Tracking Workout "Afterburn" with Breezing™

High-intensity interval training (HIIT) is an aerobic training wherein short bouts of anaerobic exercise are interrupted with relatively similar or shorter rest periods. Each exercise interval begins before complete metabolic recovery, thereby ensuring increasing cardiovascular stress correlated to fat burning, beneficial immune response, and neuromuscular conditioning and growth [1]. A potentially useful measure of the efficiency of HIIT is **Excess Post-exercise Oxygen Consumption** (EPOC), also known as workout "afterburn". Clinical studies have shown up to 25% increase in oxygen consumption during this time, depending on the specific exercise routine and the performing individual [2, 3]. Tracking an individual's EPOC for various exercises is thus critical for evaluation of exercise efficiency. Traditionally, EPOC can only be measured at clinical or sport facilities. The introduction of Breezing™ Metabolism Tracker has made tracking of Resting Energy Expenditure (REE) and portions of the total EPOC available and affordable to everyone. This note summarizes a comprehensive study* of EPOC with Breezing™ Metabolism Tracker.

Study Method: A six-week long HIIT intervention was designed and overseen by a personal trainer and conducted with sedentary office workers. Evaluations included the capability of Breezing™ Metabolism Tracker to detect EPOC as well as to determine to what extent an individual's EPOC correlated with muscle growth.

The study involved 29 sedentary subjects (16 male and 13 female) of BMI between 17.3 and 31.8, and aged between 20 and 42 years. The subjects were placed in either a HIIT group (19 subjects) or control group (10 subjects), and dietary provisions were kept minimal and identical. Pre- and post-study body composition analyses were performed via Martin's 7-skinfold and 6-perimeter measurement and calculation methods [4, 5]. Each session of HIIT lasted 4 minutes, consisting of 8 sets of 20-seconds kettle bell thrusters or sandbag front squats with 10-seconds seated rest between sets. Each midday session was conducted near the lunch break (12:00 pm) on Mon, Wed, and Fridays. All subjects in the study measured a resting, pre- and several post-HIIT energy expenditures (EE) using a Breezing™ Metabolism Tracker. By the completion of the 4-minute session, each intervention subject's heart rate reached maximum, defined as 220 bpm – subject age; the first post-HIIT EE was measured once heart rate dropped to half of the maximum and breathing frequency returned to comfortable, resting value.

Results: Fig. 1 compares EE changes (denoted as ΔEE) for the intervention (red, and blue) vs. control (grey) groups. The average ΔEE on a day** with HIIT (red) was ~110 kCal/day greater than a day without HIIT (blue) for the intervention group and ~141 kCal/day greater than that of the control group (grey); these HIIT-utilized calories correlated strongly ($t=-2.70$, $DF=19$, $p=0.01$) with increased muscle mass vs. insignificant changes in the control group. Lastly, HIIT subjects showing a > 6.1% increase in muscle mass also demonstrated

higher EPOC (average 241 kCal/day, SEM = 77) whereas HIIT subjects showing < 1.1% increased muscle mass averaged 70 kCal/day, SEM = 58 (α = 0.20).

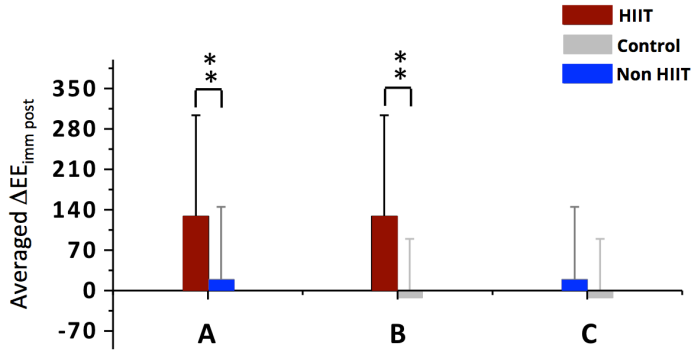

Figure 1. Average changes of EE (ΔEE) in HIIT group immediately following training is represented by red bars and are compared in A) to non-training days (Non HIIT: blue bars) and in B) to the control group. In C), non-HIIT days are compared to control group (ΔEE).

Conclusions: High-intensity interval training results in bursts of energy expenditure, the effect of which can be measured by Breezing™ Metabolism Tracker. This study provides a backbone for testing all exercise strategies purported to boost EPOC, and overall, offers cost effective, mobile, and personalized reliable measurements of energy expenditure.

*Conducted and processed in the Center for Bioelectronics and Biosensor, Biodesign Institute, Arizona State University, in collaboration with Troy Anderson (http://atscoaching.com).

*** Average ΔEE on a day represents the difference of EE measures assessed in units of "kCal/day" at given point of times before and after first post-HIIT condition.*

References

[1] W. D. McArdle, F. I. Katch, and V. L. Katch, "Exercise Physiology: Energy, Nutrition, & Human Performance," *Lippincott Williams & Wilkins,* 2007.

[2] J. Speakman and C. Selman, "Physical activity and resting metabolic rate," *Proceedings of the Nutrition Society,* vol. 62, pp. 621–634, 2003.

[3] M. M. Manore, N. L. Meyer, and J. Thompson, "Sport Nutrition for Health and Performance," *Human Kinetics (Ed.),* vol. Second Edition, 2009.

[4] A. D. Martin, W. D. Ross, D. T. Drinkwater, and J. P. Clarys, "Prediction of body-fat by skinfold caliper - assumptions and cadaver evidence," *International Journal Of Obesity,* vol. 9, pp. 31-39, 1985.

[5] R. Lee, Z. Wang, M. Heo, R. Ross, I. Jansen, and S. T. Heymsfield, "Total body-skeletal muscle mass: development and cross-validation of anthropometric prediction models.," *Am J Clin Nutr* vol. 72, p. 796e803, 2000.