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Cortical activation pattern during horseback riding simulation: A functional NIRS study

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Objectives
Horseback riding is known to have positive effects on the musculoskeletal system, cognition, and psychological condition. Previous studies on the positive effects of horseback riding show it improves core muscle activation, gait, body stability, and cognitive function. In the current study, we investigated changes in cortical activation during simulated horseback riding in normal subjects by using functional near-infrared spectroscopy (fNIRS).

Methods
Eleven healthy normal subjects were recruited for this study. The fNIRS was performed using an fNIRS system with 49 channels. Simulated horseback riding was performed in the seated position, holding the device's bar with both hands and with feet on the pedals to stabilize posture and looking to the front throughout the task. We measured oxyhemoglobin (HbO) levels in 49 channels.

Results
During performance of the horseback riding task, the highest HbO values were observed in channel 38 (HbO, 0.0165) and in the following channels in descending order: channel 34 (HbO, 0.0145), channel 42 (HbO, 0.0118), channel 33 (HbO, 0.0116), and channel 39 (HbO, 0.0111). Group analysis showed that the HbO values in the primary sensori-motor cortex (SM1) and premotor cortex (PMC) were higher than that in the prefrontal cortex (PFC), and there was no difference between the SM1 and PMC HbO values.

Conclusions
We observed cortical activation in the PMC, SM1, and PFC, brain regions that are related to motor execution of the trunk and leg, motor planning, and cognition.

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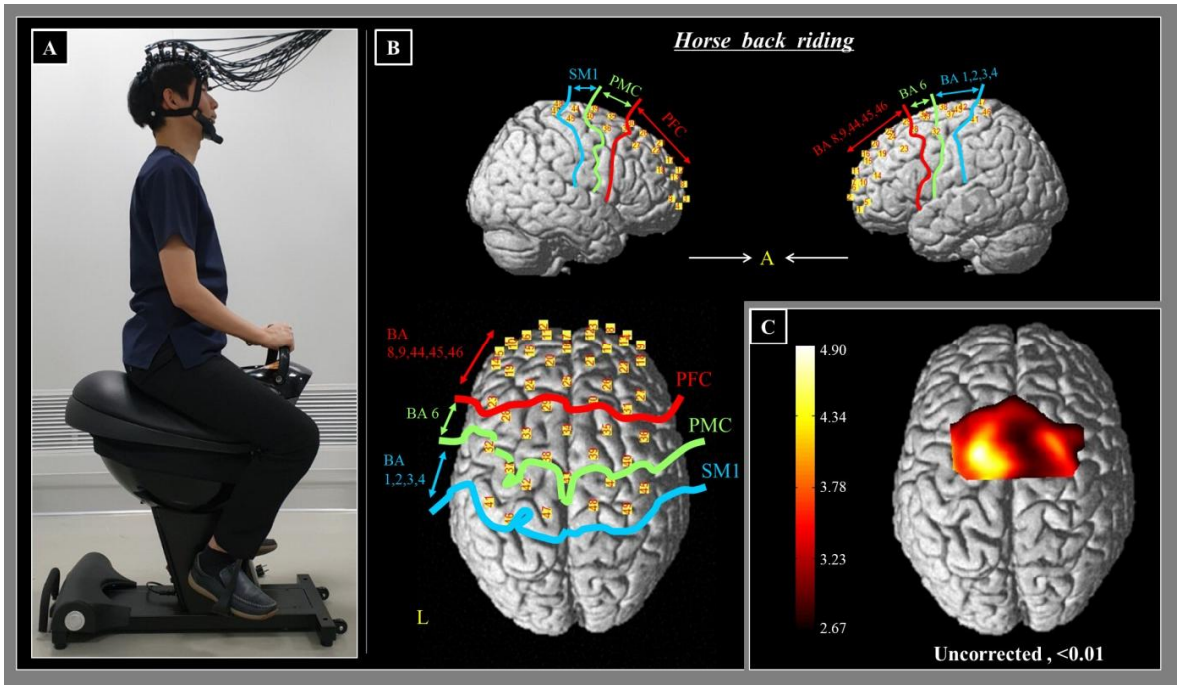

Figure. 1 (A) Simulated horseback riding position. The subject is seated and instructed to hold the bar with both hands and put their feet on the pedals to stabilize posture during the horseback riding task. (B) Location of 49 channels and three regions of interest based on Brodmann area (BA) and anatomical location of brain areas. The primary sensorimotor cortex (SM1): BA 1,2,3, and 4; premotor cortex (PMC): BA 6; and the prefrontal cortex (PFC): BA 8,9,44,45, and 46. (C) Group-average t-statistic maps of oxyhemoglobin (HbO) values during the performance of simulated horseback riding task using Near Infrared Spectroscopy-Statistical Parametric Mapping (NIRS-SPM) software (corrected with expected Euler characteristics, $p < 0.05$, uncorrected).