 1 shows the difference in Systolic and Diastolic blood pressure readings during rest and kayaking phases. Figures 2-4 illustrate the heart rate changes of the three subjects throughout the kayaking route.

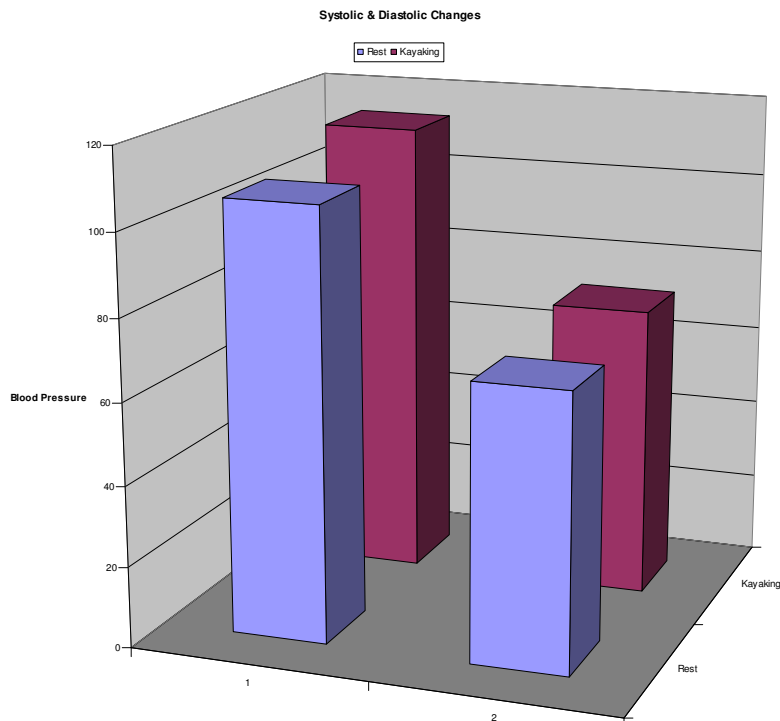


Figure 1

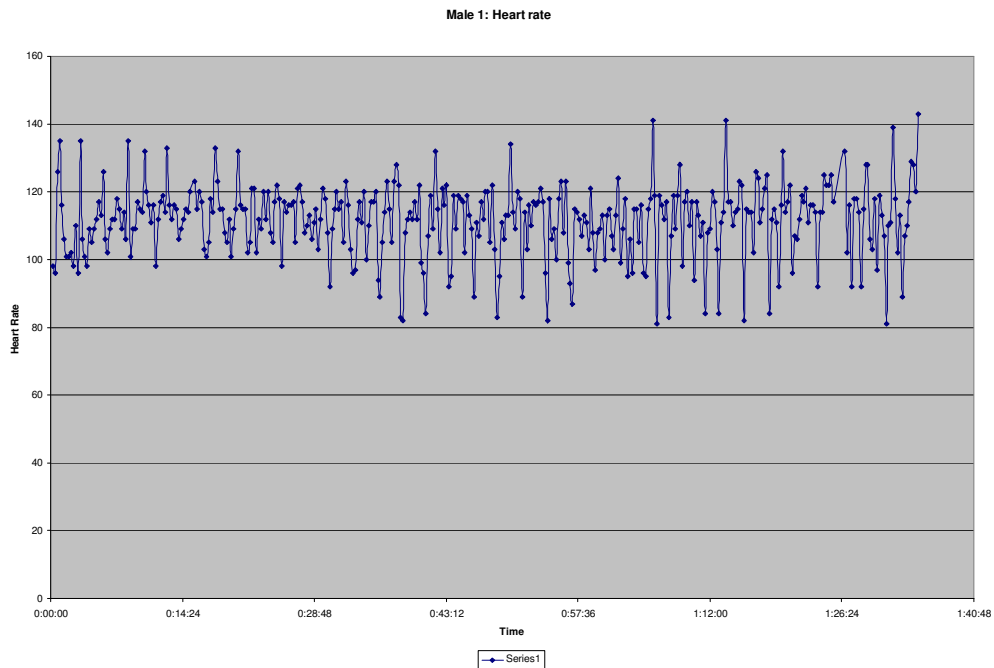


Figure 2

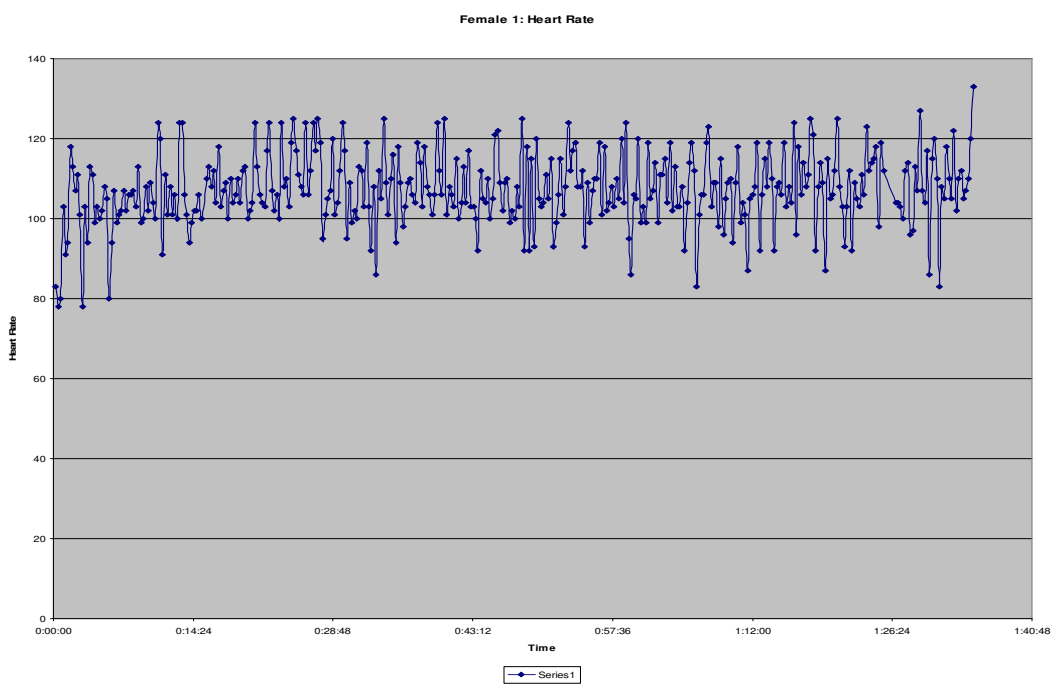


Figure 3

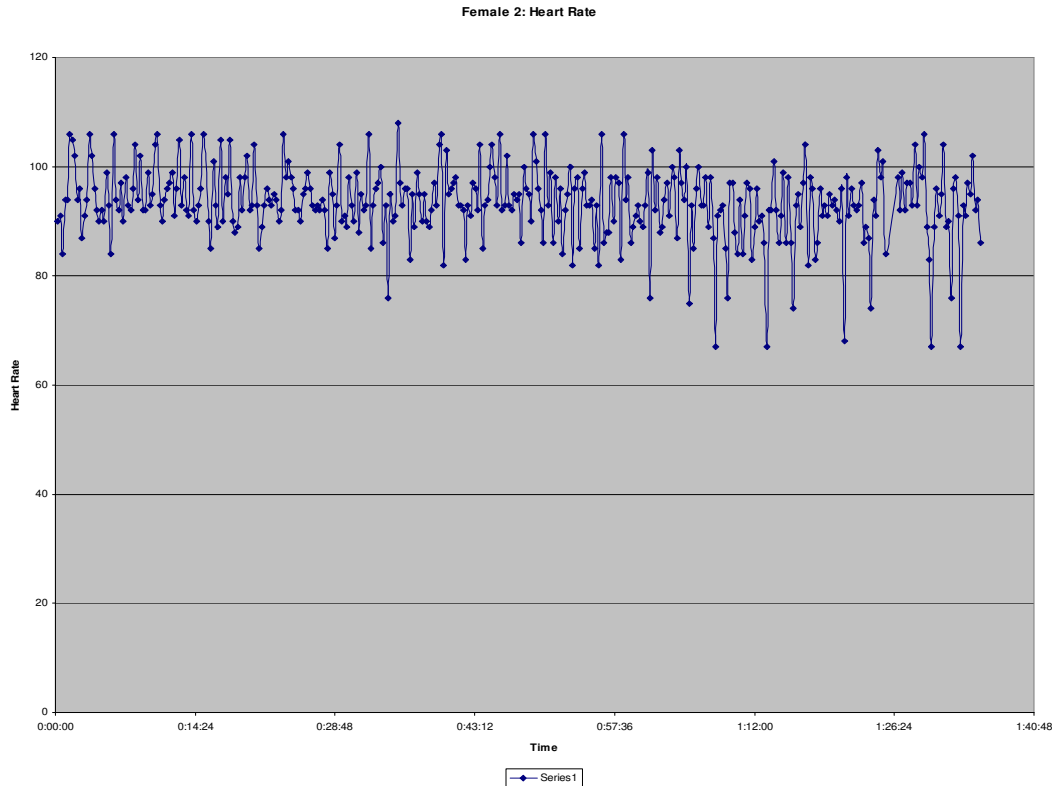


Figure 4

Table 5:

Subject	Max Heart Rate	Target Heart Rate (40-59%)
Female 1	199	120-145
Female 2	198	118-143
Male 1	187	114-137

Table 4:

Subject	Time	Heart Rate (bpm)	Estimated VO ₂ max (mL/kg/min)
Female 1	14:56	120	46.9
Female 2	15:31	100	47.0
Male 1	15:28	100	46.4

$$[132.853 - (0.0769 \times \text{weight}) - (0.3877 \times \text{age}) + (6.315 \times \text{gender}) - (3.2649 \times \text{time}) - (0.1565 \times \text{HR})]$$

Discussion

Research was needed for this topic because there is a lack of previous research showing the physiological effects of recreational kayaking. A similar experiment done on the physiological effects of indoor rock climbing showed some similar results to our study. In this experiment, they tested both beginner and intermediate climbers. Both groups showed an increase in heart rate and RPE during their climb. The data that we collected is supported by past research. Although previous experiments have not

examined the physiological effects of kayaking, they have studied other recreational activities, causing us to question if kayaking produces the same results.

As figures 2-4 illustrate, the subject's heart rate increased with the onset of exercise. The mean of their heart rate was also significantly higher than their resting heart rate. Table 4 shows the subjects target heart rate. In our directions to them we wanted them to keep an intensity of moderate/recreational level. ACSM suggests a heart rate percentage between 40-59% is moderate.¹ Our subject's heart rates remained within their ranges for the greater portion of the kayaking excursion, however, there were many points when they dropped below the recommended levels.

According to ACSM guidelines, systolic blood pressure readings should increase with exercise.¹ Both systolic and diastolic showed a visible increase during the kayak exercise, compared to resting blood pressure levels. Because the most common forms of measuring physical exertion are through the analysis of heart rate and blood pressure, our results support our hypothesis. Both increased and therefore produced a positive physiological response from kayaking.

The ACSM recommends that the average individual expend 150-400 kcals per day.¹ By putting our subjects weight (in kg) into an equation, we determined that our subjects burned between 714-895 kcals during our 120 minute workout. This exceeds the recommended values.

VO₂ max is considered the best cardio-respiratory, endurance, and fitness measurement.⁸ The greatest improvement in VO₂ max occurs when exercise involves the use of large muscle groups over prolonged periods in activities that are rhythmic and aerobic in nature (walking, hiking, running, stair climbing, swimming, cycling, rowing, and others).¹ In our study, we did not have a baseline VO₂ max measurement to compare our findings to. Therefore, the Rockport Walking Test confirmed the fact that our subjects were in good health and physical conditions. They were able to successfully meet our requirements of recreational kayaking.

We also used Likert-type Ratings of Perceived Exertion scale to monitor the subject's intensities levels. We chose the scale that goes from 8 to 22; with 8 being very, very light and 22 being very hard/fatigued. RPE is an accepted method by the ACSM to monitor progress toward maximal exertion during exercise testing. However, during clinical and practical trials, subjects underestimated their RPE by 5-10 % during the early and middle stages of exercise.¹ Our results show that the more experienced kayaker (male1), had significantly lower RPE ratings. This could be because of previous kayaking experience, familiarity, and reduced levels of anxiety.⁸

Assumptions and Limitations:

There were a few assumptions associated with our experiment. It was assumed that participants would not participate in physical activity 24 hours before either experiment. It was also assumed that the participants would consume normal food and drink intake prior to the experiment. During the testing, it was assumed that the kayakers would maintain an RPE between 10-16, or what we considered a recreational intensity. Subjects did not have a RPE scale in front of them to help them correctly assess their level. Subjects were also required to express their RPE level out loud, and could possibly have been influenced by what the other subjects were reporting.

One of the limitations of our study is that the results are kayak specific. It can not be presumed that similar results would occur with the use of a different brand of kayak. Another limitation of our study was that we tested for estimated VO_2 max, instead of measuring VO_2 max. One thing limiting our study was the conditions of the Chippewa River. Since this river is not a whitewater river, we were testing on calmer water, which had a large impact on our study.

In our study it was found that as RPE's increased, heart rate also increased. Although heart rate had a tendency to fluctuate, overall, higher numbers were recorded when the RPE numbers were larger. Another physiological effect of kayaking is increased blood pressure. With prolonged moderately intense kayaking, there is a significant rise in blood pressure readings. This increase is also directly related to an increase in RPE's and heart rate.

More research on recreational kayaking is needed. In future studies, a larger population should be studied. It would also be very beneficial to study the benefits of recreational kayaking over a period of time. It would then be possible to see if kayaking caused permanent physiological changes to occur in the body. Measuring VO_2 using a portable device would allow researchers to more closely monitor the changes in oxygen uptake. Future research should explore recreational kayaking, while also looking into other alternative forms of exercise. By doing this, researchers will be giving people more options to meet the recommended guidelines of a healthy lifestyle.

CONCLUSION:

Our study found that recreational kayaking produces positive physiological benefits. Our subjects' heart rates remained in the ACSM recommended range for moderate intensity (40-59 %).¹ By increasing their heart rate and sustaining it for a duration of time (120 minutes), they are meeting recommended requirements of an exercise prescription. This proves that recreational kayaking is an acceptable form of physical activity to replace more traditional forms of exercise. Anyone who is interested in adding variety and fun to their exercise regime should consider trying kayaking. This specifically applies to groups similar to those in our study; young, healthy and active individuals.

ACKNOWLEDGEMENTS

We would like to thank the University of Wisconsin-Eau Claire's Outdoor Recreation Department for providing us with kayaks, paddles, and lifejackets.

Address for correspondence:

Pederson, HP, 217 ½ Gilbert Street, University of Wisconsin-Eau Claire, Eau Claire, WI 54701. (608) 772-1962, pedershm@uwec.edu

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