



Biomarkers of Maximal Oxygen Consumption: a comparison between responders and non-responders to high-intensity interval and continuous endurance training

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Abstract

Even though the recommendations for aerobic levels enhancements can promote benefits for the majority of people, the cardiorespiratory fitness (CRF) responses may vary from individual to individual, from non-responder up to high responder after traditional continuous endurance training (CET). In this sense, current studies have been reported the high-intensity interval training (HIIT) to be more effective than CET to improve CRF. Therefore, the aim of this study was to compare the incidence of CRF non-responders between CET and HIIT. Sixty-nine healthy young men (18-30 years old), were randomized in two 8 weeks exercise programs: CET (3-4 times/week, 40 min/day at 70-75% of heart rate reserve (HRR)) or HIIT (3-4 times/week, 40 min/day of 5 x 4:3 sets at 50-90% of HRR). The incidence of CRF non-responders to HIIT was lower in comparison to CET (5.8% vs. 22.8%, respectively, $P = 0.045$). These results indicate the current guidance for prescribing exercise may not be sufficient to improve CRF for a substantial proportion of healthy young men and the HIIT to be an alternative method to minimize the incidence of CRF non-responders to CET.

Key words: Endurance Training, Responsivity, Non-Responder

Introduction

Cardiorespiratory fitness (CRF) is an established predictor of cardiovascular disease and all-cause mortality¹. It is recognized that CRF improves as a result of exposure to endurance exercise training and is determined by the maximal oxygen consumption (VO_{2MAX}). Currently, the American College of Sports Medicine (ACSM) Position Stand recommends that in healthy adults exercising at moderate intensity for 150 minutes per week or at vigorous intensity for 75 minutes per week for developing and maintaining CRF². Despite this, there is an enormous interindividual variability in the ability to improve CRF in response to regular exercise in a range from 0 (non-responder) to 1 L of oxygen (high responders), mainly after traditional continuous endurance training (CET) programs³⁻⁵. More recently, studies have been reported the high-intensity interval training (HIIT) to be more effective than CET to improve CRF. However, it is unknown if HIIT can minimize the incidence of CRF non-responders. Therefore, the aim of this study was to compare the incidence of CRF non-responders between CET and HIIT programs.

Results and Discussion

Sixty-nine healthy young men (18-30 years old), physically inactive, were randomized in two 8 weeks exercise programs: CET ($n = 35$, 3-4 times/week, 40 min/day at 70-75% of heart rate reserve (HRR)) or HIIT ($n = 34$, 3-4 times/week, 40 min/day composed by 5 bouts of 4 min at 90% of HRR intercalated with 3 min at 50% of HRR) using a cycle ergometer. The VO_{2MAX} was measured during a maximal incremental exercise pre (test and re-test) and post both training programs. Non-responders were defined as any change in CRF, determined by VO_{2MAX} , within two typical error ($2 \times TE$) of measurement ($\pm 242 \text{ ml}\cdot\text{min}^{-1}$)³. The comparison of the incidence of non-responders between CET and HIIT was performed using Chi-Square Test. The significance

criterion adopted was 5% ($P < 0.05$). The results are presented in the Figure 1.

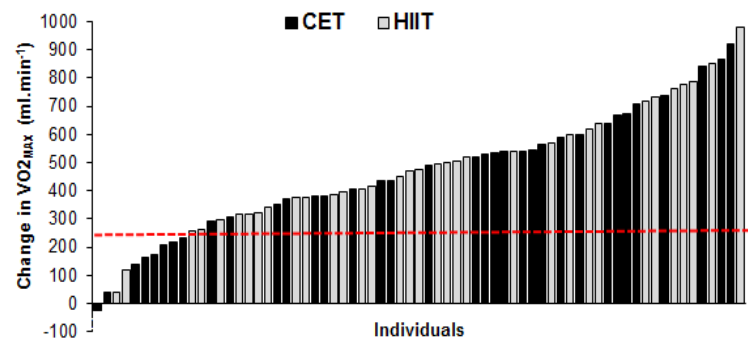


Figure 1. Individual changes in maximal oxygen consumption (VO_{2MAX}) after continuous endurance training (CET) and high-intensity interval training (HIIT). The red line represents two typical error ($2 \times TE$) of measurement. Values below this line ($< 242 \text{ ml}\cdot\text{min}^{-1}$) represent CRF non-responder subjects. Non-responders were 22.8% (8 of 35) and 5.8% (2 of 34) for CET and HIIT, respectively. The incidence of non-responders to HIIT was lower in comparison to CET ($P = 0.045$).

Conclusions

The current guidance for prescribing exercise may not be sufficient to improve CRF for a substantial proportion of healthy young men and the HIIT is suggested as an alternative method to minimize the incidence of CRF non-responders to CET.

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¹ Kodama, S. et al. *JAMA*, **2009**, 20, 2024.

² Garber, C. E. et al. *Med Sci Sports Exerc*, **2011**, 43, 1334.

³ Bouchard, C. et al. *Plos One*, **2012**, 7, e37887.

⁴ Bouchard, C.; Rankinen, T. *Med Sci Sports Exerc*, **2001**, 33, S446.

⁵ Sisson, S. B. et al. *Med Sci Sports Exerc*, **2009**, 41, 539.

⁶ Milanovic, Z.; Sporis, G.; Weston, M. *Sports Med*, **2015**, 45, 1469.