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Prevention of sarcopenia and regulation of the ERK1/2 and p38MAPK phosphorylation by resistance training

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Objective Study of the effect of treadmill resistance training on the cross section and phosphorylation of ERK1/2 and p38MAPK of gastrocnemius of aging rats, and explore the role of resistance training in prevention and regulation of sarcopenia.

Methods 11-month-old male Sprague-Dawley (SD) rats ($n = 40$, SPF grade, initial body weight 776.9 ± 50) were raised in various cages in a room with a room temperature of $23 \pm 2^\circ\text{C}$, a humidity of 40–60%, and a natural light/dark cycle. After eight months, the treated rats were then divided into one sedentary group (control, $n = 8/\text{group}$) and four groups for resistance training (GRT 1-GRT 4, GRT for Group for Resistance Training, $n = 8/\text{group}$) lasting for 8 weeks. For resistance training, GRT1 to GRT4 carried no loading, 30% maximum loading, 50% maximum loading and 70% maximum loading, respectively. The protocol for treadmill running was as follows: 15m/min (speed), 35° (slope), 15s each time, an interval for 30s between two runnings, four runnings as one training, an interval for 3mins between two training, three training as one cycle, two cycles one training day, and one-day break between two training days. The morphology and cross section of gastrocnemius and the phosphorylation of the ERK1/2、p38MAPK proteins in the rats were examined after 8 weeks' training.

Results Compared with the control, GRT1-GRT4 displayed relatively better aligned muscles fibers and noticeably larger cross-sectional area ($P < 0.05$). The content of p-ERK1/2 (phosphorylated ERK1/2) displayed a descending trend as the loading increased compared with the control (GRT1 VS control, $P > 0.05$; GRT2 VS control, $P < 0.05$; GRT3 VS control, $P > 0.05$; GRT4 VS control, $P > 0.05$). However, the pairwise comparison revealed that only the difference between GRT1 and GRT2 was significant. Similarly, the content of p-p38MAPK (phosphorylated p38MAPK) displayed a descending trend as the loading increased compared with the control (GRT1 VS control, $P > 0.05$; GRT2 VS control, $P > 0.05$; GRT3 VS control, $P < 0.01$; GRT4 VS control, $P < 0.01$). Besides, the pairwise comparison revealed that the difference between GRT1 and GRT3 was significant ($P < 0.05$) and that between GRT1 and GRT4 was even highly significant ($P < 0.01$).

Conclusions Resistance training with middle-class intensity or above can prevent sarcopenia. ERK1/2 and p38MAPK were subject to high-level phosphorylation in aging skeletal muscles, which resulted from the stress-like status of the aging body. Treadmill training of with middle-class intensity or above can reduce ERK1/2 and p38MAPK phosphorylation in aging skeletal muscles of rats, which indicates that resistance training can effectively prevent sarcopenia by inhibiting ERK1/2 and p38MAPK phosphorylation.