Low-Load Resistance Training Combined with Hypoxia Provided Greater Muscle Thickness and Bone Density than Traditional Resistance Training

Chaiyawat Namboonlue, Patpiya Sirasaporn, Kriangkrai Kongjan, Preetiwat Wonnabussapawich, Worrawut Thuwakum, Lertwanlop Srisaphonphusitti, Apiwan Manimmanakorn

1Exercise and Sport Sciences Program, Graduate School, Khon Kaen University, Thailand
2Department of Rehabilitation Medicine, Faculty of Medicine, Khon Kaen University, Thailand
3Sport and Exercise Science Program, Faculty of Science and Technology, Nakhonratchasima Rajabhat University, Thailand
4Department of Sport Science, Faculty of Science and Technology, Uttaradit Rajabhat University, Thailand
5Department of Sports Science, Faculty of Education, Surindra Rajaphat University, Thailand
6Department of Physiology, Faculty of Medicine, Khon Kaen University, Thailand
7Back, Neck and Other Joint Pain Research Group, Faculty of Associated Medical Sciences, Khon Kaen University, Thailand

*Corresponding author: mapiwa@kku.ac.th, apiwanta@yahoo.com

Abstract

Introduction: The aim of this study was to investigate the effects of low-load resistance training combined with two hypoxic doses on muscle thickness, bone mass and muscular performance in athletes.

Methods: Thirty-seven male team sport athletes (19.5 ± 1.1 y, 172.3 ± 4.0 cm, 65.1 ± 12.3 kg) were divided into 3 resistance training groups; 1) normoxic high-load (80%1RM) resistance training (HRT; F\textsubscript{O2} = 20.9%), 2) hypoxic low-load (50%1RM) resistance training (HLT\textsubscript{1}; F\textsubscript{O2} = 13.6%) and 3) hypoxic low-load (50%1RM) resistance training (HLT\textsubscript{2}; F\textsubscript{O2} = 15.8%). Resistance training included 3 sets of 15 repetitions of knee extensions and 3 sets of knee flexions, 3 days a week for 5 weeks. The thickness of quadriceps femoris (QF) determined using ultrasonography (LOGIQ e, GE Model Co., Ltd. USA) before and after 5 weeks training.

Results: Muscle thickness and bone mass were significant increase in HLT\textsubscript{1} group (19.05 ± 7.63% and 1.46 ± 2.49%) compared with HRT (9.36 ± 7.30% and 0.12 ± 1.58%, P<0.05, respectively. Compared with HRT groups, HLT\textsubscript{1} showed substantial improvement in maximal voluntary contraction (MVC\textsubscript{6}) 33.71 ± 12.66% vs 19.41 ± 6.51%, (P<0.05) after training.

Conclusions: Training with high dose hypoxic condition (F\textsubscript{O2} = 13.6% equal to 3,400 m above sea level) induced greatest muscle thickness, bone mass density, muscular performance when compared with traditional (high-load) resistance training and low dose hypoxic training. This strategy could be replacing traditional resistance training for muscular performance improvement without any injury.

Keywords: Muscle Thickness, Muscle Strength-Endurance, Simulated Altitude