High-intensity interval training for health and performance: A polarized perspective

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It is well accepted that endurance exercise training of sufficient intensity and duration induces major adaptations in skeletal muscle that play an important role in the training-induced improvements in the ability to perform prolonged strenuous exercise (Hawley, 2002). However, the precise type and dose of exercise needed to enhance performance and/or induce health benefits are contentious. Observations from world-class endurance athletes indicate that outstanding performances have occurred following training regimens that place little emphasis on competition-specific intensity. A model of "polarized training" has been proposed in which athletes perform only a small portion of their training at competition/race-pace intensities, with the emphasis on low-intensity, high-volume workouts, and exposure to extreme high-intensity training sessions. The findings that "polarized" training enhances endurance performance are not without precedent. Over a decade ago we investigated the effects of different interval-training programs on simulated 40 km cycling time trial performance (Stepto *et al*., 1999). We found that interval training with work bouts close to race-pace (8 × 4 min at 85% of peak aerobic power output [PPO]) significantly enhanced performance (2.8%, 95% CI = 4.3-1.3%). Yet, to our surprise, supra-maximal work bouts (12 × 30 s at 175% of PPO) were just as effective in improving performance (2.4%, 95% CI = 4.0-0.7%). The apparent nadir in enhancement between 30 s and 4 min work bouts indicate that there is more than one mechanism by which interval training enhances performance lasting ~1 h. While "polarized" training describes the distribution of training intensity, it is worth noting that the total time spent at race pace can still be substantial due to the high overall training volume accumulated by most elite endurance athletes. With regard to health benefits, a growing body of evidence suggests that high-intensity interval training (HIT) can serve as an effective alternate to traditional endurance-based training, inducing similar or even superior physiological adaptations in healthy individuals and diseased populations, at least when compared on a matched-work basis (Gibala *et al*., 2012). HIT can also stimulate physiological remodeling comparable to moderate-intensity continuous training despite a substantially lower time commitment and reduced total exercise volume (Gibala *et al.*, 2012). In this regard, it may well be that HIT represents a form of "polarized training" for sedentary or unfit individuals. Certainly the unique genetic and/or molecular signature resulting from polarized training is a fertile area for future research. Indeed, directly linking exercise-induced signaling cascades in skeletal muscle to defined metabolic responses and specific changes in gene and protein expression that occur after diverse interval training regimens may provide clues as to why HIT is such a potent intervention for promoting health outcomes, while also enhancing athletic performance and exercise capacity.

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