Effect of Structured Resistance Training on Neuromuscular Activation in Underweight Young Male Adults

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Abstract:

Background: Underweight young males (BMI <18.5 kg/m²) represent an understudied population at risk for neuromuscular deficits, including reduced motor unit recruitment and impaired muscle fiber synchronization. While resistance training is well-established for improving neuromuscular function in healthy and obese populations, its specific effects in underweight individuals remain poorly characterized. This gap limits evidence-based exercise prescription for this group.

Objective: To evaluate the effect of six months phase wise follow up structured progressive resistance training (PRT) program on neuromuscular activation — assessed via surface electromyography (sEMG) — in underweight young male adults, and to determine whether training-induced adaptations differ from age-matched normal-weight controls.

Methods: Thirty underweight males (BMI: 16.2–18.4 kg/m², age: 18–25 years) were randomly allocated to a PRT group (n = 15) or a sedentary control group (n = 15). The PRT group underwent three supervised sessions per week for six months, comprising compound and isolation exercises targeting major muscle groups at 60–80% of one-repetition maximum (1-RM), with progressive overload applied biweekly. Neuromuscular activation of the vastus lateralis, biceps brachii, and rectus abdominis was quantified using sEMG root mean square (RMS) amplitude and median frequency (MDF) during maximal voluntary isometric contractions (MVIC) at baseline and post-intervention. Muscle strength (1-RM) and body composition (DEXA) were recorded as secondary outcomes. Data were analyzed using repeated-measures ANOVA ($\alpha = 0.05$).

Results: The PRT group demonstrated significant improvements in sEMG RMS amplitude across all measured muscles ($p < 0.05$), indicating enhanced motor unit recruitment and activation. MDF values increased significantly in the vastus lateralis and biceps brachii ($p < 0.05$), suggesting reduced muscular fatigue susceptibility and improved fiber-type recruitment efficiency. Mean 1-RM strength gains ranged from 22–35% across compound lifts. Lean body mass increased by a mean of 2.1 kg ($p < 0.05$). No significant changes were observed in the sedentary control group. Group × time interaction effects were significant for all primary neuromuscular outcomes ($p < 0.05$).

Conclusion: A 6 months structured resistance training program produces substantial neuromuscular adaptations in underweight young males, including improved motor unit recruitment, enhanced activation efficiency, and greater fatigue resistance. These findings support the integration of progressive resistance training into rehabilitation and health-promotion strategies for underweight young men, and highlight the importance of tailored exercise programming for this population.

Keywords:

Resistance training neuromuscular activation underweights EMG motor unit recruitment young adults muscle strength.