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Normalization Removes Differences in Contractile Properties and Corticospinal Excitability Between Single- and Multi-Joint Exercises

Felix Proessl, Maria C. Canino, Adam J. Sterczala, Courtenay Dunn-Lewis, William R. Conkright, Aaron M. Sinnott, Meaghan E. Beckner, Shawn R. Eagle, Fabio Ferrarelli, Anne Germain, Chris Connaboy, Bradley C. Nindl, FACSM, Shawn D. Flanagan. University of Pittsburgh, PA

Single- and multi-joint exercises are commonly used resistance modalities to assess contractile function and corticospinal excitability. Initial work suggests neurophysiological function may be task-specific, but results are constrained to smaller corticospinal excitability ranges. **PURPOSE:** The purpose of this study was to compare neurophysiological function during stimulus-response curves (SRC) between an isometric squat (SQT) and knee extension (KE). **METHODS:** Twenty-two young adults (2 women, 20 right-footed, age: 25±5yrs, BMI: 25.9±3.1, VO2: 46.2±8.8 ml·kg⁻¹·min⁻¹) performed isometric SQT (n=7) or KE (n=15), with hip-, knee- and ankle-joint angle at 90° as part of a larger study, exposing participants to operational stress during a 5-day long testing series. Maximum strength and muscle activity (RMS) were recorded during maximum voluntary contractions (MVCs) using a linear force transducer and electromyography (EMG) sensors placed over the vastus lateralis, respectively. SRCs were conducted with transcranial magnetic stimulation and a double cone coil from 5-100% of stimulator output over the dominant motor cortex leg hotspot during intermittent isometric contractions at 15% MVC. Corticospinal excitability was assessed by SRC_{MAX}, SRC_{SLOPE} and SRC_{v50} (midpoint of the rising phase). As responses did not differ across days, outcomes were grand-averaged and independent t-tests or Mann-Whitney U were used for between-group comparisons. **RESULTS:** Greater maximum force and muscle activity were evident for KE compared to SQT (Force: $1303.9\pm407.0 \text{ vs. } 812.8\pm189.5 \text{N}, p<0.001; \text{EMG}_{\text{RMS}}: 0.24\pm0.1$ vs. 0.14 ± 0.1 , p=0.02). During sustained isometric contractions, absolute EMG_{RMS} was higher in KE $(0.056\pm0.014 \text{ vs. } 0.043\pm0.003, p=0.03)$, but similar when normalized to EMG_{MAX} (29.8 ± 15.8) vs. 34.0 \pm 11.3%, p=0.21). Absolute SRC_{MAX} was almost twice as high in KE compared to SQT $(1.4\pm0.7 \text{ vs. } 0.7\pm0.4 \text{mV}, p=0.02)$, but similar when normalized to mean EMG_{RMS} during sustained isometric contractions (KE: 25.3±14.0 vs. SQT: 17.4±10.7mV·EMG_{RMS}-1, p=0.21). SRC_{V50} and SRC_{SLOPE} did not differ (p>0.05). **CONCLUSION:** Single- and multi-joint exercises present distinct contractile and absolute corticospinal properties, which vanish after normalization, warranting caution when comparing results between studies.

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