

# 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  $VO_{2max}$  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-Minute Cross Trainer for the high-intensity interval training. The more muscles are trained and the larger the range of motion (ROM) of all these muscles, the higher the  $VO_{2max}$  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, 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 and high-intensity intermittent training on  $VO_{2max}$  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  $VO_{2max}$  60 minutes each session.  $VO_{2max}$  was measured before and after the training and every week during the 6 week period. As each subject's  $VO_{2max}$  improved, exercise intensity was increased to keep them pedaling at 70% of their actual  $VO_{2max}$ . 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 minute warm-up, the subjects did seven to eight sets of 20 seconds at 270% of  $VO_{2max}$ , 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  $VO_{2max}$  before doing 4 sets of 20 seconds intervals at 170% of  $VO_{2max}$ . This latter session was not continued to exhaustion. Again,  $VO_{2max}$  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  $VO_{2max}$  by about 10%, but had no effect on anaerobic capacity. The high intensity intermittent protocol improved  $VO_{2max}$  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  $VO_{2max}$  (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 at 70% of  $VO_{2max}$  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 minute 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 hour period with 4 min ROM exercise than with 60 min endurance training on treadmill, bike or stepper.**