



# The Advantages of High Intensity Training

## Aerobic high-intensity intervals improve VO<sub>2</sub>max more than moderate training

Helgerud J, HÅydal K, Wang E, Karlsen T, Berg P, Bjerkaas M, Simonsen T, Helgesen C, Hjorth N, Bach R, Hoff J. *Med Sci Sports Exerc*, 39(4): 665-71, 2007.

**PURPOSE:** The present study compared the effects of aerobic endurance training at different intensities and with different methods matched for total work and frequency. Responses in maximal oxygen uptake (VO<sub>2</sub>max), stroke volume of the heart (SV), blood volume, lactate threshold (LT), and running economy (CR) were examined. **METHODS:** Forty healthy, nonsmoking, moderately trained male subjects were randomly assigned to one of four groups: 1) long slow distance (70% maximal heart rate; HRmax); 2) lactate threshold (85% HRmax); 3) 15/15 interval running (15 s of running at 90-95% HRmax followed by 15 s of active resting at 70% HRmax); and 4) 4 x 4 min of interval running (4 min of running at 90-95% HRmax followed by 3 min of active resting at 70% HRmax). All four training protocols resulted in similar total oxygen consumption and were performed 3 d.wk for 8 wk. **RESULTS:** High-intensity aerobic interval training resulted in significantly increased VO<sub>2</sub>max compared with long slow distance and lactate-threshold training intensities (P<0.01). The percentage increases for the 15/15 and 4 x 4 min groups were 5.5 and 7.2%, respectively, reflecting increases in V O<sub>2</sub>max from 60.5 to 64.4 mL x kg(-1) x min(-1) and 55.5 to 60.4 mL x kg(-1) x min(-1). SV increased significantly by approximately 10% after interval training (P<0.05). **CONCLUSIONS:** High-aerobic intensity endurance interval training is significantly more effective than performing the same total work at either lactate threshold or at 70% HRmax, in improving VO<sub>2</sub>max. The changes in VO<sub>2</sub>max correspond with changes in SV, indicating a close link between the two.

## High-density lipoprotein cholesterol in young men

Musa DI, Adeniran SA, Dikko AU, Sayers SP. *J Str Cond Res*. 10.1519/JSC.0b013e318198fd28. Publish ahead of print 2009.

This study examined the impact of an 8-week program of high-intensity interval training on high-density lipoprotein cholesterol (HDL-C), total cholesterol (TC), and the atherogenic index (TC/HDL-C) in 36 untrained men ages 21-36 years. Participants were randomly assigned to an interval training group (n = 20) or a control group (n = 16). Participants in the experimental group performed 3.2 km of interval running (1:1 work:rest ratio) 3 times a week for 8 weeks at an intensity of 90% of maximal heart rate (~423 kcal per session). Results indicated significant pre- to posttraining changes in HDL-C (1.1 vs. 1.3 mmol.L, p < 0.0001) and TC/HDL-C (3.8 vs. 3.1, p < 0.0001) but no significant changes in TC (3.9 vs. 3.8 mmol.L, p > 0.05) with interval training. It was concluded that an 8-week program of high-intensity interval training is effective in eliciting favorable changes in HDL-C and TC/HDL-C but not TC in young adult men with normal TC levels. Our findings support the recommendations of high-intensity interval training as an alternative mode of exercise to improve blood lipid profiles for individuals with acceptable physical fitness levels.

## High-intensity aerobic interval training increases fat and carbohydrate metabolic capacities in human skeletal muscle

Perry CG, Heigenhauser GJ, Bonen A, Spriet LL. *Appl Physiol Nutr Metab*, 33(6):1112-23, 2008.

High-intensity aerobic interval training (HIIT) is a compromise between time-consuming moderate-intensity training and sprint-interval training requiring all-out efforts. However, there are few data regarding the ability of HIIT to increase the capacities of fat and carbohydrate oxidation in skeletal muscle. Using untrained recreationally active individuals, we investigated skeletal muscle and whole-body metabolic adaptations that occurred following 6 weeks of HIIT (~1 h of 10 x 4 min intervals at ~90% of peak oxygen consumption (VO<sub>2</sub> peak), separated by 2 min rest, 3 d.week-1). A VO<sub>2</sub> peak test, a test to exhaustion (TE) at 90% of pre-training VO<sub>2</sub> peak, and a 1 h cycle at 60% of pre-training VO<sub>2</sub> peak were performed pre- and post-HIIT. Muscle biopsies were sampled during the TE at rest, after 5 min, and at exhaustion. Training power output increased by 21%, and VO<sub>2</sub> peak increased by 9% following HIIT. Muscle adaptations at rest included the following: (i) increased cytochrome c oxidase IV content (18%) and maximal activities of the mitochondrial enzymes citrate synthase (26%), beta-hydroxyacyl-CoA dehydrogenase (29%), aspartate-amino transferase (26%), and pyruvate dehydrogenase (PDH; 21%); (ii) increased FAT/CD36, FABPpm, GLUT 4, and MCT 1 and 4 transport proteins (14%-30%); and (iii) increased glycogen content (59%). Major adaptations during exercise included the following: (i) reduced glycogenolysis, lactate accumulation, and substrate phosphorylation (0-5 min of TE); (ii) unchanged PDH activation (carbohydrate oxidation; 0-5 min of TE); (iii) ~2-fold greater time during the TE; and (iv) increased fat oxidation at 60% of pre-training VO<sub>2</sub> peak. This study demonstrated that 18 h of repeated high-intensity exercise sessions over 6 weeks (3 d.week-1) is a powerful method to increase whole-body and skeletal muscle capacities to oxidize fat and carbohydrate in previously untrained individuals.

# Effect of exercise training intensity on abdominal visceral fat and body composition

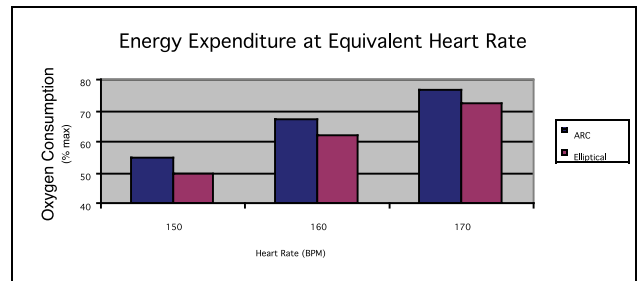
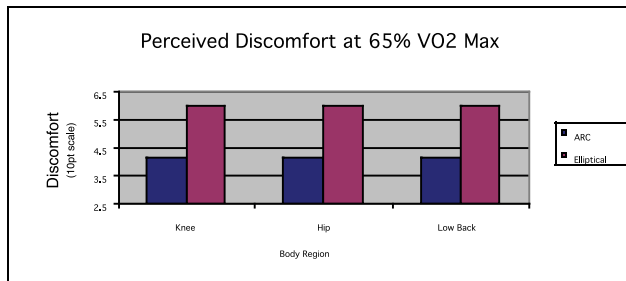
Irving BA, Davis CK, Brock DW, Weltman JY, Swift D, Barrett EJ, Gaesser GA, Weltman A. Med Sci Sports Exerc. 40(11):1863-1872, 2008.

The metabolic syndrome is a complex clustering of metabolic defects associated with physical inactivity, abdominal adiposity, and aging. **PURPOSE:** To examine the effects of exercise training intensity on abdominal visceral fat (AVF) and body composition in obese women with the metabolic syndrome. **METHODS:** Twenty-seven middle-aged obese women (mean +/- SD; age = 51 +/- 9yr and body mass index = 34 +/- 6 kg.m) with the metabolic syndrome completed one of three 16-wk aerobic exercise interventions: (i) no-exercise training (Control): seven participants maintained their existing levels of physical activity; (ii) low-intensity exercise training (LIET): 11 participants exercised 5 d.wk at an intensity <= lactate threshold (LT); and (iii) high-intensity exercise training (HIET): nine participants exercised 3 d.wk at an intensity > LT and 2 d.wk <= LT. Exercise time was adjusted to maintain caloric expenditure (400 kcal per session). Single-slice computed tomography scans obtained at the L4-L5 disc space and midthigh were used to determine abdominal fat and thigh muscle cross-sectional areas. Percent body fat was assessed by air displacement plethysmography. **RESULTS:** HIET significantly reduced total abdominal fat (P < 0.001), abdominal subcutaneous fat (P = 0.034), and AVF (P = 0.010). There were no significant changes observed in any of these parameters within the Control or the LIET conditions. **CONCLUSIONS:** The present data indicate that body composition changes are affected by the intensity of exercise training with HIET more effectively for reducing total abdominal fat, subcutaneous abdominal fat, and AVF in obese women with the metabolic syndrome.

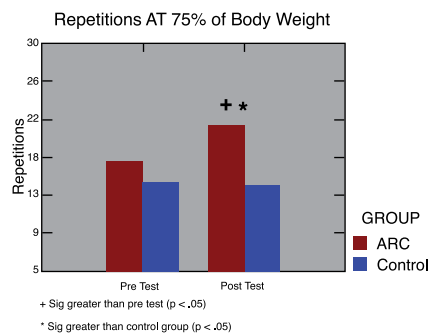
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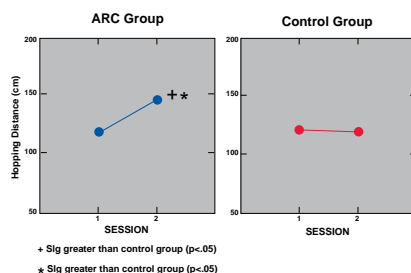


## High intensity training on the CYBEX Arc Trainer improves muscular endurance

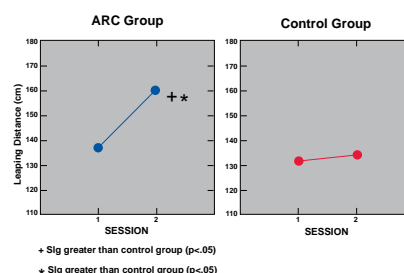


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