

The alternation of functional motor network in the profession fighter populations.

Wanyong Shin¹, Katherine Koenig¹, Blessy Mathew¹, Bank Sarah², Mark J Lowe¹, Michael Phillips¹, Michael T Modic³, and Charles Bernick²

¹Radiology, Cleveland Clinic, Cleveland, Ohio, United States, ²Lou Ruvo Center for Brain Health, Cleveland Clinic, Las Vegas, Nevada, United States, ³Neurological Institute, Cleveland Clinic, Cleveland, Ohio, United States

Target audience: Traumatic brain injury researcher

Purpose: Traumatic brain injury (TBI) has been reported in professional combat athletes [1]. The Professional Fighters' Brain Health Study (PFBHS) is a longitudinal cohort study in which active professional fighters under brain MRI at baseline evaluation and annually over 4 years.. In this study, we presented the preliminary results of functional connectivity (fc) alternations between 1st and 2nd year imaging.

Methods:

MR experiment: Scan was conducted in Siemens 3T scanner (Siemens AG, Erlangen, Germany) using 32 channel head coil. The following MR parameters are used in single shot gradient refocusing echo (GRE) echo planar imaging (EPI) for resting state fcMRI; FOV=24×24cm², matrix=128×128, flip angle = 80°, TR/TE=2800/28ms, 4mm thickness, 30 slices, 1628 Hz/per voxel, repetition = 132.

Subjects: PFBHS recruited active professional fighters (boxers and mixed martial artists). The participants with MR-visible CNS disease or neurological disorder were excluded in the study. Thirteen professional fighters (age =32±6yr, female=2) were scanned twice with one year interval. As described in ref [2], the individual fight related information and clinical measures including CNS Vital Signs assessment were collected prior to each scan.

fcMRI Analysis: after the first 4 points of images were discarded, 128 time series images were motion-corrected using AFNI 3dvolreg command. Physiological and cardiac noises were removed using PESTICA [3], and low bandwidth Hamming filter (< 0.01 Hz) was used to remove high frequency noise and 6mm full-width-half-maximum Gaussian spatial filtering was applied. Six voxels in left motor cortex (M1) were chosen as a seed. The correlation coefficient between average time-series from the seed and voxelwise timeseries signal was calculated, and converted to Student t-score. Whole brain t-score distribution was normalized into z-scores. Individual z-score maps were co-registered into Talairach space.

Statistical analysis: voxel-wise paired t-test between 1st and 2nd year z-score maps was conducted with the number of professional fights (=0.54 ±0.88) as a covariate using *3dttest++* command in AFNI [4]

Results: It was observed that z-scores between 1st and 2nd scans with one year interval were decreased in the right M1 (t-score = -2.60) and supplementary motor area (t-score = -2.59) with the number of fights as a covariate.

Discussion: It was reported that mTBI altered default mode network (DMN [5]. We previously reported that the number of knockouts predicts decreased DMN connectivity [6]. We conducted DMN analysis with a posterior cingulate cortex seed and monitored the significance change of DMN using 1st and 2nd year scan without any significant change observed (results now shown here). Previous research indicates that more severe brain injury alters and possibly reorganizes the motor network [7]. However, our finding does not explain whether the decreased motor network connection during one year according to the number of fights implies the reorganization of the motor network or the reduction of the actual motor function capability. This study is limited by a small sample size and requires confirmation among larger groups exposed to repetitive head trauma.

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Reference

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Paired t-test between 1st and 2nd years

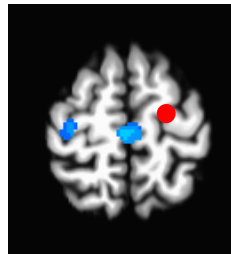


Fig 1. The change of z-score from left M1 seeds between 1st and 2nd year scan were t-tested with a number of professional fights as a covariate. Red circle localized the seed ROI and cool color indicated the decreased functional connectivity (z-score between 1st and 2nd scans, $p < 0.05$).