

The Effects of Foot Reflexology for Smoking Cessation on Brain Activities with Functional Magnetic Resonance Imaging (fMRI): A Pilot Study

Pisit Wattanaruangkowit¹ Sombat Muengtaweepongsa²
Tharadol Kengganpanich³ and Mondha Kengganpanich³

¹Department of Radiology, Faculty of Medicine, Thammasat University, Pathum ani 12120, Thailand

²Center of Excellence in Stroke, Faculty of Medicine, Thammasat University, Pathum ani 12120, Thailand

³Department of Health Education and Behavioral Sciences, Faculty of Public Health, Mahidol University, Bangkok 10400, Thailand

Background:

Foot reflexology is a treatment with the hypothesis that such massage stimulation on the feet may cause a therapeutic effect which should be helpful for smoking cessation. However, its mechanism of action in the brain of smoking people remain unknown. Functional magnetic resonance imaging (fMRI) is helpful for real-time brain activity detection.

Objective:

This pilot study aims to compare the brain activity effects of foot reflexology with fMRI between smoking and nonsmoking subjects.

Methods:

This study is a double-blinded clinical trial which 22 participants were divided into experimental (smokers) and control groups (nonsmokers). Both groups did not know which group they are in (experimental or control group). We performed the reflexological stimulation in three points for both group under the fMRI examination, where researchers applied the pressure with the right and left thumbs, respectively with 45 seconds for pressure application. The total duration of the reflexological stimulation was approximately 10 minutes per participant. The three massage points used in this study include the following (Figure 1): Above the hallux next to the toe index finger (area number 1) (b) Inside of the hallux attached to the toe index finger (area number 2) (c) The outer squares, both the top and bottom of the hallux (area number 3) All fMRI measurements were performed using a Siemens MAGNETOM Skyra 3.0 Tesla scanner, high-resolution 3D T1 resolution, and an MPRAGE sequence-weighted structural image with a repetition time of (TR) 1900 ms, echo time (TE) 2.30 ms, field of view (FOV) 230mm, and 0.8mm slice thickness for rapidly acquiring images. Echo planar imaging (EPI) was defined at TR 3000 ms, TE 30 ms, FOV 200mm, 5.0mm slice thickness, and spatial distortion of EPI images was reduced using gradient field mapping; TR=737 ms, TE=4.92 ms, FOV=320mm, and 3.0mm slice thickness. The fMRI response signal was labeled as intense, positive, and negative, giving a score of two, one, and zero, respectively. We compared the mean response score in each brain area before and after foot stimulation among groups and between groups, using the *t*-test. A value of $p < 0.05$ was considered statistically significant.

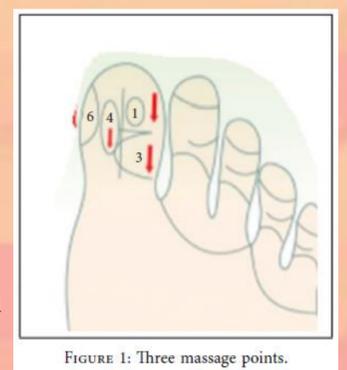


FIGURE 1: Three massage points.

Results:

Among the 22 participants, six nonsmokers were assigned as a control group and one in the control group was excluded due to the low-quality fMRI resulting from currently taking anxiolytic drugs. Among the remaining 16 smokers assigned to the experimental group, one had a claustrophobic condition and refused to continue testing with MRI. Finally, five nonsmokers in the control group and 15 smokers in the experimental group remained for the study. When the ipsilateral foot gets massaged, the contralateral correlated cortex, such as the precentral gyrus of the frontal lobe and the postcentral gyrus of the parietal lobe (pre- and post-CG), basically expresses a present signal in the fMRI. The fMRI of the brain response in the area correlated with foot stimulation, including the precentral and postcentral gyri (pre- and post-CG), became intense or present for all participants (Figures 2(a), 2(b), and 3(a)). The signals became intense only at the right postcentral gyrus (sensory area) during left foot stimulation in 13 participants. In comparison, the signals became intense during right foot stimulation at the left postcentral gyrus in seven participants. We found the response outside the correlated pre and post-CG, including other parts of the frontal cortex outside the precentral gyrus (Figures 2(c) and 3(b)), other parts of the parietal cortex outside the postcentral gyrus, occipital and temporal cortex, and thalamus, bilaterally. The fMRI response outside the correlated area in the cerebral hemisphere may lead to therapeutic effects.

Conclusion:

The fMRI of the brain is feasible and safe for demonstrating foot reflexology reactions. The response signal outside the correlated motor-sensory cortical area with foot reflexology may have clinical significance and may be helpful for smoking cessation. We suggest conducting a large-scale, randomized controlled trial to confirm these findings.

Key words: Foot Reflexology, Smoking Cessation, Brain Activities, Functional Magnetic Resonance Imaging (fMRI)

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Additional information: Assoc.Prof.Dr. Mondha Kengganpanich, Faculty of Public Health, Mahidol University, kmondha@yahoo.com

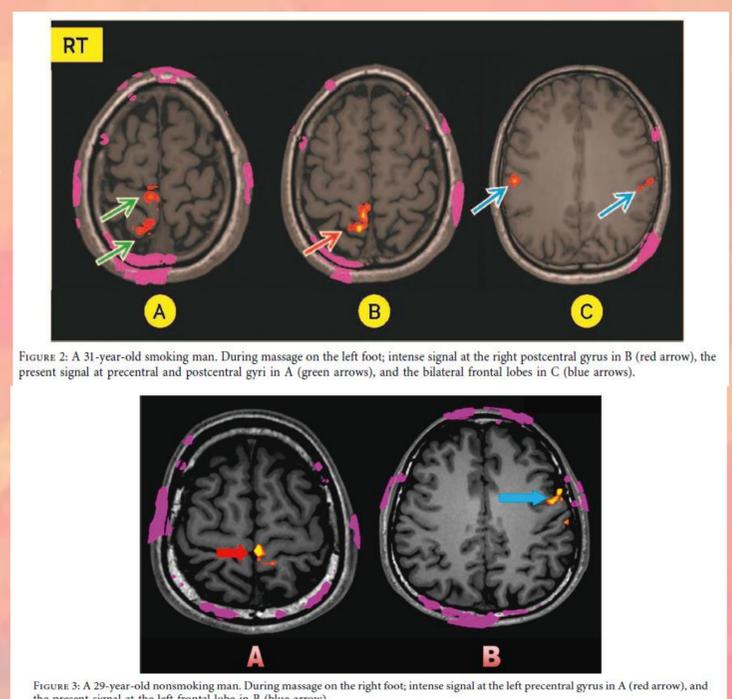


FIGURE 2: A 31-year-old smoking man. During massage on the left foot; intense signal at the right postcentral gyrus in B (red arrow), the present signal at precentral and postcentral gyri in A (green arrows), and the bilateral frontal lobes in C (blue arrows).

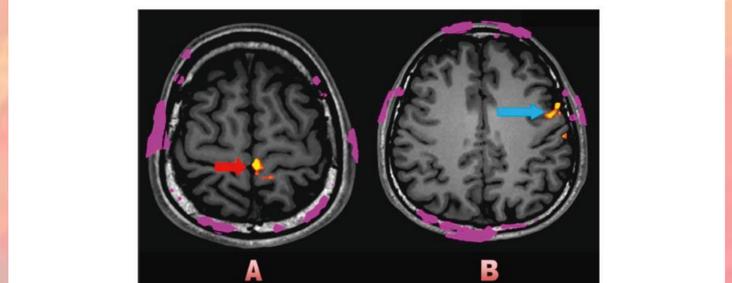


FIGURE 3: A 29-year-old nonsmoking man. During massage on the right foot; intense signal at the left precentral gyrus in A (red arrow), and the present signal at the left frontal lobe in B (blue arrow).

