A Comparison of Collegiate Freshman and Seniors and the Physiological Effects from Daily Stair Climbing.

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ABSTRACT

Abstract. Ries, J.R., Baustert, J., VonFeldt, A. A Comparison of Collegiate Freshman and Seniors and the Physiological Effects from Daily Stair Climbing. *J. Undergrad. Kin. Res.* 2005;1(1):39-47.This study was conducted to compare the physiological response of freshman and senior collegiate students when climbing stairs. 20 subjects were selected to complete this study: 10 freshman males and 10 senior males. Heart rate monitors were worn by the subjects while they ascended and descended the stairs behind the McPhee building at the University of Wisconsin - Eau Claire. Variables measured for this study include resting heart rate, target heart rate, percent of target heart rate met, and the time it took to climb stairs, The study found that the physiological response of collegiate freshman and seniors showed no significant difference, however, there is a physiological benefit to stair climbing in general

Key Words: Heart Rate, Exercise, Aerobic exercise, Cardiovascular, Physiology.

Introduction

Most College campuses across the United States have some type of stairs that students regularly go up and down, whether it be climbing stairs to get to a 5th floor class room or walking from lower to upper campus to reach the residence halls. It is possible for the students get tired and winded from climbing the stairs, but most of the students never think twice about the exercise they get and the benefits of that exercise.

A persons resting heart rate, blood pressure, and BMI in correlation with overall general statistics can place that individual into many different health categories. However, one characteristic alone is not enough to place someone in a healthy or not healthy category. For example, the body mass index table is a guideline, but is not perfect. It does not take into account a person's muscle mass, frame size, or bone mass. Again, however, it will at least give some sort of indication as to whether an individual is around a healthy weight. To get a better idea of how healthy someone is cardiovascular, more items such as heart rate and skin folds must be added to the equation.

There are numerous reports showing that indeed cardiovascular fitness is significantly affected by daily aerobic exercise. According to Lorraine Wallace and Janet Buckworth "Physical activity is recognized as an essential component

of a healthy lifestyle. The publication of the Surgeon General's Report on physical activity and health has brought heightened awareness regarding the importance of a physically active lifestyle in the prevention of numerous chronic health problems, such as type II diabetes mellitus, osteoporosis, coronary heart disease, hypertension and depression" (1). Another such report, according to Shelley Drozd, is that "Five 2-minute bouts of stair-climbing can give you a heart-pumping workout equivalent to 36 minutes of walking" (2). However, the reports give only brief data on their subjects and their findings as to how specific areas of cardiovascular fitness are benefited by daily stair climbing. The purpose of this study is to explore whether or not daily stair climbing would benefit an individual's cardiovascular system in relation to their resting heart rate and percent of target heart rate into a heart rate zone that meets the ACSM guidelines (3-5 days/week, accumulations of 20-60 minutes/session at an intensity of 55-90% of heart rate max), and which collegiate class is termed healthier. Also according to ACSM, to maintain cardiorespiratory fitness and weight control, the individual may follow the above recommendations or in place of one 20- to 60-minute session on a given day, the recommendations state that two to six 10-minute periods of aerobic activity throughout the day can be used to fulfill the requirements for the amount of exercise. In addition to ACSM recommendations, according to Pate RR, et al, "Every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week" (3). By getting the readings from each group we will be able to estimate whether an accumulation (multiple stair climbs) would be sufficient for a cardiovascular exercise based on heart rate, time, and target heart rate.

On average, the typical UWEC student ascends and descends the stairs behind McPhee anywhere between one and three times per day. We are merely going to describe the physiological changes that occur when you climb a set of stairs. According to an article posted in Current Health 2, you can climb stairs for 15 minutes and burn 150 calories (4). Moreover, climbing only three to four flights of stairs at a moderate pace (approximately 50-70 s) elicits peak circulatory demands similar to, but at a much more rapid rate of adjustment than, 10 minutes of horizontal walking at 2.5 mph intermittently carrying a 30-pound weight or 4 minutes of walking up a moderately steep slope (5). We are then going to compare the results of incoming freshman at the University of Wisconsin - Eau Claire (UWEC) to the seniors at the University of Wisconsin – Eau Claire that attend the university. We hypothesize that both groups will achieve a heart rate percentage that is high enough for exercise. We also hypothesize that the seniors resting HR at UWEC will be higher than the freshman and the seniors will reach a higher heart rate more quickly than the freshman due to typical greater inactivity in seniors compared to freshman.

Methods

Subjects:

For the test the investigators used a total of 20 male subjects. It was important that 10 freshman and 10 senior males selected for the test all had similar lifestyles. To determine similarities and differences between subjects, a

brief questionnaire was used that included the following: name, age, class level, resting HR, height, weight, BMI, number of days worked out per week, and total amount of time worked out per session. For the best results it was important to get individuals that worked out at least 3 to 5 days a week to make sure that they stayed healthy throughout a given week. Originally, it was discussed to use more subjects, but to actually obtain over 20 subjects of similar lifestyles would not be an easy task. Also it might be too much information to actually compare to find out the answer to what needed to be found. Before the test even begins it is important for the investigators to receive the permission of all the subjects that were going to be tested. The best way to get the subjects permission is have them fill out a questionnaire and consent form that is approved by the University IRB. The questionnaire helps gather the proper subjects to do the test for the best possible results. Once the questionnaire is completed and the subject is a good candidate for the experiment it is important for them to complete the next task which is the informed consent. The informed consent not only gives the investigator permission to do the tests on the subjects but it tells them what is actually going to be done to them throughout the test. Once both of these important documents are completed the tests may begin.

Instruments:

For the research project the investigators used a Polar T31-coded heart rate monitor and watch for gathering the heart rate information of the subjects. This type of heart rate monitor is one of the newest models that POLAR TECH has come out with. The features are the most advanced and gives very accurate information. For the experiment it was easy to access multiple heart rate monitors because the investigators were able to check them out with the professor's permission.

When obtaining the measurements to the tests it wasn't difficult because once each subject went up and down the hill once there heart rate was being monitored by a polar watch which recorded all the heart rate data. The watch was then connected to a computer program which converted the data into an excel spread sheet. This made the results more accurate because it showed what happened during the entire test for each subject. Having the monitor take down the information the entire time gave the investigators more accurate results to work with for the experiment. The investigators used SPSS data editor and Excel Spread sheets to evaluate the data. One of the positive aspects of doing this type of test was that it took little if no effort on the subject's behalf. The subjects results were downloaded instantly once there test was done which made the situation less of a hassle. We also used a BMI calculator found at www.cdc.gov/nccdphp/dnpa/bmi/calc-bmi.htm to calculate the subjects BMI.

Validity and Reliability:

Validity is the degree of accuracy to what you are trying to find. It is important to have a high level of validity to make your experiment more defined. The main goal of this experiment was to find out if freshman or seniors had a better average heart rate when climbing up and down the stairs. Whoever had

the better average heart rate would show that this group would have one of many aspects of being healthier then the other group. By knowing this information it could influence the students, teachers, and the University to evaluate current standards on the importance of being a healthy individual.

Even though this is only one test of many that could be done it still shows an average idea of what needs to be done when it comes to either older or younger students with there lifestyles. This test was accurate when measuring the heart rate of the subjects because the only aspect that was tested was the heart rate. The equipment that was used was very accurate because the heart rate monitors and watches were sent to the company that made them to get them fixed to be more accurate for testing. When using the equipment we did many test runs before any actual tests were done to make sure that the information was accurate. The monitors that were used were specifically designed to take a person's heart rate which makes our results very accurate.

Procedures:

For the study the investigators had each subject fill out a questionnaire. Then, explained and show how to, each subject found their pulse and recorded their own resting heart rate. Resting heart rates (RHR) were recorded while the subjects were at rest. After RHR, the testers explained to the subjects how the testing would occur. Each subject was instructed to walk up the stairs behind the McPhee building on the University of Wisconsin - Eau Claire campus at a normal moderate pace, making sure to walk on each step (no skipping steps) and to turn around once they reached the top of the stairs, turn around, and walk down the stairs at about the same pace. It was important for the subjects to know that they were not allowed to stop or use the side-railings for support throughout the climb (6). If any of the subjects did this it would alter the information and give false results. Each subject then put on a Polar T31-coded heart rate monitor. The testers helped with this procedure, while the subject also put on the Polar Watch. Once the watch was started and a heart rate was seen on the watch, the subject started up the stairs. Once the subject returned at the bottom of the steps, the testers stopped the watch. Each subject only had to go up and down the stairs one time to get the results that were needed to conduct the study. Each test conducted; on average, lasted anywhere from 3 to 5 minutes, which made testing quick and easy. During the test one of the investigators stayed at the bottom of the hill and the other was at the top. We had someone at both ends of the test to make sure that there were no problems with the subject or the equipment that they were using for the test. It is important to have each subject ascend and descend properly to get the most accurate results for the test.

To make sure that the procedures discussed above worked properly the investigators had to conduct some pilot tests prior to the initial study. The investigators of the test and the professor of the course met to see what it was like to test a person with a heart rate monitor on. Prior to the test it was important to let the subjects rest at the bottom of the hill for a couple of minutes to make sure that they were giving off an accurate average heart rate. Doing these experiments prior to testing gave an average of how long each subject

would take to go ascend and descend the stair case during their test. During the pilot testing it is very important to get familiar with the equipment that was going to be used, as to prevent any unnecessary time or confusion with the subjects. Each investigator wanted to make sure that they know how to properly use the equipment and read the results to conduct a good experiment. For the experiment the main instrument used was the heart rate monitors which had to be checked out by the professor and given to the investigators. The investigators were responsible for these instruments and used them when needed for testing. On the preceding page is a visual example of the experiment and the grounds the experiment took place at:

Figure 1: Demonstration of subject climbing stairs

Statistical Analyses:

For this study the independent variable was the comparison between freshman and upper class man and the dependant variable is the physiological response of the individual's heart rate, and percent of maximal heart rate when climbing the back stairs at the University of Wisconsin Eau Claire. The tests used for statistical analyses were group and independent *t*-Tests, which were done using a program called SPSS (12.0).

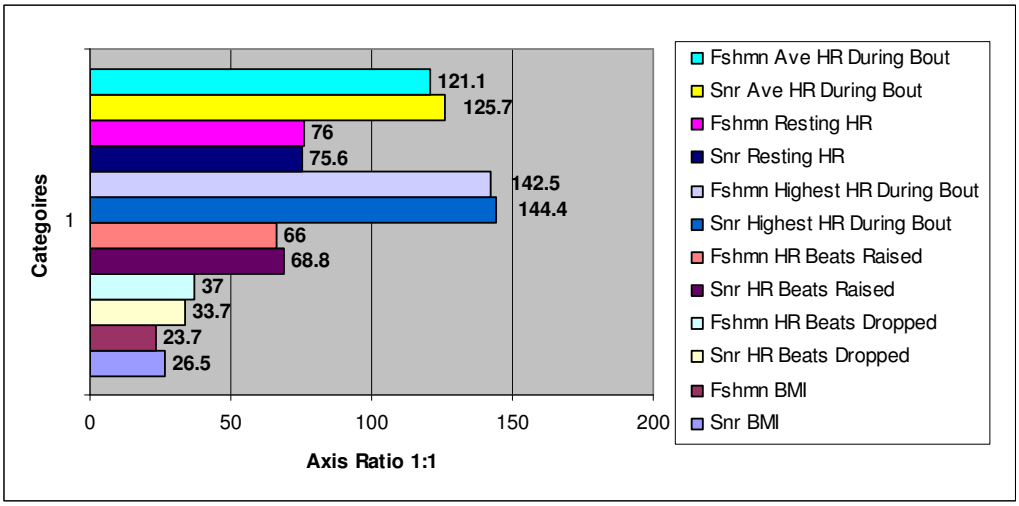
Results

Significance for each category was set at $p < .05$. The following are the results from some specific categories: highest heart rate $t\,(18) = -.251$, $p = .804$; resting heart rate $t\,(18) = .125$, $p = .902$; average heart rate during bout $t\,(18) = -.672$, $p = .510$; percent heart rate max $t\,(18) = -1.054$, $p = .306$

The investigators accepted the null hypothesis, which found that there was no significant difference between freshman and senior collegiate students in the case of average heart rate for both groups during the test, percent of the maximum heart rate achieved, and resting heart rate. As shown by figure 2, freshman average heart rates during the bout are very similar to those average

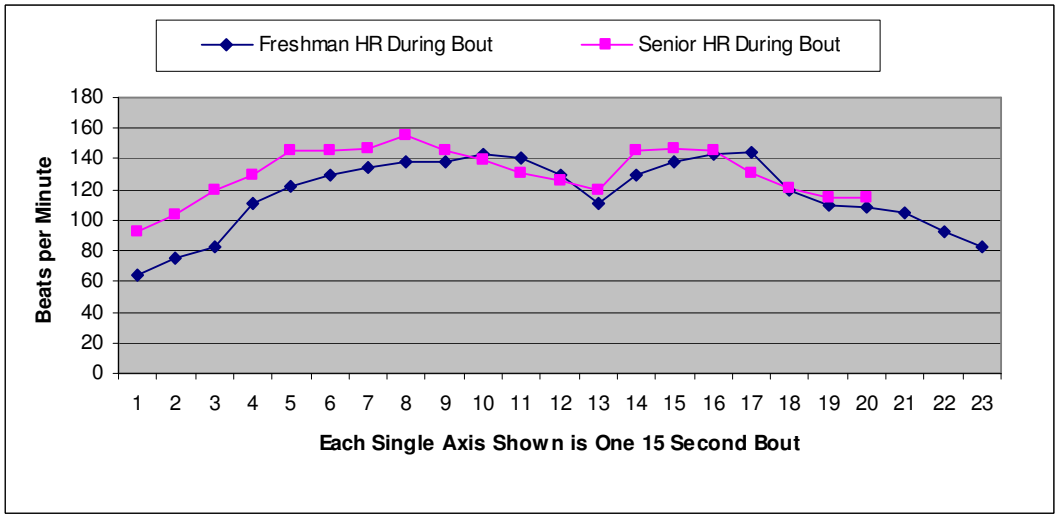
heart rates of the seniors during the bout. There is only a minimal difference between the two groups in every other category as well. The freshman's average maximum heart rate achieved while climbing the stairs was 142 beats per minute. This is 70.5 percent of the average maximum heart rate for the group. The average maximum heart rate achieved while climbing the stairs for the seniors was 144.4 beats per minute. This is 73.0 percent of the maximum heart rate for their age group.

Figure 2: Avg HR for freshman and seniors



In figure 2, it illustrates the similarities of the freshman and senior's heart rate levels during the bouts. Each bullet represents the average for the ten males in each grouping. Even though some subjects took longer or shorter, and had higher or lower resting heart rate, the levels for each class level are very similar. This suggests that both collegiate levels are closely related physiologically and health wise.

Figure 3: Average Heart Rate during Bout of All Freshman vs. All Seniors



Discussion

In the study the investigators found that climbing stairs has a great enough increase in physiological responses related to heart rate max to provide adequate exercise. The average maximum heart rate achieved by the subjects was about 72 percent of their estimated maximum heart rate. This fits with in the American College of Sports Medicine (ACSM) guidelines for healthy aerobic activity. The guidelines set up by the ACSM are an individual should exercise cardiovascularly 3-5 times per week at an intensity that is 55-90 percent of their estimated maximum heart rate for an accumulation of 30 to 45 min. If an individual can meet and maintain these guidelines set by the ACSM, their aerobic endurance and health levels will increase. The publication of the Surgeon General's Report on physical activity and health has brought heightened awareness regarding the importance of a physically active lifestyle in the prevention of numerous chronic health problems, such as type II diabetes mellitus, osteoporosis, coronary heart disease, hypertension and depression. The findings in this study can be related to previous studies conducted on stair climbing activities. Even thought the findings in this study did not yield a difference between freshmen and seniors, the study still shows that daily bouts of stair climbing can be physically healthy. According to CA Boreham, et al, “The study confirms that accumulating short bouts of stair climbing activity throughout the day can favorably alter important cardiovascular risk factors in previously sedentary young women. Such exercise may be easily incorporated into the working day and therefore should be promoted by public health guidelines” (7). Another study supporting the physiological gains comes from Shelley Drozd where she states in her research article that “Five 2-minute bouts of stair-climbing can give you a heart-pumping workout equivalent to 36 minutes of walking” along with that indeed cardiovascular fitness is significantly affected by daily aerobic exercise” (2).

Due to the lack of studies related to this stair climbing and the physiological effects, comparison between studies made it difficult. This study found that when comparing the physiological responses of the freshman versus the seniors that there was not a significant difference between freshman (m=142.5) and senior (m=144.4) collegiate students and the percent of maximum heart rate reached (55-90). This is important to know because both groups of subjects were required to accomplish the same task of climbing the stairs with the same set of limitations. The limitations were that each subject was to take each step at a rhythmic pace going all the way up the stairs and all the way back down the stairs. This tells us that the freshman’s cardiovascular system has to work just as hard as the senior’s to accomplish the same task. This rejects our hypothesis that the freshman’s physiological response would be less than the upperclassman’s. The original assumption made was that upperclassman would have lost or decreased regular workout habits through out college; where as incoming freshman would maintain their daily physical activity levels from high school. This could still be the case, however the study shows that there was no significant difference between the two groups. Since both of the groups had similar increases in heart rate it can be assumed that both groups are in similar

shape and have similar cardiovascular endurance. A further study or an extension to this study that could be conducted could be comparing a subject's BMI to the physiological response of climbing the stairs. Or to compare climbing a flight of stairs versus walking up a hill, which one has a greater physiological response.

CONCLUSIONS

The main objective of this study was to conduct testing that would show the comparison of physiological responses of freshman students versus upperclassman. The study showed that there was no significant difference in the physiological responses between the freshman and upperclassman. The study showed that stair climbing increases heart rate enough to meet the ACSM guidelines for healthy aerobic activity. This study is applicable to males between the ages of 18 and 25. Future research dealing with this project could entitle a comparison of taking stairs versus walking up a hill.

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