Science & Sports (2018) xxx, xxx—xxx

Disponible en ligne sur ScienceDirect www.sciencedirect.com

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

ORIGINAL ARTICLE

Eccentric resistance training reduces both non-response to exercise and cardiovascular risk factors in adult with overweight or obesity

L'entraînement excentrique en force réduit les facteurs de risque cardiovasculaire d'adultes en surpoids ou obèses avec une moindre fréquence de non-réponses

A. Díaz-Vegas [a,d], A. Espinoza [b], C. Cofré [d], P. Sánchez-Aguilera [c,*]

[a] *Nutrición y Dietética, Facultad de Ciencias de la Salud, Universidad San Sebastián, Lota 2465, Providencia, Santiago, Chile*
[b] *Laboratorio de Fisiología del Ejercicio, Escuela de Kinesiología, Universidad Santo Tomás, Ejército 146, Santiago, Chile*
[c] *Laboratorio de Fisiología Celular del Músculo, Facultad de Medicina, Universidad de Chile, Av. Independencia 1027, Independencia, Santiago, Chile*
[d] *Facultad de Ciencias Médicas, Universidad de Santiago de Chile, Av. Libertador Bernardo O'Higgins 3363, Santiago Centro, Santiago, Chile*

Received 8 November 2017; accepted 4 December 2017

KEYWORDS
Cardiovascular diseases;
Cardiovascular risk factors;
Obesity;
Resistance training;
Non-responding prevalence

Summary
Objectives. — The aim of this study was to compare the effect of concentric or eccentric resistance training on different cardiovascular risk factors and the prevalence of non-response to exercise.
Materials and methods. — Twenty two overweight or obese men were divided into two exercise groups and underwent concentric (CRT) or eccentric resistance (ERT) training respectively, that consisted in squats developed with the help of a Russian belt. Each protocol was performed in four sets of eight repetitions, developed three times per week for four weeks.

* Corresponding author.
E-mail address: pablosanchez@ug.uchile.cl (P. Sánchez-Aguilera).

https://doi.org/10.1016/j.scispo.2017.12.002

Please cite this article in press as: Díaz-Vegas A, et al. Eccentric resistance training reduces both non-response to exercise and cardiovascular risk factors in adult with overweight or obesity. Sci sports (2018), https://doi.org/10.1016/j.scispo.2017.12.002

Results. — CRT reduced waist circumference (WC) from 111.1 ± 4.30 to 109.4 ± 4.69 cm and systolic pressure (SP) from 119.7 ± 6.41 to 117 ± 5.32 mm Hg. ERT reduced the WC from 110.5 ± 4.69 to 104.4 ± 4.05 cm and SP from 121.2 ± 4.74 to 116.9 ± 5.18 mm Hg. ERT had greater effect reducing WC value compared to CRT (−3.5% and −11.7% for CT and ET respectively). Additionally, CRT and ERT increased the VO2 peak from 29.5 ± 2.01 to 30.5 ± 1.43 ml/kg/min and from 28.6 ± 2.34 to 31.92 ± 2.31 ml/kg/min respectively. Finally, higher percentage of responses to training was observed after ERT protocol compared to CRT.

MOTS CLÉS
Maladies cardiovasculaires ;
Facteurs de risque cardiovasculaires ;
Obésité ;
Entraînement musculaire ;
Non-réponse à l'exercice physique

Résumé
Objectifs. — L'objectif de cette étude était de comparer l'effet de l'entraînement en résistance concentrique ou excentrique sur différents facteurs de risque cardiovasculaire et la prévalence de la non-réponse à l'exercice.
Matériels et méthodes. — Vingt-deux hommes en surpoids ou obèses ont été répartis en deux groupes d'exercices et ont subi un entraînement en résistance de type concentrique (CRT) ou excentrique (ERT), respectivement, constitué de génuflexions réalisées à l'aide d'une ceinture russe. Chaque protocole a compris 4 ensembles de 8 répétitions, réalisés 3 fois par semaine pendant 4 semaines.
Résultats. — Le CRT a réduit le tour de taille (TT) de 111,1 ± 4,30 à 109,4 ± 4,69 cm et la pression artérielle systolique (SP) de 119,7 ± 6,41 à 117 ± 5,32 mm Hg. L'ERT a réduit le TT de 110,5 ± 4,69 à 104,4 ± 4,05 cm et la SP de 121,2 ± 4,74 à 116,9 ± 5,18 mm Hg. L'ERT a eu un effet plus important sur la réduction de la valeur de TT par rapport au TRC (-3,5 % et -11,7 % pour CT et ET respectivement). En outre, CRT et ERT ont augmenté le pic VO2 de 29,5 ± 2,01 à 30,5 ± 1,43 ml/kg/min et de 28,6 ± 2,34 à 31,92 ± 2,31 ml/kg/min respectivement. Enfin, un pourcentage plus élevé de réponses à l'entraînement a été observé après le protocole ERT par rapport à CRT.

1. Introduction

Cardiovascular diseases (CVD) are the first contributor to global morbidity and mortality [1] and it has been established that sedentary lifestyles are major modifiable risk factor for CVD [2]. According with these observations, several organizations have recommended increasing physical exercise level to improve the cardiorespiratory fitness in general population [3,4]. Epidemiological studies have shown that sedentary behavior are positively associated with higher prevalence of most CVD risk factors, such as hypertension and central obesity, among others [3]. Aerobic physical exercise is commonly used to reduce CVD risk factors [5]. Interestingly, resistance training (RT) is not included in cardiac rehabilitation guidelines at the same level as aerobic training [5]). Nowadays, several researches have emerged showing that RT may present beneficial effects on cardiovascular health [6,7].

According to the type of movements, RT could be divided into dynamic RT and static or isometric RT. Dynamic RT involved concentric and eccentric contraction. Concentric actions involve the shortening of muscle fibers and eccentric actions implicate an active lengthening of the muscle fibers [8]. Based on the specificity principle of strength training [9], it has been postulated that concentric and eccentric resistance training (CRT and ERT, respectively) provides a different stimulus to the muscle and, therefore, could produce different local and systemic adaptations [10,11]. For instance, CRT decreases resting blood pressure in normotensive adult [12] and ERT reduces resting blood pressure in hypertensive older subject [13]. In spite of the differential adaptation to ERT or CRT, the effect of these training protocols on CVD risk factors in obese or overweight population has not been completely defined.

In spite of all benefits of exercise training intervention — in average term —, there is a wide interindividual variability after physical training [14]. This interindividual variability suggests that after the same stimulus, some subjects may achieve positive effects (e.g., responders) whereas other subjects may exhibit unchanged response after training (e.g., non-responders, NR) [14,15]. The prevalence of NR has been described after different training protocols such as endurance [16], CRT [14] or high intensity interval training [15]. For instance, the prevalence of NR in the change of systolic pressure (SP) and diastolic pressure (DP) is between 60.9 and 59.1% respectively, after concentric resistance training [17]. Nevertheless, none of these studies have reported the change on CVD risk factors and the prevalence of NR after CRT or ECT in adults with overweight or obesity.

Thus, the aim of this study was to assess the effect of dynamic CRT or ERT on different CVD risk factors such as peak oxygen consumption; central obesity; body mass index and blood pressure (BP). Additionally, we evaluated the prevalence of NR in the different variables after both types of trainings. Both CRT and ERT showed a significant reduction of central obesity and BP; without effect on body mass index. Additionally, the magnitude of the effect was higher after ERT than CRT. Interestingly, the prevalence of NR subjects was lower after ERT than CRT.

Please cite this article in press as: Díaz-Vegas A, et al. Eccentric resistance training reduces both non-response to exercise and cardiovascular risk factors in adult with overweight or obesity. Sci sports (2018), https://doi.org/10.1016/j.scispo.2017.12.002