A FMRI GRAPH THEORY STUDY OF THE EFFECT OF GENDER AND AGING ON TOPOLOGY OF FUNCTIONAL BRAIN NETWORKS

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Target Audience. Neurologists and Neuroradiologists.

Purpose. Previous studies have detected an association between aging and abnormal long- and short-range functional connectivities of the human brain[1]. The combined effect of aging and gender on functional network measures has not been investigated yet. Aim of this study was to analyze age- and gender-related effects on large-scale functional brain networks using a graph theory approach[2].

Methods. Graph theoretical analysis was applied to resting state (RS) functional MRI data from 132 healthy controls (62 men and 70 women, mean age=40.6 years, range=8-84 years). Whole-brain networks were constructed using graph theory and the Brain Connectivity toolbox[3]. The global topology of functional networks was examined by computing the average degree, clustering coefficient, characteristic path length, global and local efficiency, hierarchy and assortativity. Regional network properties, including the integrated degree and local efficiency of each network node, were also assessed. The effects of age, gender and "age *x* gender" interactions on global functional network measures were assessed by using linear regression models. Correlations between aging and regional network properties were assessed by using the Spearman's Rank correlation coefficient.

Results. Significant age-related abnormalities (i.e., lower degree, clustering coefficient, local and global efficiency and hierarchy; and higher path length and assortativity) were detected in both genders. Males showed higher average network values than females. Both genders experienced a significant age-related decline of nodal degree and local efficiency of several regions of the frontal lobe (including the bilateral anterior cingulate cortex, middle and superior frontal gyrus, orbitofrontal cortex, precentral gyrus and supplementary motor area), temporal regions, posterior cingulate cortex/precuneus and deep gray matter nuclei (Figure 1). No significant "age *x* gender" interaction was found for global and regional network metrics.

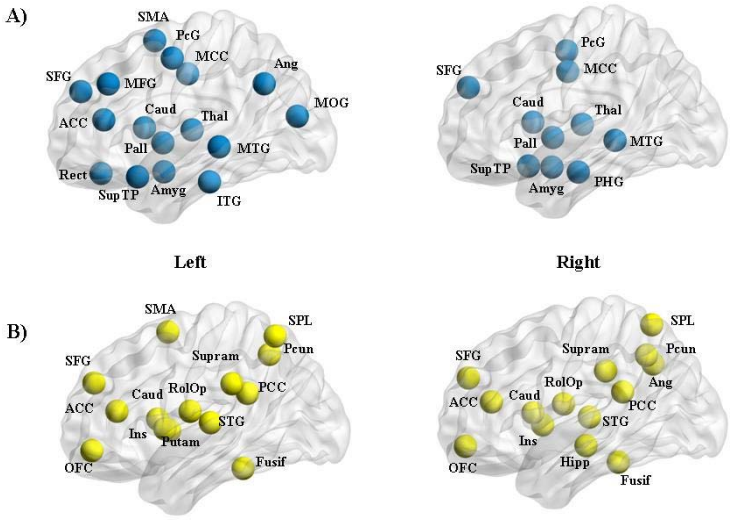

Figure 1. Brain regions showing significantly decreased nodal degree (**A**) and local efficiency (**B**) with aging.

Discussion. Age-related decline of functional network measures were detected in both genders. The effect of aging was more severe in regions of the frontal lobes and the basal ganglia than in the other brain areas. Gender does not influence such an altered network connectivity with aging.

Conclusion. Using graph theoretical analysis, we showed an age-related decline of functional network connectivity measures in both genders, which might contribute to clarify fundamental pathophysiologic aspects of neurological and psychiatric conditions.

References.

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