

BOLD ALTERATIONS IN SCHIZOPHRENIA: SPECTRAL CHANGES IN RESTING-STATE FMRI SIGNAL

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TARGET AUDIENCE: Psychiatrists who target in Schizophrenia.

PURPOSE

Schizophrenia is a mental illness with cognitive impairments, which could be due to the abnormal neural oscillations in the brain[1]. It is believed that the neural oscillations reflect multiple physiological mechanisms in the brain networks, especially prominent in the low-frequency oscillations (LFO) [2]. Therefore, the abnormal LFO distributions may reflect the impaired cognitive functions in schizophrenia patients. In this project, we examined and compared three different frequency bands regarding the amplitude of low frequency fluctuation (ALFF) and fractional amplitude of low frequency fluctuation (fALFF) between schizophrenia patients and normal control.

METHODS

Twenty-three schizophrenic persons and twenty-nine healthy subjects participated in the experiments using a 3T Trim system with a 12-channel head coil. All subjects were instructed to relax with their eyes closed, to think of nothing in particular, and not to fall asleep. The functional images were obtained using the GE-EPI sequence and 43 axial slices aligned along the AC-PC line. Imaging parameters were TR / TE = 2500 ms/ 27 ms, in-plane resolution = 64 × 64, and FOV = 220 × 220 mm. Two-hundred sequential images were obtained with the total acquisition time of 8 min 27 s. Functional data were pre-processed with motion correction, spatial normalization, smoothing. The nuisance covariates (WM, CSF, and six motion parameters) were regressed out. After linear detrending, data was filtered using slow-5 (0.01–0.027 Hz), slow-4 (0.027–0.073 Hz), and slow-3 (0.073–0.2 Hz), and then ALFF/fALFF maps were generated correspondingly to each band. Between-group ALFF/fALFF differences were accessed based on the statistical criteria of FWE-corrected $P < 0.05$. We retrieved the BOLD signal in thalamus and proceeded the power spectrum analysis. The power spectra differences were accessed between groups using two-sample t-test with the statistical threshold $P < 0.05$.

RESULTS

Figure 1 and Figure 2 show that the group comparison of ALFF/fALFF maps between patients with schizophrenia and normal controls, respectively, in distinct frequency bands. Compared to controls, schizophrenia patients had decreased ALFF/fALFF in slow-5 band, identified in the middle occipital cortex, superior temporal and lingual gyrus. Decreased ALFF/ fALFF in slow-4 was located in the thalamus, superior temporal gyrus, and cuneus. The ALFF in the slow-3 bands was observed no significant differences, but the decreased fALFF in the slow-3 band was located on cerebellum and brain stem. Duo to the significant differences in slow-4 located in the thalamus, we examined the accuracy of spectrum in thalamus. Figure 3 shows the power spectrum difference in thalamus between groups is found in the 0.04-0.1 Hz.

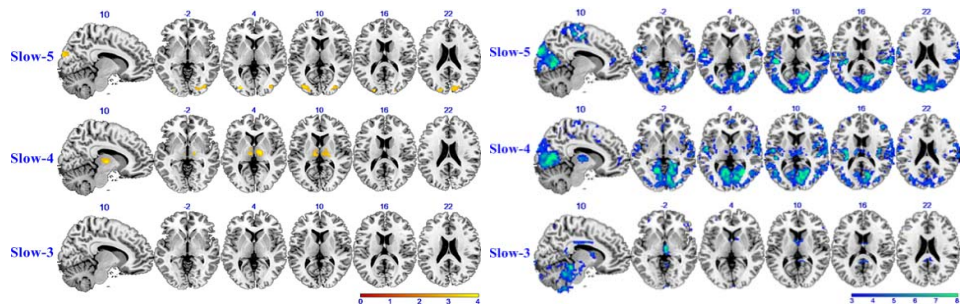


Fig.1 Between-group ALFF contrast maps (NC>SZ) in 3 different frequency ranges ($z > 3$).

Fig.2 Between-group fALFF contrast maps in 3 frequency ranges. Blue clusters show NC>SZ in fALFF.

DISCUSSION

Previous studies indicated a certain relationship between the neural oscillations and frequency specificity [2]. We found the spatial and spectral specificities in of LFO in schizophrenia patients. These results might be induced by the disorder, and the LFO shift might be related to the cognitive impairments. Meanwhile, we observed the major power spectrum difference of thalamus in the 0.04-0.1 Hz, but in ALFF map, the thalamus was present in the slow-4 band. The frequency mismatch shall be further investigated. The traditional frequency band (0.01-0.08 Hz) may not be specific to distinguish the spectral abnormality in schizophrenia.

CONCLUSIONS

To provide further evidence to study the functional alterations in schizophrenia, this study indicated that the appropriate frequency bands would be preferred to examine the functional abnormality of schizophrenia.

REFERENCES

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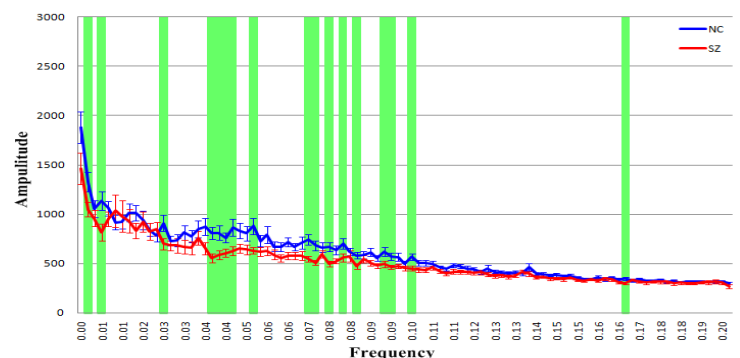


Fig.3 The power spectrum difference in thalamus between NC (blue) and SZ (red). Green bar shows the significant difference in each frequency bin.