

RESEARCH ABSTRACT

ENDURANCE TRAINING VS. SPRINT INTERVAL TRAINING

By Brad Bowser

INTRODUCTION

Traditional endurance training (ET) typically includes prolonged (≥ 60 minutes) sessions of moderate-intensity exercise performed three to seven times per week for several weeks. In contrast, low-volume sprint interval training (SIT) is defined as all-out, high-intensity, sprint-type training with periods of rest between each exercise. The actual exercises in SIT typically last fewer than 10 minutes per session.

Although the volume of exercise for SIT is substantially less than for ET, the two different techniques recently have produced similar muscle adaptations and cardio respiratory fitness levels. This study is aimed at determining whether people who undergo six weeks of ET or SIT do, in fact, display similar muscle and cardio respiratory fitness adaptations.

METHODS

Twenty active but untrained subjects (10 men, 10 women) participated in this study. Subjects were placed in matched fashion into either the ET or SIT groups based on their cardio respiratory fitness levels (VO_{2peak}). The ET group performed continuous cycling five days per week for six weeks at 65 percent of their VO_{2peak} . They performed 40 minutes



In this study, sprint interval training involved a cycle ergometer. Other sprint-like exercises may produce similar results.

of exercise per session for the first two weeks; 50 minutes per session for weeks 3 and 4; and 60 minutes per session for the last two weeks. The SIT group performed three sessions of 30-second all-out cycling sprints with a resistance equal to $.075 \text{ kg (kg body mass)}^{-1}$. These sprints were performed three times a week for six weeks. They performed four sprints per session during the first two weeks, five sprints during weeks 3 and 4, and six sprints per session during the last two weeks. Rest (4.5 minutes) was given between each sprint (30 seconds), with the subject con-

tinuing to cycle with minimal resistance. VO_{2peak} , peak power output during cycling, and muscle fiber composition were determined for all participants both pre- and post-training.


RESULTS

Both groups displayed a significant increase (7 percent) in VO_{2peak} and peak power output during cycling (SIT = 17 percent; ET = 7 percent). However, there were no significant differences between the ET and SIT groups on these measures. Similarly, muscle fiber composition also showed increases in mitochondrial

markers, lipid oxidation and oxidative capacity – with no differences between the ET and SIT groups.

DISCUSSION

As designed, the SIT group had a weekly volume of exercise that was 90 percent less than the ET group. This corresponded to a weekly time commitment of about 1.5 hours for the SIT group and 4.5 hours for the ET group. Of the 1.5 hours (SIT), only 10 minutes were spent exercising as the majority of time was spent in the recovery period. Considering that both training programs resulted in similar adaptations, SIT may be a more time-efficient training program for improving cardio respiratory fitness and endurance.

It is important to note that, in this study, SIT involved sprinting on a cycle ergometer. It is likely that other types of all-out, high-intensity, sprint-like exercises may produce similar results. According to this research, adding SIT training to an exercise program may provide greater variety while minimizing the time commitment and maintaining the same benefits as traditional endurance training. 

Burgomaster, K., Howarth, K., Phillips, S., et al. Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. *Journal of Physiology*. 586;2008:151-160.

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TAKING EXERCISE TO NEW HIGH

By Richard Willy

CrossFit, P90X and Insanity have become the rage among those seeking new levels of fitness. These commercially available, high-intensity exercise programs are especially popular with top-level athletes, law enforcement officers, members of the military, and those looking for quick weight loss. The specifics of these programs may differ, but each one involves multi-joint exercises, such as squats, pull-ups and Olympic lifts.

- P90X is a 90-day, video-guided program designed for home use. Weights, resisted tubing or one's body weight supply the resistance.
- Insanity is the next level up from P90X and promises similar results in just 60 days. It incorporates plyometrics (jumping), calisthenics and kick-boxing.
- CrossFit workouts involve plyometrics and calisthenics but also the throwing of heavy medicine balls or the repeated overhead hoisting of a steel ball with a handle, known as a kettlebell.

Traditionally, individuals seeking to gain fitness have relied heavily on moderate-intensity endurance exercise, such as running, cycling or cardiovascular machines. However, recent evidence suggests that shorter bouts of interval training may be as or even more effective in achieving fitness goals.



CrossFit workouts incorporate the repeated overhead hoisting of a steel ball with a handle, known as a kettlebell.

Interval training is characterized by repeated efforts of high-intensity exercise of five minutes or fewer interspersed with short rests. In a recent study, college-aged subjects doing interval training achieved the same if not greater fitness and health gains compared with matched control subjects participating in a traditional endurance exercise program.

Gains in the interval training group were achieved in a fraction of the time that was required to achieve the same gains in the endurance trained

group. Interval-trained subjects completed 10 one-minute sprints on stationary bikes at maximal effort three times per week. To achieve the same results, the endurance-trained group needed 10 hours of cycling per week.

A promising follow-up study suggests that interval effort does not even have to be maximal to achieve the same results as maximal interval training. Thus, interval training may make sense for time-pressed individuals.

But while the infomercials and online forums report

amazing results for many participants, the very nature of these programs may place individuals at risk for serious injuries. With each of these programs, emphasis is placed on intensity, speed of movement and number of repetitions rather than on technique. Injury risk skyrockets when performing maximal repetitions of an exercise as fast as possible while using poor technique. Even when performed properly, many of the exercises may put a high level of stress on a participant's knees, shoulders and spine. In addition to a potential for musculoskeletal injury, high-intensity exercise in deconditioned (a condition of compromised health and fitness that makes daily activities difficult) individuals may create a life-threatening condition known as rhabdomyolysis. This occurs when pieces of severely damaged muscle dislodge and become free floating in the bloodstream. These pieces become lodged in the kidneys, resulting in kidney failure and requiring emergency kidney dialysis. Recently, a legal settlement was awarded to a former CrossFit participant who developed rhabdomyolysis after a particularly high-intensity CrossFit workout.

Another drawback of

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interval exercise programs is their short-term nature. These programs focus on maximal fitness gains in a relatively short time period. However, they are not designed to deliver fitness gains over the long term. In fact, research suggests that exercise programs that have a high level of discomfort may actually result in an aversion to later exercise. In these studies, individuals who exercise at their preferred intensity level and duration report high levels of psychological and physical reward. These feelings increase even more as time intervals increase between workout sessions. In contrast, individuals who exercise at a prescribed duration and intensity report lower feelings of psychological and physical reward. High-intensity exercisers tend to view their workouts more negatively as time increases post-workout. Thus, individuals who exercise at their preferred intensity often are eager to work out again; individuals who exercise at a prescribed intensity and duration often approach their next workout with a sense of dread. Consequently, exercise programs that have a high level of discomfort often are associated with a higher rate of participant dropout than are programs that encourage self-selected exercise loads.

Individuals who already are in excellent shape, who are free of health issues, and who have minimal injury histories may benefit the most from these programs. Clearance from a physician is recommended for any individual who would like to begin these programs. A musculoskeletal evaluation performed by a licensed physical therapist

may help a participant customize these programs to minimize injury risk.

Even if CrossFit, P90X and Insanity are not right for you, you still can incorporate some of the principles of interval exercise into your normal workout routine. Each week, try replacing one of your normal endurance-paced workouts with a basic interval workout. For example, after an easy 10-minute warm-up, complete five one-minute submaximal sprints on a stationary bike. Allow one minute of easy spinning between sprints. Follow this workout with a cool-down period of easy spinning for five minutes. Be sure to get clearance from your physician first.

While the allure of a regimented interval program may be difficult to resist for some, an exercise program that is done at your pace may pay greater dividends in the long run. However, many may benefit from adding an interval workout into their weekly workout routines. You may experience a boost in your fitness while decreasing the time commitment of your current exercise program. ■

Burgomaster, K., Howarth, K., Phillips, S., Rakobowchuk, M., Macdonald, M., McGess, S., Gibala, M., Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. *Journal of Physiology*. 1;2008:1-2.

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Q&A

INTERVAL TRAINING

By Dr. Irene Davis

WHAT ARE P90X, INSANITY AND CROSSFIT?

These are commercially available, high-intensity interval training programs involving plyometrics (jump training) and high-speed, repetitive, multi-joint movements. P90X and Insanity involve bodyweight resistance activities as well as dumbbells and elastic tubing exercises and are conducted at home. CrossFit involves the lifting of heavier weights and typically is done in a gym.

WHAT IS INTERVAL TRAINING AND HOW DOES IT DIFFER FROM ENDURANCE TRAINING?

Interval training is a type of physical training that involves bursts of high-intensity work alternated with periods of rest or low activity. Endurance training involves low-intensity exercise over long, continued periods of time. The total exercise volume of interval training is significantly less than that of endurance training.

WHAT ARE THE BENEFITS OF INTERVAL TRAINING?

The benefits of interval training include improved cardiovascular health and stamina and increased

muscular strength and power. This program can be done in a brief amount of time, so it is ideal for those with busy schedules. The benefits of this exercise can be realized very quickly.

WHAT ARE THE RISKS OF INTERVAL TRAINING?

There is an increased risk of musculoskeletal injury because of the high intensity of the exercise, especially in those with low baseline fitness. In very rare cases, it can lead to a life-threatening condition called rhabdomyolysis. This involves a rapid breakdown of skeletal muscle, which can lead to kidney failure and death.

HOW CAN I SAFELY INCORPORATE INTERVAL TRAINING INTO MY EXERCISE PROGRAM?

Before engaging in any high-intensity exercise program, you should seek the advice of your physician. If you have a history of musculoskeletal injury, consult your physical therapist, who can assess whether you need to modify any of the exercises to reduce your risk of injury. If you simply want to add an interval component to your exercise program, substitute it for one or two of your endurance workouts. ■



CASE STUDY

OVERTRAINING LEADS TO INJURY

By Jim Couch

PATIENT HISTORY

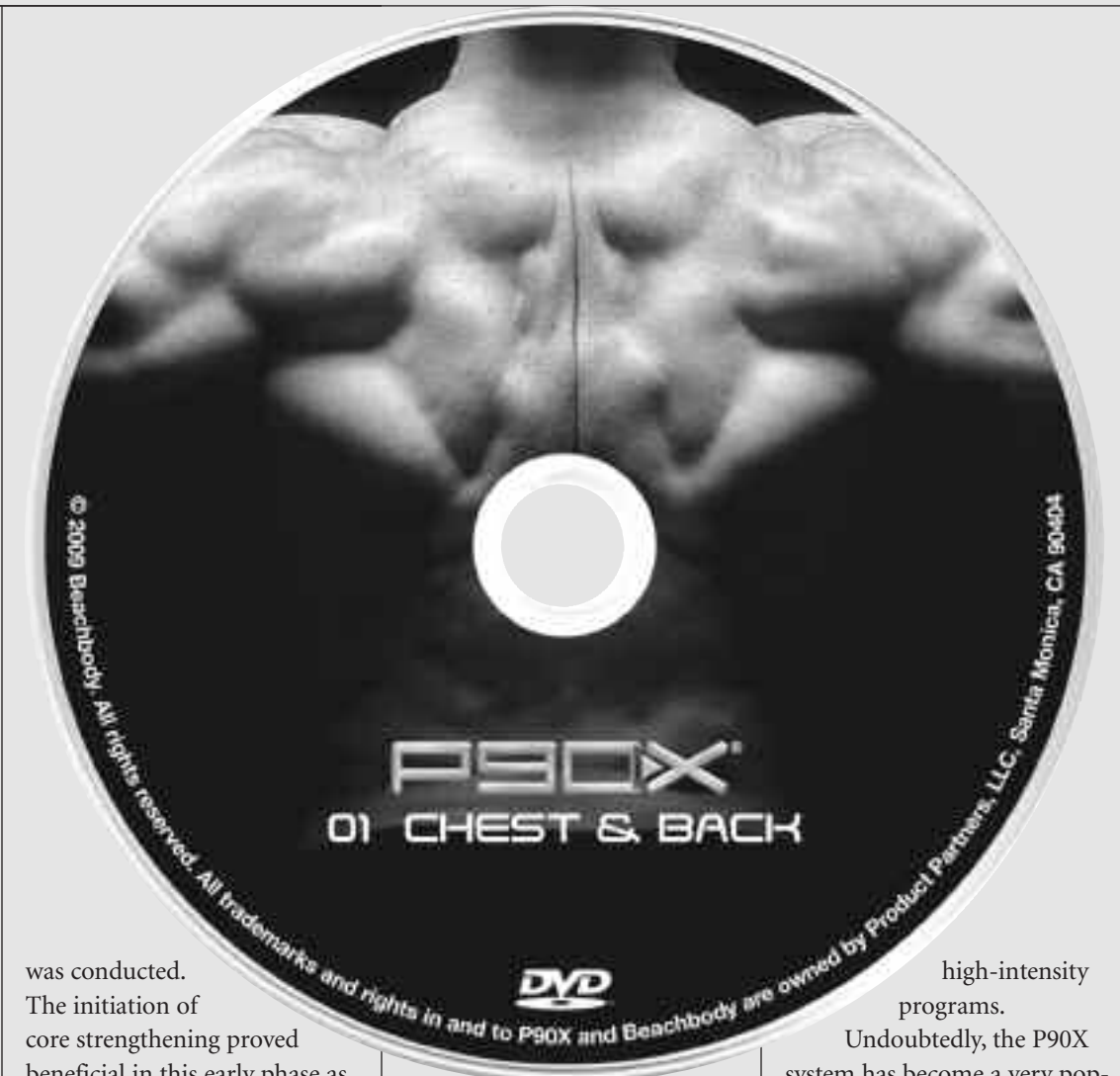
A 42-year-old policeman presented with right medial tibial pain as a result of overtraining. The patient reported starting a P90X workout a few weeks prior to the onset of pain. This workout included cyclic plyometric activities such as repetitive jumping. The patient described a gradual onset of medial shin symptoms, which worsened with physical activity. He was seen by his primary care physician, who ruled out bony involvement based upon negative radiographs. He was then referred to physical therapy.

ASSESSMENT

The patient was slightly overweight and exhibited poor alignment of the lower extremities, including excessive hip internal rotation, genu-valgum and pes planus. Significant weakness was noted in his trunk flexors/extensors, hip abductors, quadriceps and ankle invertors. He demonstrated exquisite tenderness over the lower medial third of the tibia and posterior tibialis tendon. He was unable to squat, stand on one leg or negotiate stairs without pain. The act of jumping was most painful of all.

TREATMENT

His workout program was reviewed and any plyometric (jumping) activities that would further aggravate his symptoms were eliminated. He was treated with ice to reduce the inflammation, and soft tissue mobilization and stretching



was conducted. The initiation of core strengthening proved beneficial in this early phase as it provided a physical challenge to the patient without increasing his symptoms. In his second week of physical therapy, lower extremity strengthening exercises in weight-bearing positions were initiated. These exercises were done barefoot, with the patient focused on standing on three distinct points of his foot (heel and first and fifth metatarsal heads). This tripod stance was extremely challenging and exhausting. As the patient progressed, this same tripod posture was emphasized with more challenging activities, i.e.

squatting, stairs, lunges, etc. Double leg squats were possible after the first week, with single leg squats possible by the middle of the second week. Jogging on a mini-tramp for five minutes was performed at the end of the third week. By the conclusion of week 5, the patient was jumping rope continuously for two minutes and could perform the previously painful P90X jump routine without symptoms.

SUMMARY

This case demonstrates the potential danger of these new

high-intensity programs. Undoubtedly, the P90X system has become a very popular exercise program that can result in significant changes in physique without injury – but only if followed carefully. The system provides several options for each exercise, ranging in level of difficulty. Unfortunately, this patient chose the more challenging exercise option despite his relatively low baseline level of fitness. He believed he would achieve a greater benefit sooner. However, he paid a price in the form of injury. ■