Science & Sports (2017) xxx, xxx—xxx

Disponible en ligne sur ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com

ORIGINAL ARTICLE

The effect of different exercise modalities on the heart rate recovery response

Les effets de différents types d'exercice sur la fréquence cardiaque lors de la récupération

B.R. Counts, J.P. Loenneke, P.D. Loprinzi*

The University of Mississippi, Department of Health, Exercise Science, and Recreation Management, 229 Turner Center, P.O. Box 1848, 38677 MS, United States

Received 10 August 2016; accepted 28 April 2017

KEYWORDS
Vagal tone;
Autonomic nervous system;
Accelerometry

Summary
Background. — Heart rate recovery (HRR) is inversely associated with poor health outcomes and co-morbidities, and methods to enhance HRR can occur following aerobic and resistance training activities. It is unknown the role that these exercise modalities have on one another using a national sample. Therefore, the purpose of this study was to examine the association of meeting one, both or neither of the guidelines for muscle strengthening activities (MSA) and moderate to vigorous physical activities (MVPA) guidelines on HRR.
Methods. — Data from the 2003—2004 National Health and Nutrition Examination Survey were used ($n = 564$; 20—49 yrs). Participants completed a submaximal treadmill test and HRR was determined as the difference from maximal heart rate achieved and heart rate during the first minute (HRR_1) and second minute (HRR_2) into recovery.
Results. — There was no association for meeting one guideline at HRR_1 ($P = 0.135$), but those that met both guidelines had an enhanced HRR_1 ($P = 0.046$). In addition, meeting one ($P < 0.001$) or both guidelines ($P < 0.001$) was associated with a greater $HRR_{.2}$.
Conclusion. — Therefore, we suggest that by adopting both MSA and MVPA guidelines, one may have favorable health outcomes given the previously established inverse relationship between HRR and all-cause mortality.

* Corresponding author.
E-mail address: pdloprin@olemiss.edu (P.D. Loprinzi).

http://dx.doi.org/10.1016/j.scispo.2017.04.013
0765-1597/

Please cite this article in press as: Counts BR, et al. The effect of different exercise modalities on the heart rate recovery response. Sci sports (2017), http://dx.doi.org/10.1016/j.scispo.2017.04.013

MOTS CLÉS
Tonus vagal ;
Système nerveux autonome ;
Accéléromètre

Résumé
Objectifs. — Le but de cette étude était d'examiner l'association entre l'activité physique objectivement quantifiée et la fréquence cardiaque en récupération.
Matériels et méthodes. — Les données utilisées étaient tirées de l'étude NHANES 2003—2004. L'activité physique a été évaluée par accéléromètre, et la fréquence cardiaque en récupération a été évaluée à partir d'un test d'effort sur tapis roulant. La récupération de la fréquence cardiaque à une (HRR1) et deux minutes (HRR2) a été calculée.
Résultats. — Après ajustement, l'activité physique légère et vigoureuse, respectivement, étaient associées à HRR1 (β-ajusté 0,69, IC95% : 0,22 à 1,14 ; β-ajusté 1,94, IC95 % : 0,01 à 3,9) et HRR2 (β-ajusté = 0,99, IC95 % : 0,35 à 1,62 ; β-ajusté = 5,88, IC95 % : 2,63 à 9,12). L'activité physique modérée n'était pas associée à HRR1 (β-ajusté ajusté = 0,60, IC95 % : —0,41 à 1,62), mais était associée avec HRR2 (β-ajusté ajusté = 2,28, IC95 % : 1,27 à 3,8). Quand l'activité physique spontanée augmentait, il y avait une plus grande association avec la fréquence cardiaque en récupération.
Conclusion. — Ces résultats peuvent contribuer à expliquer les liens entre activité physique régulière et divers indicateurs de bonne santé.

1. Introduction

Improvements and maintenance of cardiorespiratory function are some of the benefits associated with exercise and physical activity [1]. One cardiovascular adaptation is heart rate recovery (HRR), which is defined as the change in heart rate following the cessation of exercise. Additionally, enhancing HRR is inversely associated with all-cause mortality [2], but is positively associated with physical activity [3]. It has been hypothesized that this enhanced HRR adaptation following exercise training is due to increases in vagal activity following exercise completion in response to baroreceptor changes [4].

Throughout the literature, improvements in HRR are commonly noted following an Aerobic Exercise test (e.g. Maximal Oxygen test) in aerobically trained individuals compared to a less active population [5,6], and have shown that cardiovascular markers improved with aerobic type activities [7]. Other exercise modalities, such as resistance training are beneficial for increasing skeletal muscle size and strength, with the most beneficial adaptation of skeletal muscle being that it aids in metabolism and everyday movements [8,9]. Additionally, resistance training has been shown to improve cardiovascular function [10], by reducing blood pressure, resting heart rate, and increasing peak oxygen consumption [11]; however, these changes are largely influenced by baseline values (i.e. those with low baseline values may improve). For example, an individual with high cardiovascular function may not observe further improvements following exercise that does not produce higher cardiovascular demands [12]. Furthermore, resistance training has been shown to enhance the HRR adaptation following a graded cycle test [13]. When compared to endurance-trained adults, a similar HRR response in strength-trained athletes was observed, and was greater than the sedentary controls [14].

The cardiovascular benefit of enhancing HRR is associated with reducing all-cause mortality [2]. However, this is supported by an aerobic-based exercise test and it can be hypothesized that individuals who regularly partake in aerobic-based exercise would be a better tester at an aerobic based test compared to individuals who are more naïve to that modality of exercise. Further, resistance training has been shown to enhance HRR following an aerobic-based test and had a similar HRR compared to an aerobically trained population [14]. Therefore, the purpose of this study was to examine the association of resistance training engagement and HRR following an aerobic-based treadmill test. Additionally, we aimed to examine whether there is an additive association of concurrent aerobic-based physical activity and muscle strengthening activity (MSA) participation on HRR. We hypothesized the following:

- resistance training engagement would be associated with HRR after an aerobic-based treadmill test;
- aerobic-based physical activity participation would be associated with HRR to a greater extent than resistance training;
- those that engaged in both resistance training and aerobic training would have an enhanced HRR when compared to those that engaged in none or only one of these physical activity behaviors. If indeed there is an additive association between MSA and aerobic-based physical activity on HRR, then this would further our knowledge of the joint effects of resistance training and aerobic activity on HRR, as HRR is a predictor of various health outcomes, including early mortality.

2. Methods

2.1. Experimental approach to the problem

Data from the 2003—2004 National Health and Nutritional Examination Survey (NHANES) was used for this analysis because this is the only cycle that collected data on all study variables. Analysis was completed on those participants that completed three stages of submaximal treadmill test. In addition, analysis on participants was categorized based on if they met the guidelines for MSA or moderate to vigorous physical activity (MVPA).

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