

Alterations in Sprint Duration and Intensity During Reduced-Exertion High-Intensity Interval Training and the Effects on VO₂max and Resting Blood Pressure in College-Aged Individuals

Reese Michaels and John Zajac

Faculty Sponsor: Dr. Candace Receno

Department of Exercise Science and Athletic Training

Ithaca College, Ithaca, NY

ABSTRACT

High-intensity interval training (HIIT) has become a popular alternative to traditional continuous moderate-intensity (MICT) methods of exercise and provides benefits from a time-efficiency standpoint by significantly reducing the duration of a single exercise session, serving as an attractive option for time-limited individuals. Despite the reduction in training time, interval training has shown to be effective in significantly increasing aerobic fitness capacity (VO₂max) among participants (1,2) as well as lowering resting blood pressure (6,8,9,10). HIIT is commonly perceived as more enjoyable than MICT and provides similar benefits (3,4,5), but HIIT may be perceived as too intensive for some populations. Reduced-exertion high-intensity interval training (REHIT) is a fairly new training modality intended to target similar health and fitness benefits as HIIT while minimizing sprint bout duration, frequency, and intensity, to an even greater extent, making it a convenient training method for all individuals. Despite the low-

volume, low-duration approach of REHIT compared to HIIT, this training style has demonstrated significant improvements in participant aerobic fitness capacity (2,6,7), as well as resting blood pressure (6,8). The low-volume and decreased time commitment of REHIT could make this an ideal training approach for busy and/or lesser trained individuals without compromising improvements to health. This study aimed to determine if altering REHIT protocols, by lowering workload and/or interval duration, from those previously studied would still yield significant improvements in participant aerobic fitness and resting blood pressure. Previous literature has shown that REHIT protocols of 2 x 20s sprint intervals at workloads of 7.5% bodyweight (BW) elicit significant improvements in participant VO_2max (2), but little to no investigation has been done on workloads between 4-5% and sprint intervals of 15-seconds in duration. However, 10-second sprint intervals have been investigated and show no significant improvements in VO_2max (2). Therefore, studying a 15-second REHIT group and lower intensity workloads may be useful in determining a more efficient REHIT program that still produces significant improvements in VO_2max with potential benefits to resting blood pressure. Data was collected as part of a larger study where eighteen college-aged individuals (n=12 male, n=6 female) with a mean baseline VO_2max of 38.6 mL/kg/min were randomized into one of three REHIT training groups: [1] 2 x 20s sprint intervals at a workload of 5%BW, [2] 2 x 20s sprint intervals at a workload of 4%BW, and [3] 2 x 15s sprint intervals at a workload of 5%BW. For all groups, REHIT was done on a cycle ergometer with training sessions conducted 3 times per week for 4 weeks with 24-hours of rest between each session. To assess exercise-induced changes in VO_2max , participants performed graded exercise tests (GXT) on a cycle ergometer pre- and post-training. Changes to resting blood pressure were measured via an electronic blood pressure monitor cuff. In a seated position and resting state, participants had three separate measurements taken on the same day

before and after the 4-week training, with the average of the three measurements used to compare any changes between pre- and post-training resting blood pressure. Vertical jump height, psychological, and anthropometric measures were also taken for each participant to assess any additional health benefits resultant from REHIT. Data analyses are currently ongoing, but the primary expectation is an increase in aerobic fitness capacity, on average, among all participants of the study regardless of group. Additionally, it is also expected there will be an average decrease in resting systolic and diastolic blood pressure among participants in this study based on previous decreases in resting blood pressure observed in published REHIT and interval-based training studies (8,9,10). Group-specific VO₂max results from this study could contribute to determining the most efficient REHIT protocol. If each group exhibits a similar average significant increase in VO₂max from pre- to post-training, it may be deduced that a 15-second REHIT program elicits the greatest fitness benefits from a time-efficiency perspective and that a 4% bodyweight resistance REHIT program elicits similar benefits from a reduced-intensity perspective but requires longer sprint intervals. Regardless of the outcome, results from this study will contribute to what has been investigated on REHIT already by suggesting low-end cutoffs for effective and/or ineffective protocol metrics to increase participant aerobic fitness capacity, ultimately determining the most efficient REHIT protocol(s).

Works Cited

1. Gross, M., Swensen, T., & King, D. (2007). Nonconsecutive- versus consecutive-day high-intensity interval training in cyclists. *Medicine and science in sports and exercise*, 39(9), 1666–1671. <https://doi.org/10.1249/mss.0b013e3180cac209>
2. Nalçakan, G. R., Songsorn, P., Fitzpatrick, B. L., Yüzbasioglu, Y., Brick, N. E., Metcalfe, R. S., & Vollaard, N. B. J. (2018). Decreasing sprint duration from 20 to 10 s during reduced-exertion high-intensity interval training (REHIT) attenuates the increase in maximal aerobic capacity but has no effect on affective and Perceptual Responses. *Applied Physiology, Nutrition, and Metabolism*, 43(4), 338–344. <https://doi.org/10.1139/apnm-2017-0597>
3. Heisz, J. J., Tejada, M. G., Paolucci, E. M., & Muir, C. (2016). Enjoyment for High-Intensity Interval Exercise Increases during the First Six Weeks of Training: Implications for Promoting Exercise Adherence in Sedentary Adults. *PloS one*, 11(12), e0168534. <https://doi.org/10.1371/journal.pone.0168534>
4. Jung, M. E., Bourne, J. E., & Little, J. P. (2014). Where does HIT fit? An examination of the affective response to high-intensity intervals in comparison to continuous moderate- and continuous vigorous-intensity exercise in the exercise intensity-affect continuum. *PloS one*, 9(12), e114541. <https://doi.org/10.1371/journal.pone.0114541>

5. Martinez, N., Kilpatrick, M. W., Salomon, K., Jung, M. E., & Little, J. P. (2015). Affective and Enjoyment Responses to High-Intensity Interval Training in Overweight-to-Obese and Insufficiently Active Adults. *Journal of sport & exercise psychology*, 37(2), 138–149. <https://doi.org/10.1123/jsep.2014-0212>
6. Cuddy, T. F., Ramos, J. S., & Dalleck, L. C. (2019). Reduced Exertion High-Intensity Interval Training is More Effective at Improving Cardiorespiratory Fitness and Cardiometabolic Health than Traditional Moderate-Intensity Continuous Training. *International journal of environmental research and public health*, 16(3), 483. <https://doi.org/10.3390/ijerph16030483>
7. Metcalfe, R. S., Babraj, J. A., Fawkner, S. G., & Vollaard, N. B. (2012). Towards the minimal amount of exercise for improving metabolic health: beneficial effects of reduced-exertion high-intensity interval training. *European journal of applied physiology*, 112(7), 2767–2775. <https://doi.org/10.1007/s00421-011-2254-z>
8. Ruffino, J. S., Songsorn, P., Haggett, M., Edmonds, D., Robinson, A. M., Thompson, D., & Vollaard, N. B. (2017). A comparison of the health benefits of reduced-exertion high-intensity interval training (REHIT) and moderate-intensity walking in type 2 diabetes patients. *Applied physiology, nutrition, and metabolism = Physiologie appliquee, nutrition et metabolisme*, 42(2), 202–208. <https://doi.org/10.1139/apnm-2016-0497>
9. Skutnik, B. C., Smith, J. R., Johnson, A. M., Kurti, S. P., & Harms, C. A. (2016). The Effect of Low Volume Interval Training on Resting Blood Pressure in Pre-hypertensive

Subjects: A Preliminary Study. *The Physician and sportsmedicine*, 44(2), 177–183.

<https://doi.org/10.1080/00913847.2016.1159501>

10. Grace, F., Herbert, P., Elliott, A. D., Richards, J., Beaumont, A., & Sculthorpe, N. F. (2018). High intensity interval training (HIIT) improves resting blood pressure, metabolic (MET) capacity and heart rate reserve without compromising cardiac function in sedentary aging men. *Experimental Gerontology*, 109, 75–81.

<https://doi.org/10.1016/j.exger.2017.05.010>