

Aerobic Energy Expenditure on a 60-Minute Exercise Video With Mini Medicine Balls

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KEY WORDS: exercise, exertion, metabolism, energy use

ABSTRACT

Seven male and 6 female subjects participated in a series of experiments to determine the aerobic cost of cardio exercise following a 1-hour exercise video. The Mitch Gaylord “Cardio Workout” involved using a 2-lb mini medicine ball. Before, during, and for 4 hours after exercise, oxygen consumption was measured. The study was conducted on both men and women with a variety of body types. Subjects were in the age range of 20-40 years, healthy and free of cardiovascular disease or orthopedic injuries. The oxygen consumption was measured by a VO-2000 metabolic cart. The results of the experiments showed that the average energy use of the group was 517.4 ± 231.7 calories while the average for the men was 654.1 calories and for the women was 358 calories. The greatest expenditure for the men was over 1,000 calories burned during the workout. The lowest for the men was 389.3 calories. For the women, the data ranged from a low of 263.5 to a

high of 542.15 calories. During the heaviest part of the workout, the caloric expenditure averaged 663 calories per hour with some subjects using more than 1,600 calories per hour.

INTRODUCTION

Abdominal exercise is a common type of exercise accomplished to increase abdominal tone and strengthen the abdominal muscles as an aid in posture.¹⁻³ The main muscles involved during abdominal exercise are the transverses abdominis, external obliques, internal obliques, and rectus abdominis.⁴ These muscles are involved in rotating and flexing the trunk. They also affect the lumbar spine by providing stability.⁵

However, in recent years, while a number of new types of commercial abdominal equipment have been developed, there seems to be no consensus on if or how well these machines can train the abdominal muscles. Abdominal exercise can be accomplished in the seated position with some of these exercise machines.^{6,7} Other machines place the subject in the supine position. Whether a machine places the subject in the seated position or on the floor to perform an

Table 1. General characteristics of the subjects.

	Height (cm)	Weight (kg)	Age (years)	% Fat
Mean	173.5	76.9	29.5	24.1
SD	8.1	17.9	10.3	7.0

abdominal exercise, there seems to be great variability in muscle activity during exercise. Substitution of other muscles is common and hinders training of only the abdominal muscles.⁸ Szasz and colleagues³ have questioned the use of an abdominal physical fitness test by the United States Army because of substitution of hip flexors for abdominal muscles during standard supine crunches. The analysis of muscle use was accomplished through the surface electromyogram.⁹

Most types of abdominal workouts do not provide whole body aerobic training; they target only a few muscle groups. Aerobic training is needed in a good exercise program to increase cardiovascular and aerobic fitness. A good exercise regime should then combine the 2 types of training.

There are forms of exercise that have been proven to train the abdominal muscles well and also recruit training of other major muscles. This investigation will examine a type of a medicine ball. Medicine balls have been used historically for training upper and lower body muscles as well as core muscle.¹⁰ Medicine balls have been used for resistance training programs for middle aged school boys,^{10,11} to increase the motor abilities and fitness in obese children,¹² to activate shoulder and arm muscles during axial load exercises,¹³ to increase physical ability in male and female athletes for soft ball,¹⁴ for training for aerobic activity like volleyball,¹⁵ and for core endurance programs for activities such as rowing.¹⁶ Exercises like upper body chest passes can be used readily for gymnasts,¹⁷ whereas other exercises are

used more for coordination and to perform strengthening.¹⁸

A new type of medicine ball has been developed called a mini medicine ball (approximately 8 inches in diameter). It has an accompanying video with a 1-hour workout. In the present investigation, we examined the energy use of the body during such a workout and for 4 hours after to measure the post exercise oxygen consumption (EPOC).

SUBJECTS AND METHODS

Subjects

Six female and 7 male research subjects participated in these experiments. They were in the age range of 18-48 years old and free of orthopedic or cardiovascular disease. The general characteristics of the subjects are shown in Table 1. They were selected to provide a variety of ages and body types. All protocols and procedures were explained to each subject who signed a statement of informed consent as approved by the human review committee of Azusa Pacific University.

Oxygen Consumption, Ventilation, Carbon Dioxide Production, and Respiratory Quotient

A VO-2000 portable metabolic cart (Aero Sport Inc., Minneapolis, Minnesota, USA) was used in these studies. The analyzer was a battery-operated metabolic cart containing a CO₂ infrared analyzer, a fuel cell-based oxygen analyzer, and a pneumotach. The analyzer was calibrated with the local barometric pressure and temperature at the beginning of each run. It sampled expiratory gases through a mouthpiece.

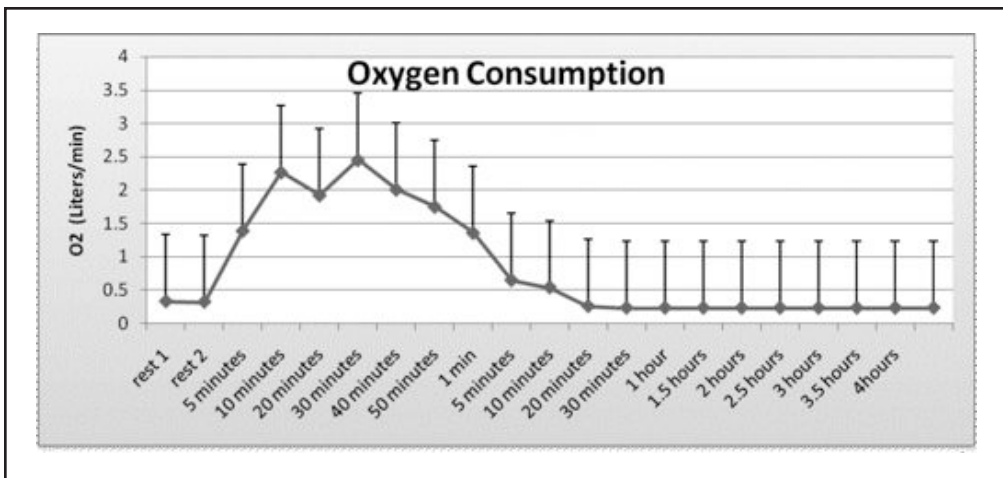


Figure 1. The average (for 12 subjects) oxygen consumption at rest, during, and for 4 hours post exercise. All data shown as mean \pm SD.

Since a mouthpiece was used, the subjects wore a nose clip. The gas was sampled breath by breath and all gas values were averaged over a 20-second period. Ventilation, oxygen consumption, and carbon dioxide production were converted to standard pressure and temperatures (STPD) and stored in the memory of the analyzer.

Exercise Videos

The exercise video used in this study is called the cardio workout video and was 60-minutes long and involves a series of exercises using the 2-lb mini medicine ball during upper body and lower body stretching and abdominal exercise.

Procedures

Subjects were asked to place the mouthpiece in their mouth, and oxygen consumption, ventilation, heart rates, and blood pressures were measured for 5 minutes. They then exercised for 60 minutes following the video and oxygen consumption was measured for an additional 4 hours while participants relaxed sitting down watching television.

RESULTS

The results of the experiments are shown in Figures 1 and 2. Before the

exercise began, the average oxygen consumption was 0.33 ± 0.11 liters per minute for the entire group of subjects. The oxygen consumption was significantly higher in the men than the women ($P < 0.05$) averaging 0.36 liters in the men and 0.29 liters in the women. During exercise, the average oxygen consumption was (for the 60-minute period) 1.87 ± 0.64 liters per minute for the group, with the average oxygen consumption of the men being significantly higher at 2.12 liters per minute compared with 1.19 liters per minute for the women. But there was variation in the groups. For example, for one man, the average was 3.81 liters per minute and for the greatest woman it was an average of 2.03 liters per minute. The average energy use during and in the period after work was 517.4 ± 237 calories of energy used for the workout. For the men, this was significantly higher at 654.1 ± 143.2 calories compared with 358 ± 98 for the women. Most of the energy was used during the workout, which averaged for the group 443.4 calories, and 74.1 calories were used in the post exercise period.

The range of response of caloric expenditure was large for the women and men. The total caloric expenditure

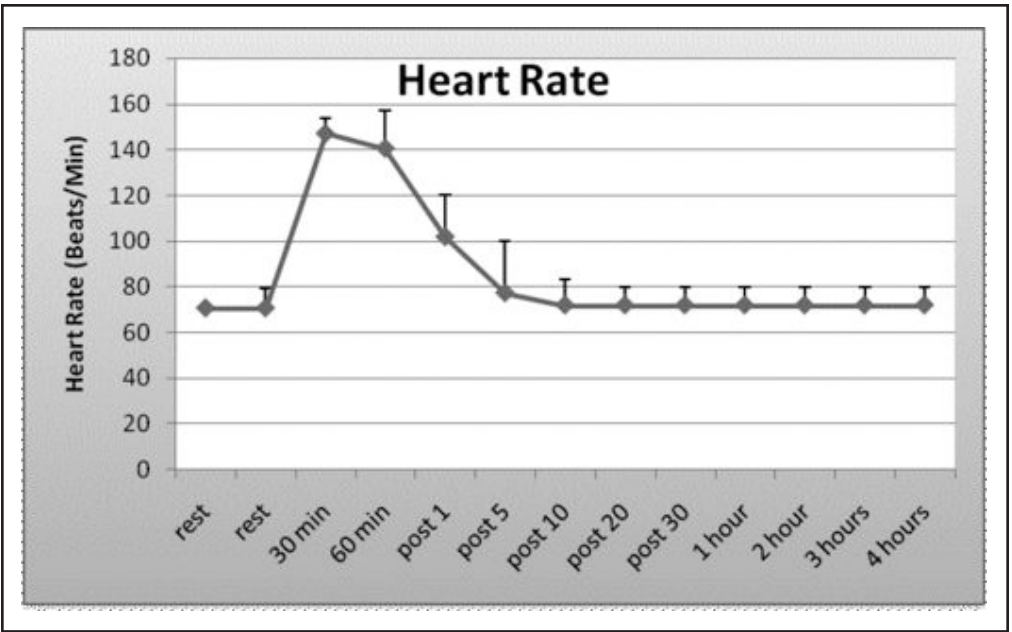


Figure 2. The average heart rate (12 subjects) before, during, and after the exercise video. All data shown as mean \pm SD.

for the men varied from a low of 389.2 to a high of 1,027.5 calories. For the women, the range was 263.5 to a high of 542.1 calories.

These results were paralleled by the heart rate and blood pressure results. As shown in Figure 2, the average heart rate at rest was 70.7 ± 8.5 beats per minute for the entire group with no statistical difference between men and women ($P > 0.05$). The average heart rate during the exercise was 136 beats per minute with no difference between men and women. This would make the exercise aerobic and is consistent with the relative percentage of the EPOC being 14.5% of the oxygen used during exercise for the group. Blood pressure only increased by an average of 4 mmHg during the exercise, also showing a high aerobic component.

Lactates started at 3.57 ± 0.54 and at the 5-minute post period as 3.79 ± 0.7 . There was no statistical difference in lactates, also showing pure aerobic exercise. The low lactate production and RQ consistently near 0.8 showed that almost all

of the energy expenditure for these subjects was due to metabolism of fat.

DISCUSSION

The present investigation examined the caloric expenditure during a 60-minute exercise video involving the use of a 2-lb mini medicine ball. Unlike other exercise bouts used to specifically strengthen abdominal¹⁻³ or other core muscles,^{4,5} here the energy use was almost at the anaerobic threshold. This is probably due to the fact that this workout involved all of the major muscle groups in the body and therefore required more energy. It was interesting that for all 13 people in the study, the exercise was just at the anaerobic threshold. Exercise at this level is ideal for training since it allows maximum use of energy in the muscle without inducing fatigue. This also maximizes fat oxidation during the exercise. It also accomplished optimal training of the cardiovascular system^{19,20} and muscle.²¹ Additionally, the exercise video studied did elicit an EPOC, which carried the caloric loss past the exercise

itself. This is due to elevated metabolism that occurs past the exercise period. Interestingly, there was some range of response. For some people, caloric expenditure would allow for about a pound of weight loss every 4 days of exercise. This is consistent with other studies showing that exercise alone is good for weight loss intervention. When added to a diet plan, weight loss is even more significant as determined in a separate study.²²

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