

## Electrical Stimulation While Resistance Training Leads to Greater Gains in Muscle Mass and Strength

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### ABSTRACT

Resistance training (RT) has long been shown to increase muscle strength and muscle mass and is widely recommended for people of all ages and ability levels. Neuromuscular electrical stimulation (NMES) is an involuntary mode of inducing muscle contractions that has been used to prevent muscle immobility, weakness, strength loss, and muscle loss in rehabilitative settings. However, the additive effects of NMES and RT are not well established. **PURPOSE:** To determine if superimposing neuromuscular electrical stimulation during a resistance training intervention elicits greater gains in muscle strength and/or muscle mass than resistance training being performed alone. **METHODS:** An electronic search was performed from EBSCO, GoogleScholar, PubMed, and ResearchGate to identify all original research investigating the effects of superimposed NMES and RT on muscle strength and muscle mass. Studies that met the inclusion criteria for the meta-analyses were included if the study design was a randomized controlled trial with NMES being superimposed during RT and outcome measure included muscle strength and/or muscle mass. Effect sizes were calculated as the standard mean difference (SMD) using a pooled standard deviation (SD) and meta-analyses were computed using random effects models. **RESULTS:** Sixteen studies met the inclusion criteria for systematic review with 14 of those being included in the meta-analysis (n=8 for strength, n=1 for muscle mass, n=5 reported both). The meta-analyses comprised of 347 subjects demonstrated that superimposing NMES during a RT intervention has a significant additive effect on increase in muscle strength (SMD: 0.21; 95% CI: 0.03 to 0.38; p = 0.02; I<sup>2</sup> = 73.05%) as well as increase in muscle mass (SMD: 0.26; 95% CI: 0.04 to 0.49; p = 0.02; I<sup>2</sup> = 21.45%), compared to performing RT alone, in a healthy population. **CONCLUSION:** Use of NMES during RT results in greater gains in muscle strength and muscle mass when compared to resistance training performed alone. Incorporation of NMES during RT may be a more effective strategy to improve muscle strength and muscle mass. Future studies should determine whether use of NMES concurrently with RT may have additive effects on metabolic and/or cardiovascular health.