

Is high-frequency neuromuscular electrical stimulation a suitable tool for muscle performance improvement in both healthy humans and athletes?

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Abstract

We aimed at providing an overview of the currently acknowledged benefits and limitations of neuromuscular electrical stimulation (NMES) training programs in both healthy individuals and in recreational and competitive athletes regarding muscle performance. Typical NMES resistance exercises are performed under isometric conditions and involve the application of electrical stimuli delivered as intermittent high frequencies trains (>40-50 Hz) through surface electrodes. NMES has been acknowledged as an efficient modality leading to significant improvements in isometric maximal voluntary strength. However, the resulting changes in dynamic strength, motor performance skills and explosive movements (i.e., jump performance, sprint ability) are still ambiguous and could only be obtained when NMES is combined with voluntary dynamic exercise such as plyometrics. Additionally, the effects of NMES on muscle fatigability are still poorly understood and required further investigations. While NMES effectiveness could be partially related to several external adjustable factors such as training intensity, current characteristics (e.g., intensity, pulse duration...) or the design of training protocols (number of contractions per session, number of sessions per week...), anatomical specificities (e.g., morphological organization of the axonal branches within the muscle) appear as the main factor accounting for the differences in NMES response. Overall, NMES cannot be considered as a surrogate training method, but rather as an adjunct to voluntary resistance training. The combination of these two training modalities should optimally improve muscle function.