

Altered local functional dynamics of primary visual, sensorimotor and auditory networks in MS

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Introduction: There have been a number of studies showing altered long-range resting state functional connectivity in Multiple Sclerosis (MS). However, local dynamics of the resting state signal have not been thoroughly investigated in MS yet. The aim of this study is to investigate differences in Regional Homogeneity (ReHo), fractional amplitude of low frequency fluctuations (fALFF) and degree centrality (DC) in three primary visual, sensorimotor and auditory networks between MS patients and healthy controls.

Methods: Data from twenty-eight MS patients (37.4 ±7.4 years old, 12 males) and twenty-eight healthy controls (35.0 ±8.7 years old, 12 males) were used in this study. RS-fMRI was performed on a 3T whole-body MR scanner by use of a 12-channel head coil with a gradient-echo echo-planar blood oxygen level dependent (BOLD) imaging sequence. After standard preprocessing steps, ReHo, fALFF and DC maps were generated using an alpha-version of the Configurable Pipeline for the Analysis of Connectomes (C-PAC, (<http://fcp-indi.github.io/>)). Dual regression on pre-specified templates¹ of the primary visual, auditory and sensorimotor networks was used to get the study-specific network masks. ReHo and fALFF were computed across the whole brain, while DC was computed within the networks only. Average within-network as well as voxel-wise values of ReHo, fALFF and DC were compared.

Results: Average (z-standardized) fALFF values were significantly decreased in the sensorimotor network ($p=0.034$) and significantly increased in the auditory network ($p=0.025$), while ReHo did not show significant changes. Voxel-wise comparisons, corrected for multiple comparisons, showed that fALFF, ReHo and DC were significantly decreased within the primary visual network (see Fig. 1). In addition, fALFF was decreased in the posterior parietal, sensory and motor cortex within the SMN and increased in the insula within the auditory network.

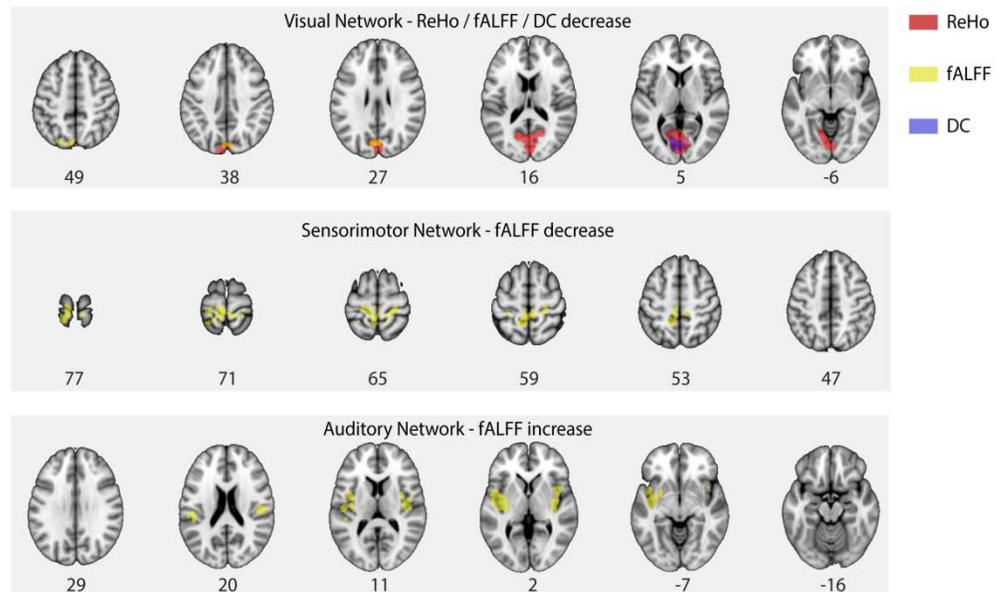


Figure 1. Voxel-wise analyses within the networks revealed clusters of decreased ReHo, fALFF and DC within the visual network and a cluster of decreased fALFF within the sensorimotor network. fALFF was increased in the posterior insula within the auditory network. Results were corrected for multiple comparisons within the study-specific network-masks using easythresh with $z>2.3$ and $p<.05$.

Discussion: We found significantly decreased fALFF, ReHo and DC in the primary visual network, suggesting that both baseline activity and local connections are reduced within primary visual areas. fALFF was reduced within the sensorimotor network, indicating reduced baseline activity within these areas. The increased fALFF in the insula may be a compensatory mechanism or may result from partial volume effects. Taken together, these results clearly show decreased local functioning of primary visual and sensorimotor areas in MS patients, and are consistent with the common clinical symptoms that are associated with these areas.

References: ¹Smith SM et al., PNAS 2009; 106: 13040-13045.