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Interval training: a time-efficient exercise strategy to improve cardiometabolic health

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1 Interval training: a time-efficient exercise strategy to improve cardiometabolic
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Interval training refers to an intermittent style of exercise in which bouts of more intense effort are separated by periods of recovery within a single training session. Application of the method for general fitness has long been recognized, but the last few years have seen an explosion of research into the physiological adaptations to interval training in both healthy individuals and people with cardiometabolic diseases. Our 2014 Clinical Corner article (Gillen and Gibala 2014) addressed one aspect of the phenomenon and specifically the potential for “low-volume” interval training to improve health and fitness. This was defined as sessions involving ≤ 10 min of intense intermittent exercise within a total time commitment of ≤ 30 min including warm-up, recovery periods between intervals, and cool down. Our review broadly used the umbrella term “high-intensity interval training” (HIIT) to describe any type of intense intermittent exercise. HIIT is now generally accepted to involve relatively intense but submaximal efforts that elicit $\geq 80\%$ of maximal heart rate; it can be distinguished from a more intense version — “sprint interval training” (SIT) — in which bouts are performed in an ‘all out’ manner or the absolute workload exceeds that normally required to elicit peak oxygen uptake (VO_{2peak}). Interval training can also involve less demanding activity characterized by alternating periods of light and moderate exercise (e.g., interval walking).

At the time of our review, a limited number of studies had examined responses to low-volume interval training in particular, and there were few direct comparisons of this type of exercise with traditional moderate-intensity

continuous training (MICT). Growing interest in the topic of low-volume interval training for health and fitness is evidenced by the fact that our review has been cited 178 times, ranking it among the top 20 most cited articles in *Applied Physiology, Nutrition and Metabolism's* (APNM). This level of attention has coincided with a large number of related submissions to the journal, yielding 31 published manuscripts over the last four years. The goal of this Virtual Issue is to highlight some of the articles published in APNM that have advanced our understanding of the effect of interval training on indices of cardiometabolic health.

Acute and short-term training studies have observed that interval training can elicit improvement in cardiometabolic health indices that are comparable, or superior, to MICT despite a reduced time commitment. Little et al. found that a single session of interval training involving 10 x 1 min cycling bouts at 90% maximal heart rate (HRmax), elicited larger and longer-lasting reductions in 24-h postprandial glycemia in obese adults, as compared to a 30-min bout of MICT at 65% HRmax that was matched for total external work (Little et al. 2014). Higgins et al. showed that 6 weeks of Wingate-based SIT induced greater reductions in whole-body fat mass and superior improvements in cardiorespiratory fitness as compared to energy-matched MICT in overweight and obese women (Higgins et al. 2016). Similar observations were found in people with type 2 diabetes (T2D), whereby cardiorespiratory fitness was increased to a greater extent after 8 weeks

of low-volume SIT as compared to a moderate-intensity walking program (Ruffino et al. 2017).

Another area that has received attention in recent years is exercise-induced changes in body composition. Our previous review highlighted several studies that had observed small but significant reductions in body fat after low-volume interval training programs lasting 6-12 weeks. An acute bout of HIIT can elicit increases in 24-hour energy expenditure that are similar to a longer period of moderate-intensity exercise, consistent with the notion that intervals can be a time-efficient method to burn calories (Skelly et al. 2014). There has been much interest in the potential mechanisms that mediate changes in body composition with low-volume interval training. Articles in *APNM* have been particularly noteworthy in this regard, reporting a number of plausible mechanisms including increases in excess post-exercise oxygen consumption (Skelly et al. 2014), post-exercise fat oxidation (Islam et al. 2017), resting metabolic rate (Schubert et al. 2017) and post-exercise appetite suppression (Panissa et al. 2016).

There is also emerging interest in the perceptual and psychological responses to interval training in various individuals. Accumulating evidence suggests that low-volume interval training is perceived as enjoyable to many, with shorter intervals producing greater positive psychological perceptions and intentions to engage in SIT as compared to longer intervals (Townsend et al. 2017). Interval-based protocols have also been shown to improve selective

attention in children when performed in a classroom setting (Ma et al. 2015).

Continued work investigating the efficacy of interval training to improve health outcomes when performed outside of a laboratory is needed.

In summary, the topic of interval training for cardiometabolic health has attracted considerable interest among readers and contributors to *APNM*. Indeed, the potential for brief, repeated bursts of relatively intense exercise to improve indices of cardiometabolic health is no longer regarded as a novelty. Research examining the effect of various interval training protocols on specific physiological and behavioural outcomes will continue to advance the field and our understanding of different exercise prescriptions that can be applied to improve health in various individuals.

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