

Canadian Study

Impact of Exercise on Body Fatness and Skeletal Muscle Metabolism

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Calorie burning comparison between high-intensity aerobic/anaerobic exercise and medium intensity pure aerobic exercise. High intensity exercise excelled impressively.

9 Times as much fat (calories) burned with 4 minute high intensity aerobic/anaerobic exercise that with 30 to 45 minutes on a treadmill at 70% VO_{2max} .

Study Conducted at Laval University, Quebec Canada

Dr. Angelo Tremblay, Ph.D., and his colleagues at the Physical Activities Sciences Laboratory, Laval University, Quebec, Canada, challenged the common belief among health professionals that low intensity, long duration exercise is the best program for fat loss. They compared the fat loss results from medium intensity aerobic exercise and interval high-intensity aerobic/anaerobic exercise.

The Testing Parameters

The Canadian scientist divided 27 inactive, healthy, non-obese adults (13 men, 14 women, 18 to 32 years old) into two groups. They subjected one group to a 21-week endurance training (ET) program of uninterrupted cycling 4 or 5 times a week for 30 to 45 minutes; the intensity level began at 60% of heart rate reserve and progressed to 85%. (For a 30 year old, this would mean starting at a heart rate of about 136 and progressing to roughly 170 bpm, which is more intense than usually prescribed for weight or fat loss.)

The other group did a 15 week program including mainly high intensity interval training (HIIT). Much like the ET group, they began with 30 minute sessions of continuous exercise at 70% of maximum heart rate reserve, but soon progressed to 10 to 15 bouts of short (15 seconds progressing to 30 seconds) or 4 to 5 long (60 seconds progressing to 90 seconds) intervals separated by recovery periods allowing heart rate to return to 120-130 bpm. The intensity of the short intervals was initially fixed at 60% of the maximal work output in 10 seconds, and that of the long bouts corresponded to 70% of the individual maximum work output in 90 seconds. Intensity on both was increased 5% every three weeks. The total energy cost of the ET program was substantially greater than the HIIT program.

The researchers calculated that the ET group burned more than twice as many calories during the exercise than the HIIT group, but no extra calories were burned after the exercise. Skinfold measurements showed that the HIIT group lost 9 times as much subcutaneous fat during 15 weeks that the ET group lost during 21 weeks. When the difference in the total energy cost of the program was taken into account, the subcutaneous fat loss for the HIIT group was NINEFOLD that of the ET group. Even though the HIIT group burned less than half the calories during the short bursts of exercise, the metabolism was raised substantially so that the HIIT group metabolized 9 times as many calories as a result of the exercise that the ET group burned during the exercise. The ET group experienced next to no additional calorie metabolism after the exercise.

Conclusions Drawn by the Researchers

Dr. Tremblay's group took muscle biopsies and measured muscle enzyme activity to determine why high intensity exercise produced so much more fat loss. They concluded: "Metabolic adaptations resulting from HIIT may lead to a better lipid utilization in post exercise state and thus contribute to a greater energy and lipid

deficit.” Therefore, high intensity intermittent training (HIIT) raises total muscle metabolism to higher levels than endurance training (ET). Even though HIIT consumes fewer calories during the 4 minutes of ET, the total calories “burned” during a 24 hour period resulting from 4 min HIIT is far greater than from 60 min of ET (treadmills, bikes, steppers etc.)

CONCLUSION: More fat loss per 24 hour period with 4 min ROM exercise than with 60 min endurance training on treadmill, bike or stepper.

Japanese Study

Effects of Moderate-Intensity Endurance and High-Intensity Intermittent Training on Aerobic Capacity and

VO_{2max}

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Study Conducted at Japan’s National Institute of Fitness and Sports Research

This study closely matched the ROM 4-Minute Cross Trainer workout in that it evaluated the improvement in VO₂ max for endurance training (ET) versus high-intensity intermittent training (HIIT).

The tests were conducted on stationary bicycles and the results would have been even more impressive if the comparison for the test would have been between endurance training on a treadmill. Bike, rower, or stair stepper on the one hand and ROM The 4-Minutes Cross Trainer for the high-intensity interval training. The more muscles trained and the larger the range of motion (ROM) of all these muscles, the higher the VO₂ max, which is the measurement with which total aerobic capacity is measured. It is the indicator that shows the condition of your total cardiovascular system (lungs, heart, and blood vessels) and its ability to transport oxygenated blood to all parts of the body.

4 Minute High Intensity Versus 1 Hour Moderate Intensity Workouts

Izumi Tabata and his colleagues at the National Institute of Fitness and Sports in Tokyo, Japan, compared the effects of moderate-intensity endurance training and high-intensity intermittent training on VO₂ max and anaerobic capacity. The high intensity training method had been used for members of the Japanese Speed Skating Team for several years. Moderate-intensity workouts were for one hour, compared to only 4 minutes per workouts for the high intensity group.

In the moderate intensity group, seven active young male physical education majors exercised on stationary bikes 5 days per week for 6 weeks at 70% of VO₂ max 60 minutes each session. VO₂ max was measured before and after the training and every week during the 6 week period. As each subject’s VO₂ max improved, exercise intensity was increased to keep them pedaling at 70% of their actual VO₂ max. Maximal accumulated oxygen deficit was also measured, before, at 4 weeks, and after the training.

A second group followed a high intensity interval program. Seven students, also young and physically active, exercised five days per week using a training program similar to the Japanese speed skaters. After a 10 minutes warm-up, the subjects did seven to eight sets of 20 seconds at 270% of VO₂ max, with a 10 second rest between each bout. Pedaling speed was 90 rpm and sets were terminated when rpms dropped below 85. When subjects could complete more than 9 sets, exercise intensity was increased by 11 watts. The training protocol was altered one day per week. On that day, the students exercised for 30 minutes at 70% of VO₂ max before doing 4 sets of 20 seconds intervals at 170% of VO₂ max. This latter session was not continued to exhaustion. Again, VO₂ max and anaerobic capacity was determined before, during and after the training.

Ground Breaking Results

The moderate intensity endurance training program produced a significant increase in VO₂ max by about 10%, but had no effect on anaerobic capacity. The high intensity intermittent protocol improved VO₂ max by about 14% while anaerobic capacity increased by 28%. Dr. Tabata believes this is the first study to demonstrate an increase in both aerobic and anaerobic power. He concludes that the rate of increase in VO₂ max (14% for the high-intensity protocol, in only 6 weeks) is **one of the highest ever reported in exercise science**. The intensity in the first protocol was at 70% of VO₂ max did not stress anaerobic components (lactate production and oxygen debt) and, therefore, anaerobic capacity was unchanged. The subjects in the high intensity group exercised to exhaustion, and peak blood lactate levels indicated that anaerobic metabolism was being taxed to the maximum. According to the researchers, a 4 minutes training program of very hard 20 second repeats may be optimal with respect to improving both the aerobic and the anaerobic energy release program. The high intensity intermittent training (HIIT) caused higher total body metabolism than the 60 minutes of endurance training (ET) resulting in much more calories “burned” during a 24 hour period.

CONCLUSION: More fat loss per 24 hours period with 4 min ROM exercise than with 60 min endurance training on treadmill, bike or stepper.