

**High-intensity interval training may reduce in-stent restenosis following percutaneous coronary intervention with stent implantation: A randomized controlled trial evaluating the relationship to endothelial function and inflammation. Am Heart J 2009;158:734-41**

*Dear Editor:*

The paper of Munk et al<sup>1</sup> adds potential reduction of in-stent restenosis to the list of the multiple benefits of high-intensity aerobic interval training (HIIT) in a broad spectrum of patients with cardiovascular disease, which have been extensively studied by several Norwegian groups.<sup>2</sup>

The training protocol was similar to that used in previous studies<sup>2</sup> and consisted of four 4-minute exercise intervals at an intensity corresponding to 80% to 90% of maximal heart rate alternating with 3-minute active recovery intervals at 60% to 70% of maximal heart rate. We would like to outline 3 limitations regarding the Norwegian HIIT protocol in patients taking part in a cardiovascular rehabilitation program.

First, the use of target heart zones may not be the most optimal way to monitor exercise intensity in HIIT,<sup>3</sup> particularly in patients with CAD, who require frequent titration of medications including  $\beta$ -blockers or calcium-channel blockers. Monitoring running velocity or cycling workload at an intensity corresponding to a percentage of  $VO_2$ max would represent a more reliable method.

Second, a recent study from our group examining the acute cardiopulmonary responses during HIIT in patients with CAD suggests that shorter intervals (15 seconds) at maximal aerobic workload interspersed with passive recovery periods may provide a more optimal balance between patient comfort, safety, and maintenance of high percentage of  $VO_2$ max.<sup>4</sup>

Finally, HIIT was not associated with serious complications in the study of Munk et al<sup>1</sup> and others that included mostly low-risk subjects.<sup>2</sup> However, in higher risk patients with more severe CAD or with heart failure who would benefit the most from HIIT in terms of

improvement of functional capacity and reduction of morbidity,<sup>5</sup> its safety has not been firmly established. Therefore, further studies are required and should include a larger number of higher risk patients with monitoring of the electrocardiogram and measurement of markers of myocardial necrosis before considering implementation of this attractive modality of aerobic training into clinical practice.

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## References

1. Munk PS, Staal EM, Butt N, et al. High-intensity interval training may reduce in-stent restenosis following percutaneous coronary intervention with stent implantation: a randomized controlled trial evaluating the relationship to endothelial function and inflammation. *Am Heart J* 2009;158:734-41.
2. Wisloff U, Ellingsen O, Kemi OJ. High-intensity interval training to maximize cardiac benefits of exercise training? *Exerc Sport Sci Rev* 2009;37:139-46.
3. Morton J. Prescribing, quantifying, and monitoring exercise intensity during interval training. *Med Sci Sports Exerc* 2007;39:1885 [author reply 1886].
4. Guiraud T, Juneau M, Nigam A, et al. Optimization of high intensity interval exercise in coronary heart disease. *Eur J Appl Physiol* 2009; Nov 14 [Epub ahead of print].
5. Meyer P, Guiraud T, Gayda M, et al. High-intensity aerobic interval training in a patient with stable angina pectoris. *Am J Phys Med Rehabil* 2010;89:83-6.