EXCESSIVE POST- EXERCISE OXYGEN CONSUMPTION (EPOC) FOLLOWING A TWENTY-MINUTE SUBMAXIMAL CYCLE TEST

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This project does not attempt to produce generalizable knowledge. It is dedicated to the practice of developing skills and demonstrating understanding of the research process.

INTRODUCTION

According to McArdle et al. (2015), Excessive Post-Exercise Oxygen Consumption (EPOC) computes the total oxygen consumed in recovery minus the total oxygen consumed at rest during the recovery period. According to McArdle et al. (2015), VO2 mL/kg/min is defined as maximal oxygen consumption. According to McArdle et al. (2015), respiratory exchange ratio (RER) is the ratio of carbon dioxide produced to oxygen consumed under rest and steady-state conditions with little reliance on anaerobic metabolism. According to Dr. et al. (2004), EPOC is also known as O2 deficit and was used as a measure of anaerobic metabolism during exercise. According to McArdle et al. (2015), there are two forms that are used to help determine EPOC for exercise and recovery: active recovery and passive recovery. Active recovery is defined as 'cooling down' or 'tapering off' and passive recovery is where an individual usually lies down presuming that total inactivity reduces the resting energy requirements and thus 'frees' oxygen to fuel the recovery process (McArdle et al., 2015). During this study, the individual performed a passive recovery. $V'O_2$ is the maximal oxygen consumption that an individual utilizes during an intense exercise (McArdle et al., 2015). Heart rate is the number of times the heart beats per minute which is based on the number of contractions of the ventricles. Pulmonary Ventilation (VE) describes the process of moving and exchanging ambient air with air in the lungs (McArdle et al., 2015).

The purpose of this study was to determine if EPOC could be assessed in a 20–32-year-old college student 10 minutes after a sub max cycling test is performed. It was hypothesized that EPOC can be assessed 10 minutes after a submaximal cycle test is performed.

METHODS

Thirty minutes before the subject arrives, the ParvoMedics metabolic cart is going to be calibrated. Breathing apparatus will be assembled and a breathing tube will be attached to the cart. The roles will be assigned to the individuals conducting the test. After the ParvoMedics metabolic cart is calibrated, the mouthpiece the subject must wear has to be assembled correctly and brought to the subject. Before having the subject sit on the bike, their height, weight, and resting heart rate must be determined. The client's age predicted-heart rate max must be determined by subtracting their age from 220 beats per minute. In order for this to remain a submaximal test the client cannot surpass 80% of their age predicted-heart rate max. Once the subject's height, weight, and resting heart rate are measured, the instructors must explain to the subject in detail what's going to happen before, during, and after the test. Allow the subject to sit on the bike to record a resting heart rate that should ideally be between sixty and one-hundred beats per minute for about three to five minutes. After the resting heart rate is recorded, the subject will insert the breathing tube into their mouth along with a nose clamp to determine their resting respiratory values (i.e. VO_2, VCO_2, VE, RR, and kcals). Once the client's resting respiratory values are evaluated by using the breathing tube and Parvomedics equipment, the subject is able to begin the test. Throughout the course of the test, heart rate must be measured every thirty seconds. Post-test length in theory, should be the same length as pre-test length in order for the client to reach a VO_2 of 3.5 mL/kg/min. In addition, watts must be changed after the first three to five minutes of the next and the next three to five minutes of the test. Watts must be increased in increments of 25 in order to gradually raise the client's heart rate starting at 25 watts and ending at 75 watts. Once the subject's HR reaches 80% then they will be connected to the metabolic cart to start collecting data. During this time, the subject's heart rate must still be recorded every thirty seconds. The client will be seated, and their post exercise resting metabolic/respiratory values will be recorded along with HR. After the subject begins their cool down, EPOC will be assessed. This process must be completed for each subject that is tested.

RESULTS

Table 1.

	VO_2 (mL/kg/min)	VE (L/min)	RER (VCO_2/O_2)	METS
Subject 1	3.5	7.37	0.85	1
Subject 2	4.9	8.25	0.84	1.4
Subject 3	3.4	9.89	1.01	0.96

Table 2.

	VO_2 (mL/kg/min)	VE (L/min)	RER (VCO_2/O_2)	METS
Subject 4	2.38	11.64	0.92	1.12
Subject 5	5.62	12.76	1.03	1.5
Subject 6	2.16	6.97	0.89	0.64

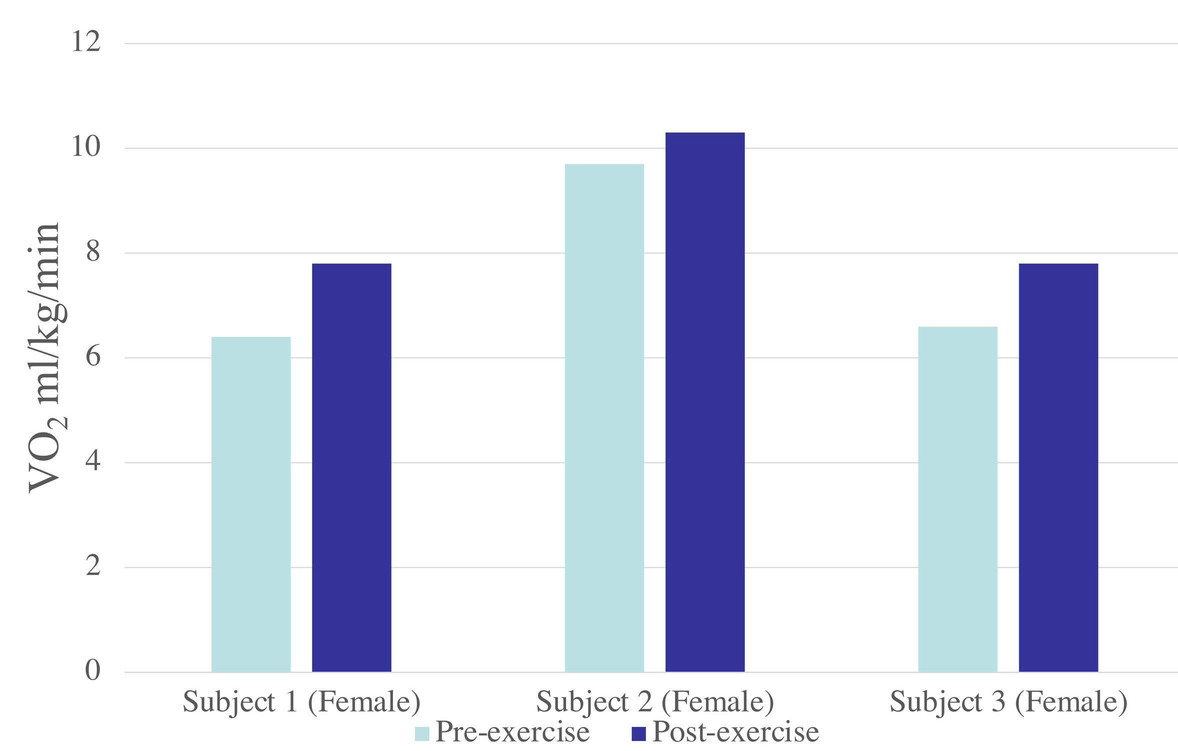

Figure 1. VO_2 (ml/kg/min) averages from three female subjects during pre and post exercise. This figure displays the differences between the VO_2 (ml/kg/min) in thee female 20–32-year-old college students before and after a thirty-minute submaximal cycle test. Subject 2 exercised before performing the test, which resulted in her VO_2 being higher.

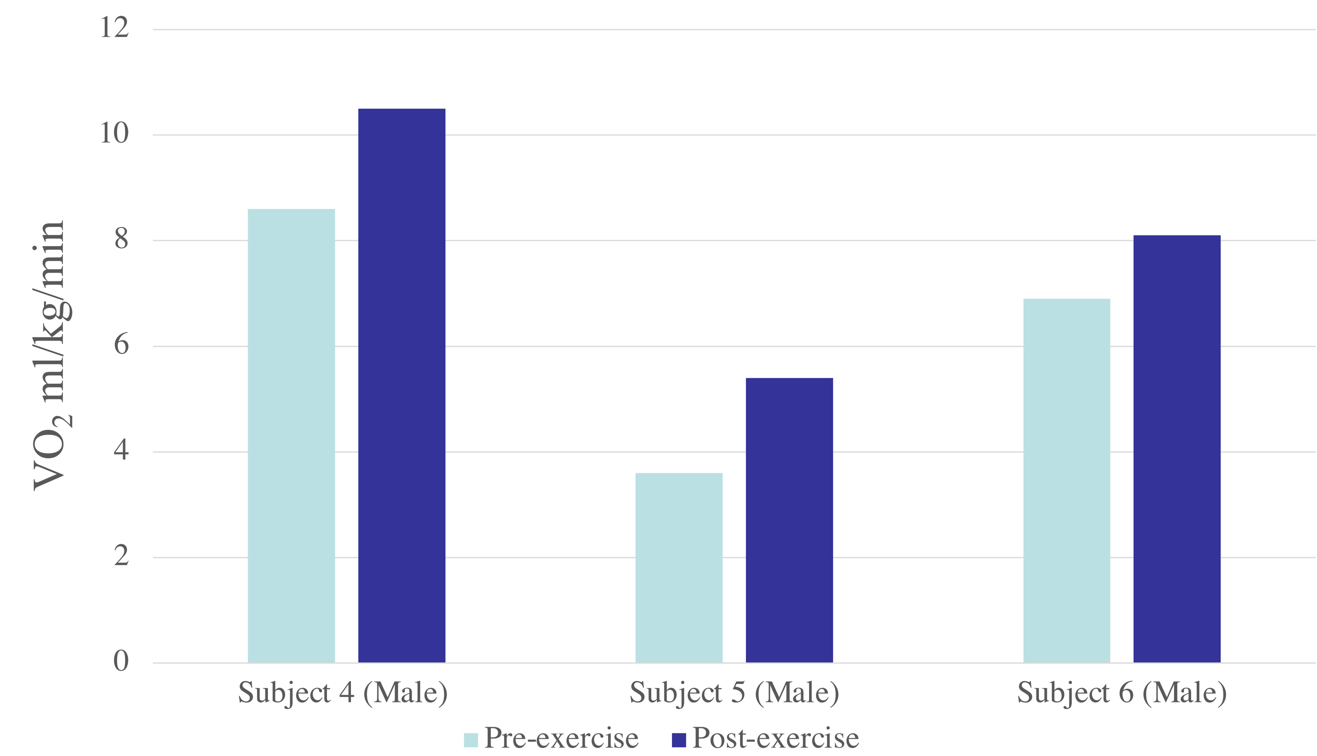

Figure 2. VO_2 (ml/kg/min) averages from three male subjects during pre and post exercise. This figure displays the differences between the VO_2 (ml/kg/min) in three male 20–32-year-old college students before and after a thirty-minute submaximal cycle test.

In Table 1 and 2, all of the variables that are presented are averages of the subjects. In addition, Table 1 represents the data of the three female subjects and Table 2 represents the data from the three male subjects. According to both figures, post- exercise VO_2 is higher in all six subjects. This indicates that subjects were in a state of oxygen deficit following the submaximal test. Tables 1 and 2 are the averages of both pre and post exercise of the subjects. Figures 1 and 2 are the VO_2 averages of only post-exercise from the subjects.

DISCUSSION

According to Sedlock (1992) , the average EPOC for a normal individual who is performing a thirty-minute exercise is 3.1 ml/kg. The subjects in the study achieved this and more following twenty minutes on a submaximal cycle test. When comparing our male subjects to the averages, the three male subjects averaged an EPOC of 3.4 ml/kg. When comparing our female subjects to the averages, the three female subjects averaged an EPOC of 3.9ml/kg. A submaximal test, unlike that of a maximal test, will not display EPOC the same way due to the fact that the individuals are not fully exerting maximally during exercise. In addition, the submaximal test only achieved 80% of the subject's age-predicted max heart rate. A twenty-minute submaximal cycle test was chosen because it is one of the best predictors of EPOC along with maximal exercise testing, high intensity interval training (HIIT), sprint interval training (SIT), and resistance training (Blaine et al., 2019).

According to McArdle et al., (2015), there are two forms that are used to help determine EPOC for exercise and recovery. These two forms are active and passive recovery. In this study, subjects used passive recovery. Following the twenty minutes on the cycle ergometer, subjects sat down in a chair where their heart rate (HR), volume of oxygen consumption (VO2), minute ventilation (VE), and fractional concentration of oxygen in expired air (FEO2) were evaluated. This allowed the subjects time to not only get back down to a resting HR, but also their oxygen following exercise. In addition to EPOC, HR was a main variable that was evaluated and assessed during the study. A good and average resting HR is between 60 and 100 beats per minute (bpm) (Harvard Health). Additionally, when an individual exercises, their HR is going to be higher than 100 bpm. For the male subjects, resting HR average before exercise was 74 bpm and post exercise average was 106bpm. For the female subjects, the resting HR average was 71 bpm and post exercise HR average was 101 bpm.

According to Nummela & Rusko (1995), EPOC can be used in different sports such as basketball, track & field, and cycling. The second half of the game or race is when an athlete will exert most of their energy and oxygen. Therefore, EPOC will be seen more from the second or latter half versus that of the beginning.

CONCULSION

In conclusion, EPOC could successfully be measured in 20–32-year-old college students ten minutes after a submaximal cycle test was performed. This test consisted of a ten-minute pre-exercise resting phase, a twenty-minute submaximal exercise phase, and a ten-minute post-exercise resting phase. The pre and pos-exercise resting phases measured metabolic variables such as VO2, VE, RER, METs, and heart rate. After the pre-exercise resting phase was completed, a client performed a twenty-minute submaximal test in which 80% of their age-predicted heart rate max had to be reached, and the experiment was concluded with the post-exercise resting phase.

EPOC has real world applications that can be utilized in many areas. EPOC application can be used in clinical environments such as measuring how long it takes a person to recover from exercise, or how long a person's energy expenditure values are increased after an exercise is completed in terms of athletics/training. Possible improvements could be made to this experiment including having clients participate in various modes of submaximal exercise testing, testing more individuals both male and female, and not limiting the exercise to strict time parameters. This experiment proved that exercise post-exercise oxygen consumption can successfully be assessed in 20–32-year-old college students, ten minutes after completing a submaximal cycle test.

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