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Corticospinal Excitability and the Size of Motor Cortex Representations Reflect Distinct Aspects of Corticomotor Function

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Corticospinal excitability (CSE) and the size of motor cortex (M1) representations are often used as markers of use-dependent plasticity. Frequently used muscles present with greater CSE and enlarged M1 representations, but the direct interplay between motor map size and CSE and is unknown. **PURPOSE:** To examine the association between CSE and the size of M1_{HAND}, M1_{LEG} and M1_{TRUNK} representations. **METHODS:** Sixteen healthy young adults (7 women, age: 26±5yrs, BMI: 23.0±2.5kg/m²) completed one experimental visit, in which transcranial magnetic stimulation was used to elicit motor-evoked potentials (MEP) in the active (15% maximum voluntary contraction) first dorsal interosseus (FDI), vastus lateralis (VL) and rectus abdominis (RA). CSE was determined based on the plateau (MEP_{MAX}) and midpoint of the rising phase (V50) of stimulus-response-curves, which express MEPs as a function of stimulator output (range 5-100%). M1 size was quantified as motor map surface area (SA) based on the delivery of 120 biphasic pulses at 0.2-0.5Hz and 120% of active motor threshold at pseudorandom locations within a 6x6cm grid placed around each hotspot. MEPs at each stimulation location were fitted to neuronavigation-derived coordinates. CSE and SA were compared across muscles using a repeated measures ANOVA. Within-muscle relations between CSE and M1 SA were examined with Pearson correlations. **RESULTS:** CSE was highest in the FDI and similar between the VL and RA (MEP_{MAX} FDI: 3.7±2.2mV, VL: 0.9±0.5mV, RA: 0.7±0.5mV, $F_{2,45}=27.1$, $p<0.01$; V50 FDI: 48.2±13.4%, VL: 65.7±10.6%, RA: 74.8±11.0%, $F_{2,45}=21.2$ $p<0.01$). Correspondingly, SA was greatest in M1_{HAND} but similar in M1_{LEG} and M1_{TRUNK} (SA FDI: 2.3±2.2cm², VL: 1.1±0.7cm², RA: 0.9±0.7cm²; $F_{2,45}=4.3$, $p=0.02$). Interestingly, within muscle, M1 CSE was not related to SA (r range: 0.07-0.17, p range: 0.54-0.79). **CONCLUSION:** CSE is greater in muscles with larger motor cortex representations but is not the result of such enlargement. Thus, CSE and M1 size appear to reflect shared but distinct aspects of corticomotor function.

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