# A Comparison of High-Intensity Interval Running and TABATA on Post-Exercise Metabolism: A Pilot Analysis

Lauren Pate, David J. Buckley, B.S., Henry Gebhardt, B.S., Tyler McHenry B.S., and James Rowe, Ph.D.

Human Performance Lab; Department of Kinesiology and Health Science; Stephen F. Austin State University; Nacogdoches, TX

*Category: Undergraduate*

## Introduction

- It is well established that energy expenditure following exercise (EPOC) remains elevated above resting values for a period of time (3).
- The magnitude and duration of this elevation may be primarily dependent on exercise intensity, with exercise duration and expenditure having a smaller influence (3, 6).
- Short durations (≤ 30 minutes) of high-intensity interval exercise (HIIE) is becoming a popular alternative for individuals who have limited time to exercise (5).
- When compared to rest, short-duration HIIE has been reported to elicit similar elevations in EPOC when compared to longer bouts of moderate-intensity continuous exercise (MICE) (1).
- Tabata is type of HIIE that consists of 7–8 exhaustive sets of 20 seconds of high-intensity exercise with a 10-second rest between the exercise bouts and can last between 4 – 30 minutes (1, 4).
- Tabata has traditionally been performed on stationary bicycles but recent Tabata regimens have started to utilize total body calisthenics without the use of any equipment (2).
- It is unclear how Tabata performed using body calisthenics would influence EPOC when compared to performing HIIE using equipment.
- The purpose of this study was to compare EPOC following a bout of total body Tabata and a bout of high-intensity interval running (HIIR) of similar intensity and duration.

## Methods

- Participants were recreationally active individuals (n = 7 {6F, 1M}; age = 22.2 ± 2.1 yrs; body mass = 64.2 ± 12.0 kg; body fat% = 26.2±3.1).
- Each participant completed 1) a rest bout, 2) a Tabata bout using only body callisthenic exercises, and 3) a bout of high-intensity interval running (HIIR) on a motorized treadmill.
- Each participant performed each of the 3 bouts on separate days with at least 7 days in between bouts.
- Two weeks prior to their first bout, each participant completed a graded maximal running test on the treadmill to determine the participants maximum heart rate.
- The running test began at 6.0 mph with a 2% incline. The speed was increased by 0.5 mph every 2 minutes until the participant reached volitional fatigue. The 2% incline was maintained during the entire test.
- One week following the running test, participants returned to the lab (on 2 separate days) to be familiarized with the Tabata and HIIR bouts prior to beginning the study.

## Methods Continued

- Once the study began, each participant abstained from exercise and replicated their dietary intake 24 hours before each bout.
- Each bout was performed in the morning and was conducted 1 - 2 hours after the participants had completed their breakfast. The breakfast and the time between the completion of the breakfast and the start of each bout was replicated for all three bouts.
- The Tabata protocol was performed before the HIIR protocol because these two protocols were set up to be performed at the same intensity. The participants' average heart rate (HR) from their Tabata bout was used to estimate the speed required to the achieve the same average HR during the HIIR.
- Therefore, the order of this study was randomly assigned in sequence as Tabta→HIIR→CS, Tabata→CS→HIIR, or CS→Tabata→HIIR.
- All bouts (Rest, Tabta, and HIIR) were performed for 25 minutes.
- Tabata involved performing repeated bouts of total body calisthenics at maximal effort for 20 seconds followed with 10 seconds of rest.
- HIIR involved repeated bouts of running at approximately the same average HR as the Tabata for 1 minute followed with 1 minute of walking at a self-selected pace.
- Approximately 3 minutes following the completion of each bout, the participants' metabolic rate (MR) was assessed using a Parvo Metabolic Cart in 10 minute intervals over the next 70 minutes.
- The MR assessment included calculating the participants' VO2 (l/min), respiratory exchange ratio (RER), fat oxidation (total grams), carbohydrate oxidation (total grams), and total energy expended (TEE) over the 70 minutes post-exercise.

## Statistical Design

- Significant differences ($p<.05$) between sessions were determined using a one-way, repeated measures ANOVA and Bonferroni post-hoc test.
- Significant differences ($p<.05$) in the heart rate (beats per min) between the Tabata and HIIR were determined using a student's paired T-test.

**TABATA**

**HIIR**

## Results

| Session 1 | | | | | | |
|---|---|---|---|---|---|---|
| Round 1 | High Knees | Plank Punch | Jumping Jacks | Side Skaters | HR | RPE |
| Round 2 | Repeat | Repeat | Repeat | Repeat | | |
| **Rest for 1-minute (walk around)** | | | | | | |
| **Session 2** | | | | | | |
| Round 1 | Split Squat-Floor Touch | Bicycle Abs | Ski Jumps | Push Ups | HR | RPE |
| Round 2 | Repeat | Repeat | Repeat | Repeat | | |
| **Rest for 1-minute (walk around)** | | | | | | |
| **Session 3** | | | | | | |
| Round 1 | Burpees | 90 degree crunches | Squats | Lunges (alternate legs) | HR | RPE |
| Round 2 | Repeat | Repeat | Repeat | Repeat | | |
| **Rest for 1-minute (walk around)** | | | | | | |
| **Session 4** | | | | | | |
| Round 1 | Mountain Climbers | Diamond Push Ups | Side-to-Side High Knees | Jump Squats | HR | RPE |
| Round 2 | Repeat | Repeat | Repeat | Repeat | | |
| **Rest for 1-minute (walk around)** | | | | | | |
| **Session 5** | | | | | | |
| Round 1 | Climbing Rope | Supine Leg Raises | Core Push Ups | Switch Jump Squats | HR | RPE |
| Round 2 | Repeat | Repeat | Repeat | Repeat | | |

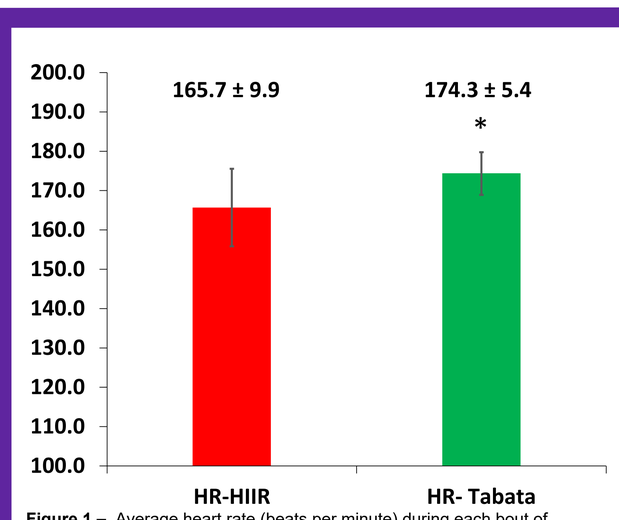


**Figure 1 –** Average heart rate (beats per minute) during each bout of exercise. * Tabata was significantly different from HIIR ($p$=.027; ES=1.1). Values are reported as mean ± standard deviation.

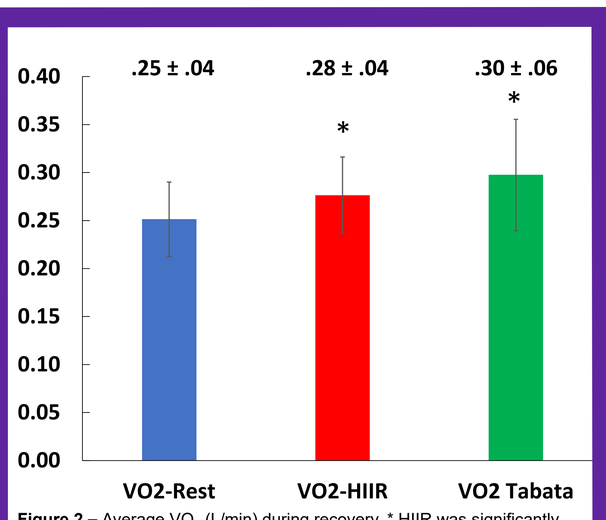


**Figure 2 –** Average $VO_2$ (L/min) during recovery. * HIIR was significantly different from Rest ($p$=.026; ES=.75). * Tabata was significantly different from Rest ($p$=.007; ES=.98). Values are reported as mean ± standard deviation.

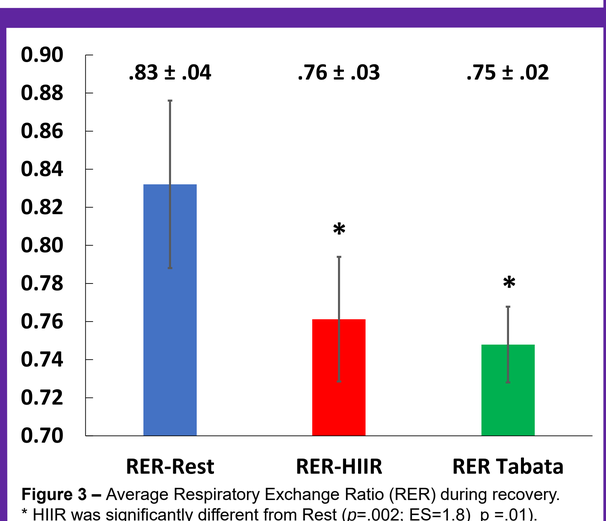


**Figure 3 –** Average Respiratory Exchange Ratio (RER) during recovery. * HIIR was significantly different from Rest ($p$=.002; ES=1.8) p =.01). * Tabata was significantly different from Rest ($p$=.01; ES=2.5) Values are reported as mean ± standard deviation.

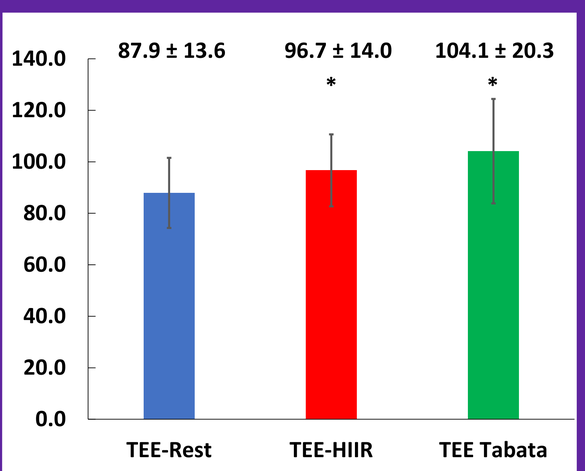


**Figure 4 –** Total Energy Expenditure (TEE) during Recovery. * HIIR was significantly different from Rest ($p$=.026; ES= .64). * Tabata was significant different from Rest ($p$=.008; ES=.94). Values are reported as mean ± standard deviation.

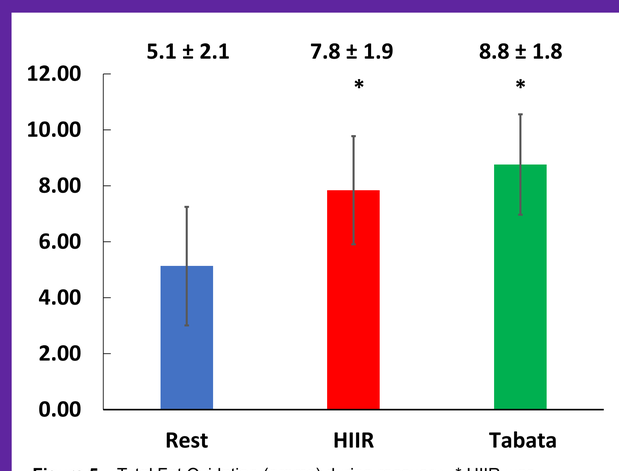


**Figure 5** – Total Fat Oxidation (grams) during recovery. * HIIR was significantly different from Rest ($p$<.001;ES=1.3). * Tabata was significantly different from Rest ($p$=.001;ES=1.9). Values are reported as mean ± standard deviation.

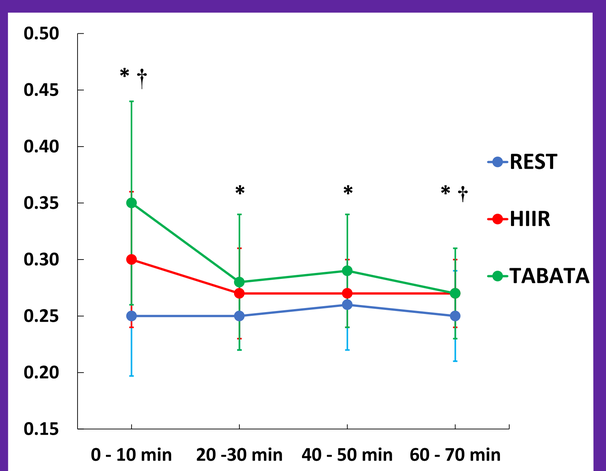


**Figure 6 –** Average $VO_2$ (liters per min) Across Time (70 minutes) during recovery. * Tabata was significantly different than Rest (p<.05). † HIIR was significantly different from Rest (p<.05).

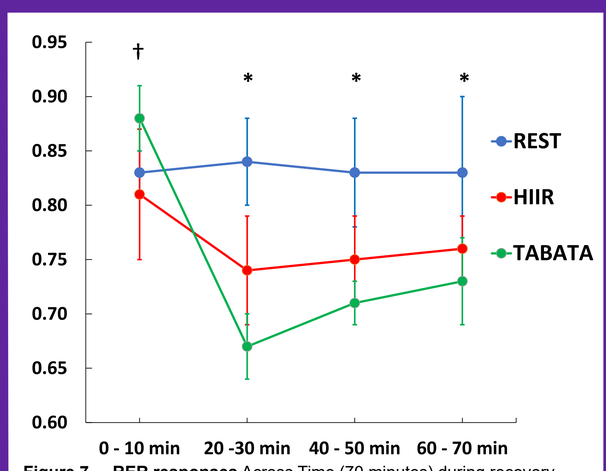


**Figure 7 – RER responses** Across Time (70 minutes) during recovery. † Tabata was significantly different than both Rest and HIIR (p<.05). * Rest was significantly different from both HIIR and Tabata ($p$<.05). Values are reported as mean ± standard deviation.

## Conclusions

- Despite the significant differences in heart rate between HIIR and Tabata both exercise bouts elicited similar changes in post-exercise metabolism when compared to rest.
- The increased rate of fat oxidation and the increased energy expenditure following exercise was comparable between HIIR and Tabata.
- Both HIIR and Tabata might be lifestyle practices that promote healthy weight management and may minimize the risk of obesity.
- The small sample size and short metabolic assessment period limits the application of our results.
- A larger sample size and an expanded assessment period could better clarify the effectiveness of these exercises.

## Literature Cited

1. Ahlert, M., Matzenbacher, F., Albarello, J. C. D. S., & Halmenschlager, G. H. (2019). Comparison of epoc and recovery energy expenditure between hiit and continuous aerobic exercise training. Revista Brasileira de Medicina do Esporte, 25(1), 20-23.
2. Emberts, T., Porcari, J., Dobers-tein, S., Steffen, J., & Foster, C. (2013). Exercise intensity and energy expenditure of a tabata workout. Journal of sports science & medicine, 12(3), 612.
3. Phelain, J. F., Reinke, E., Harris, M. A., & Melby, C. L. (1997). Postexercise energy expenditure and substrate oxidation in young women resulting from exercise bouts of different intensity. Journal of the American College of Nutrition, 16(2), 140-146.
4. Tabata, I. (2019). Tabata training: one of the most energetically effective high-intensity intermittent training methods. The Journal of Physiological Sciences, 1-14.
5. Thompson, W. R. (2017). Worldwide survey of fitness trends for 2018: the CREP edition. ACSM's Health & Fitness Journal, 21(6), 10-19.
6. Wu, B. H., & Lin, J. C. (2006). Effects of exercise intensity on excess postexercise oxygen consumption and substrate use after resistance exercise. Age (yr), 20(1), 8.