Low-Volume, High-Intensity Interval Training: A Practical Fitness Strategy

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Considering one of the most commonly cited barriers to regular exercise is “lack of time” (Trost, Owen, Bauman, Sallis, & Brown, 2002), there is a need to identify innovative and time-efficient exercise strategies for Canadians.

This article offers insights into low-volume, high-intensity interval training (HIIT); a strategy that has emerged in recent years as a potent and practical exercise alternative. For many types of practitioners, low-volume HIIT may be an attractive and realistic option they can offer or promote to clients, to help encourage physical activity and increased fitness levels.

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What is High-Intensity Interval Training?

Before we address low-volume HIIT, it’s helpful to discuss what a single session of HIIT involves. HIIT typically consists of brief, repeated bursts of intense exercise separated by short periods of rest or low-intensity exercise.

HIIT has repeatedly been shown to represent a time-efficient exercise strategy that induces many physiological, performance and health-related adaptations normally associated with high-volume endurance training, at least over the short term (i.e., weeks to months), including:

- increased cardiorespiratory fitness;
- improved exercise performance;
- increased skeletal muscle oxidative capacity; and
- improved insulin sensitivity.
A common protocol employed in many HIIT studies has been repeated Wingate Tests. This protocol involves a series of 30-second “all out” cycling bouts, against a supramaximal workload (i.e., at or near a person’s “all-out” effort).

- During each session, participants perform 4 to 6 bouts of 30-second sprints, separated by 4 minutes of recovery; the total amount of all-out exercise is only 2 to 3 minutes.

When 6 weeks of Wingate-based HIIT (performed 3 times per week) was compared to traditional endurance training (designed according to public health guidelines which consisted of 40 - 60 minutes of continuous moderate-intensity cycling, performed 3 times per week) similar training-induced changes in skeletal muscle oxidative capacity and cardiorespiratory function were found (Burgomaster et al., 2008).

These effects were realized despite a nine-fold lower training volume associated with the HIIT group compared to the endurance training group.

HIIT also induces many other endurance-like adaptations, including:
- increased resting muscle glycogen content;
- reduced glycogen utilization and lactate production during exercise;
- increased whole-body lipid oxidation; and
- enhanced exercise performance.

In other words, HIIT improves aerobic fitness!

Although Wingate-based HIIT is a highly effective exercise training strategy, it requires a specialized cycle ergometer and a high degree of participant motivation. In reality, this protocol is not always a practical option or model of exercise that fitness professionals can recommend to clients or the general public.

Findings Associated with a Practical Model of Low-Volume HIIT

Our research group aimed to identify a more practical, yet still time-efficient, low-volume HIIT model which could be more widely recommended to various clients or populations, including those at risk for chronic metabolic disease.

We tested a modified protocol involving 10 one-minute cycle sprints, at approximately 90% of maximal heart rate, interspersed with one minute of recovery between sprints, for a total of only 10 minutes of exercise within a 20-minute period.

Importantly, we found that this protocol rapidly improves cardiorespiratory fitness and skeletal muscle oxidative capacity in young healthy males (Little, Safdar, Wilkin, Tarnopolsky, & Gibala, 2010). Similar adaptations have also been seen in previously sedentary adults (Hood, Little, Tarnopolsky, Myslik, & Gibala, 2011) and overweight and obese women (Gillen et al., unpublished observations) following low-volume HIIT. In addition, this practical HIIT model increases insulin sensitivity (an important indicator of metabolic health) following just 6 sessions over 2 weeks (Hood et al., 2011).

Other variations (or models/protocols) of low-volume HIIT have also been reported to increase insulin sensitivity, improve peripheral arterial function and reduce systolic blood pressure (Gibala, Little, MacDonald & Hawley, 2012). In addition, HIIT is perceived to be more enjoyable than continuous, moderate-intensity endurance exercise (Bartlett et al., 2011).

Is Low-Volume HIIT Effective for Clinical Populations?

More recently, the usefulness of HIIT for improving disease outcomes in clinical populations has gained widespread interest. Successful outcomes have been realized in individuals with coronary artery disease, congestive heart failure, metabolic syndrome and type 2 diabetes (Gibala et al., 2012).

For example, through continuous monitoring of blood glucose levels, we found that our practical, low-volume HIIT protocol (as described earlier) effectively reduced post-meal glucose excursions and average 24-hour blood glucose concentration in patients with type 2 diabetes. This effect was apparent when measurements were made immediately following a single session of HIIT (Gillen et al., 2012), as well as when blood glucose was monitored for a 24-hour
period, starting 72 hours after a 2-week HIIT intervention (Little et al., 2011).

These benefits were realized even though the weekly training time commitment was much lower than recommended public health guidelines. Findings from these small pilot studies are compelling, however large-scale investigations are warranted to determine whether low-volume HIIT is a realistic exercise alternative for individuals with various chronic diseases.

**Does HIIT Alter Body Composition?**

Despite the abundance of evidence linking low-volume HIIT with improved cardiovascular and metabolic fitness, its effect on another key component of physical fitness — body composition — is less known.

While it’s no surprise that short-term HIIT interventions lasting only two weeks yield no change in body composition, it’s interesting to note some research has found that longer interventions may be effective. For instance, Trappe, Chisholm, Freund, & Boutcher (2008) showed that 15 weeks of low-volume HIIT was superior to traditional endurance training for reducing fat mass in women, and, in particular, intra-abdominal fat.

Notably, unpublished observations from our laboratory indicate that these favourable adaptations in body composition can actually occur in as little as 6 weeks (Gillen et al., unpublished observations).

• We found that without a change in total body mass, 6 weeks of low-volume HIIT induced significant reductions in whole body fat mass and increased lean mass in overweight women.

• Changes were also detected at specific body regions, including decreased fat mass in the abdomen and increased lean mass in legs.

Considering the short nature of each exercise bout, the precise mechanisms linking low-volume HIIT to superior fat loss is largely unknown, but increased fat oxidation during exercise, or a reduced appetite following exercise could be involved.

Additionally, low-volume HIIT may be particularly effective for inducing excess post-exercise oxygen consumption (EPOC), which enhances metabolic rate and energy expenditure in the hours following exercise. In other words, performing a session of low-volume HIIT may increase the number of calories you burn for the rest of the day.

**A Word About Safety**

Individuals who plan to engage in high-intensity exercise (independently or on the advice of a practitioner, e.g., fitness consultant) should first consult with their health care provider. Similarly, when practitioners are recommending an exercise plan or changes to exercise plans/routines, they should advise their clients or patients to consult with their health care provider.

**Summary of Findings**

Our research, along with a considerable number of other scientific findings, suggests that low-volume HIIT is a highly potent and time-efficient exercise strategy that can provide a range of health benefits in a variety of populations.

For instance, benefits may include:

• improved cardiorespiratory fitness and exercise performance;

• improved skeletal muscle metabolic health;

• improved glycemic control and insulin sensitivity; and

• improved body composition.
While additional studies are still needed to determine whether low-volume HIIT can lead to all of the health-enhancing benefits associated with traditional endurance exercise (i.e. reduced risk for chronic disease, improved quality of life, increased cognitive function, reduced all-cause mortality), our research suggests that adding periods of “high” and “low” intensity to a person’s exercise routine represents a practical and time-efficient strategy to improve many aspects of physical fitness.

**Practical Recommendations**

Here are some brief step-by-step tips for practitioners and individuals about low-volume HIIT workouts:

- Using a stationary bicycle, warm up for 2 - 3 minutes at a comfortable pace.
- Increase the resistance on the bicycle to a workload that feels to be about a 9 out of 10 (1=nothing at all; 10=maximal effort); then pedal hard for 1 minute.
- Follow this with 1 minute of light cycling that feels like a 4 out of 10. (If needed, this minute can be used for complete rest.)
- Repeat this “1 minute on, 1 minute off” protocol 10 times, for a total of 19 minutes.
- Cool down at a low-intensity for 2 - 3 minutes.

You can also apply these steps to other modes of exercise, such as swimming, running or stair-climbing.

The key is to repeatedly push “hard” for 1 minute at a time, interspersed with periods of low intensity exercise or rest.

*Jenna Gillen, BSc, is working towards her PhD under the supervision of Dr. Martin Gibala in the Kinesiology Department at McMaster University. As a member of the Exercise Metabolism Research Group, Jenna’s research focuses on the effect of high-intensity interval training on skeletal muscle metabolism in both healthy and clinical populations.*

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