

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

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### 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 ( $19.5 \pm 1.1$  y,  $172.3 \pm 4.0$  cm,  $65.1 \pm 12.3$  kg) were divided into 3 resistance training groups; 1) normoxic high-load (80%1RM) resistance training (HRT;  $F_{iO_2} = 20.9\%$ ), 2) hypoxic low-load (50%1RM) resistance training (HLT1;  $F_{iO_2} = 13.6\%$ ) and 3) hypoxic low-load (50%1RM) resistance training (HLT2;  $F_{iO_2} = 15.8\%$ ). 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 HLT1 group ( $19.05 \pm 7.63\%$  and  $1.46 \pm 2.49\%$ ) compared with HRT ( $9.36 \pm 7.30\%$  and  $0.12 \pm 1.58\%$ ,  $P < 0.05$ ), respectively. Compared with HRT groups, HLT1 showed substantial improvement in maximal voluntary contraction ( $MVC_0$ )  $33.71 \pm 12.66\%$  vs  $19.41 \pm 6.51\%$ , ( $P < 0.05$ ) after training.

**Conclusions:** Training with high dose hypoxic condition ( $F_{iO_2} = 13.6\%$  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