Speed- and Circuit-Based High-Intensity Interval Training on Excess Post-Exercise Oxygen Consumption

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ABSTRACT

Background: Due to the current obesity epidemic in the United States, there is growing interest in efficient, effective ways to increase energy expenditure and weight loss. Research has shown that high-intensity exercise elicits a higher Excess Post-Exercise Oxygen Consumption (EPOC) throughout the day compared to steady-state exercise. Currently, there is no single research study that examines the differences in EPOC resulting from high-intensity interval training (HIIT) modalities. **Purpose:** The purpose of this study is to review the impact of circuit training (CT) and speed interval training (SIT), on EPOC in both regular exercising and sedentary populations. **Methods**: A total of 24 participants were recruited from the UW-Eau Claire campus and divided into regularly exercising and sedentary groups, according to self-reported physical activity levels. Oxygen consumption was measured during and after two HIIT sessions, which was used to estimate caloric expenditure. **Results**: There was no significant difference in caloric expenditure among individuals who regularly exercise and individuals who are sedentary. There was also no significant difference in EPOC between sedentary individuals and those who regularly exercise or between SIT and CT. However, there was a significantly higher caloric expenditure from SIT compared CT in both groups. **Conclusion:** Individuals do not need to complete one modality of HIIT (SIT or CT) over the other to have a greater influence on EPOC.

BACKGROUND

- Prolonged sedentary behavior and obesity resulting from physical inactivity pose threats to overall health and contribute to a cascade of chronic conditions over the lifespan.
- The American College of Sports Medicine's (2015) exercise guidelines recommend that most American adults perform planned, structured aerobic physical activity for at least 30 min at moderate intensity on at least 3 days/wk for the past 3 months. This can be accumulated through ≥10 minute bouts of exercise and contain both moderate and vigorous intensity activities (Garber, Blissmer, Deschenes, et al., 2011).
- EPOC is referred to as an increased metabolism during recovery from a session of exercise. This increase in metabolism after exercise is due to oxygen debt and the thermic effect of activity, both of which are large contributors to the energy cost of exercise. There is a correlational relationship between exercise intensity and the extent of one's EPOC for certain exercise durations (Gore, Laforgia, & Withers, 2006).
- EPOC and energy expenditure support HIIT as a more effective, efficient form of exercise when compared to steady-state exercise.
- According to Batterham, Hopkins, Taylor, & Weston (2014), increased exercise intensity with HIIT elicits a higher VO_{2max} than steady-state exercise in healthy, active adults. Since VO_{2max} is directly correlated to intensity, a higher intensity elicits a higher EPOC (Gore et al., 2006).

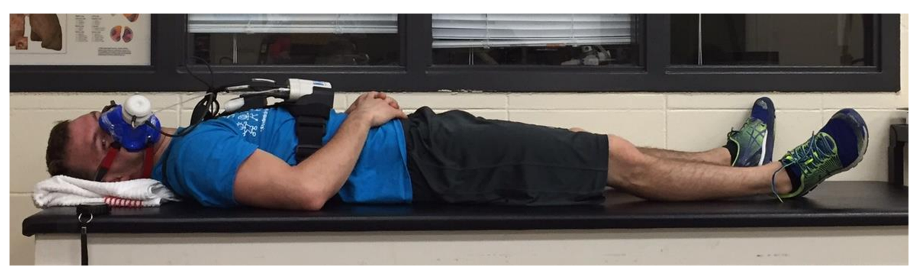
PURPOSE

The purpose of this study is to review the impact of two HIIT modalities, circuit-training (CT) and speed interval-training (SIT), on EPOC in those who exercise regularly and those who are sedentary.

METHODS

Instrumentation

- Cosmed K_4B_2 was used to analyze oxygen consumption during and after exercise.
- Polar T-31 Coded heart rate monitor was used to monitor heart rate during exercise.



Subjects

- Participants were randomly selected and categorized into regular exercisers and sedentary individuals based off of their questionnaire results.
- Once participants were classified into groups, days 2 and 3 were randomized to determine which modality the participants would complete first.

Table 1. Sample Population

	M	*SD*
Age (years)	21.3	2.5
Height (in.)	67.9	3.8
Weight (lbs.)	164.2	35.3
Resting Heart Rate (bpm)	67.6	5.9
85% Heart Rate Reserve	173.6	2.3

Sex	62% Female	38% Male
Groups	n=14 Regular Exercise	n=10 Sedentary

- In the circuit training sessions, participants completed a circuit routine with a 1:1 work-to-rest ratio, which consisted of completing ten 30-sec aerobic-based circuit exercises, each followed by 30-sec of active rest (Baudry & Roux, 2009). Refer to Figures 2 and 3 for details on the 5 aerobic-based exercises and CT session procedure.

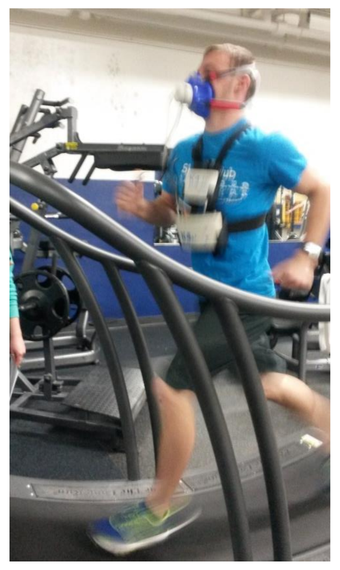


Figure 1. SIT

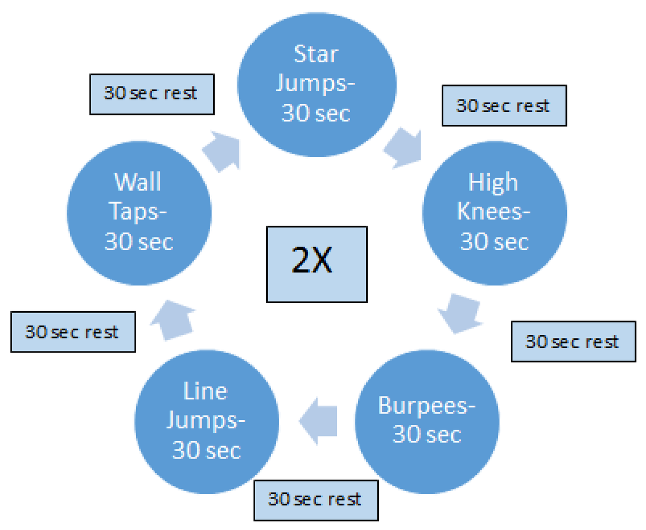


Figure 2. CT Routine

Figure 3. CT

- During each exercise session, participants were required to reach at least 85% of their HRR during the 30-sec exercise bout (Anshel et al., 2006). After each 30-sec exercise bout, heart rate and RPE were collected, including speed for the SIT.
- Once the 10-min exercise session was completed, participants laid down in the supine position for 30-min of passive recovery to collect EPOC.
- A 2x2 factorial repeated measures ANOVA was employed using SPSS software to analyze caloric expenditure during and caloric expenditure post-exercise.

ACKNOWLEDGEMENTS

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RESULTS

Table 2. Means and Standard Errors of Caloric Expenditure During Exercise Sessions by Groups

Group	Modality	Mean	Standard Error	95% Confidence Interval Lower-Bound	95% Confidence Interval Upper-Bound
Regular Exercise	SIT	94.23	8.02	77.23	111.24
	CT	76.15	6.41	62.57	89.73
Sedentary	SIT	83.93	10.06	62.60	105.25
	CT	67.29	8.03	50.27	84.32

*Note: Kcals calculated from VO2 ($ml \cdot min^{-1}/1000$)5

Table 3. Means and Standard Errors of Caloric Expenditure During Post-Exercise Sessions by Groups

Group	Modality	Mean	Standard Error	95% Confidence Interval Lower-Bound	95% Confidence Interval Upper-Bound
Regular Exercise	SIT	65.64	7.94	48.80	82.48
	CT	70.04	10.71	47.33	92.76
Sedentary	SIT	66.19	9.96	45.08	87.30
	CT	62.06	13.43	33.59	90.53

*Note: Kcals calculated from VO2 ($ml \cdot min^{-1}/1000$)5

- Using an alpha of .05, the two-way repeated measures ANOVA indicated that modality (SIT, CT) and group (regular exercise, sedentary) provided no significant interaction effect in EPOC.
- SIT expended a greater amount of kcals during exercise when compared to CT in both regular exercise and sedentary groups.

SUMMARY AND CONCLUSIONS

- We conclude that individuals do not need to complete one modality (SIT or CT) over the other to have a greater influence on EPOC
- If overall energy expenditure is the focus, SIT is more effective.

Limitations and Future Research

- The small sample size limited the possibilities for potential trends to develop into statistically significant data.
- Caloric expenditure was estimated using a predictive equation, which does not result in exact energy expenditure measurements.
- Future research should study the effect of HIIT modalities on EPOC with larger sample sizes and use respiratory exchange ratio to determine exact energy expenditure.

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