

Effects of Neuromuscular Electrical Stimulation Training on Skeletal Muscle Anabolic Signaling in Older Adults

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ABSTRACT

Neuromuscular electrical stimulation (NMES) generates involuntary muscle contraction and may be a safe and effective alternative to voluntary resistance training, which is important for those who cannot perform voluntary exercise due to age-related conditions. However, further research is needed to better understand the skeletal muscle anabolic signaling response of the mTORC1 (mammalian target of rapamycin complex 1) pathway with repeated bouts of NMES. **PURPOSE:** To determine changes in skeletal muscle anabolic signaling in response to a 4-week NMES intervention in older adults. **METHODS:** Participants ($n = 7$) in this clinical trial were healthy, older adults (70.4 ± 2.9 years). NMES was applied to the quadriceps muscles for 40 min/treatment, 3x/week for 4 weeks (12 sessions). On Day 1 and Day 12 of the NMES intervention, skeletal muscle biopsies were obtained from the *vastus lateralis* Pre-NMES and 30 minutes Post-NMES and were analyzed for phosphorylation of mammalian target of rapamycin (mTOR) and p70-S6 Kinase 1 (S6K1) anabolic signaling proteins using the SDS-PAGE Western blot technique. Phosphorylation is expressed as the ratio of phosphorylated to total protein content. Data were analyzed using paired *t*-tests and data are reported as mean \pm SE with statistical significance set at $p \leq 0.05$. **RESULTS:** On Day 1, phosphorylation of S6K1 increased (Pre-NMES: 0.652 ± 0.145 AU vs. Post-NMES: 0.979 ± 0.151 AU, $p = 0.037$) and phosphorylation of mTOR increased (Pre-NMES: 0.464 ± 0.077 AU vs. Post-NMES: 1.046 ± 0.128 AU, $p = 0.006$) from Pre-NMES to Post-NMES. On Day 12, phosphorylation of S6K1 increased (Pre-NMES: 0.628 ± 0.108 AU vs. Post-NMES: 1.253 ± 0.288 AU, $p = 0.048$) with an increasing trend for mTOR (Pre-NMES: 0.485 ± 0.044 AU vs. Post-NMES: 0.700 ± 0.154 AU, $p = 0.053$) from Pre-NMES to Post-NMES. Phosphorylated S6K1 and mTOR protein content were not different between Day 1 and Day 12 at Pre-NMES ($p > 0.05$) or at Post-NMES ($p > 0.05$). **CONCLUSION:** The findings of this study suggest that the anabolic signaling response to a bout of NMES remains upregulated after 4-weeks of treatment; thus, the response is not attenuated with short-term repeated bouts of NMES. Funding: Research Enhancement Program Grant to J Mettler and L Kipp; Research Accelerator Grant, Texas State University, to J Mettler.