Default Mode Network CBF Predicts Individual Differences in Self-esteem

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Introduction Functional brain imaging research has demonstrated great interest in resting brain function in the past decade and numerous studies have consistently suggested an organized mode of default brain function (1-4). Regions in the so-called default mode network (DMN), including the posterior cingulate cortex/precuneus (PCC/PCu), medial prefrontal cortex, and lateral inferior parietal lobule, exhibit an increased level of activity during resting states even when there are no external demands on attention (2-3). However, the exact function of DMN remains largely unknown. Some studies have suggested that the DMN may be linked to self-reflection about internal thoughts and feelings in the absence of external stimulus processing (5-6). Arterial spin labeling (ASL) perfusion MRI provides non-invasive quantification of absolute cerebral blood flow (CBF) that is tightly coupled to the neural activity, therefore, potentially being a good approach to examine the default mode of brain function (3). The present study used ASL to measure resting CBF in a large cohort of normal subjects and examined the relationship between default brain function and self-esteem, one of the most important components of the self-reflection (7).

Methods A total of 81 healthy adults (42 males, age 21-48 years) were scanned in a Siemens 3T Trio scanner at rest for 4-6 minutes using a pseudo-continuous ASL sequence. They also completed the Rosenberg self-esteem measure on a 4-piont likert scale (8). Functional image processing and analyses were carried out with SPM and the Grocer toolbox. For each subject, a mean CBF image was reconstructed, normalized, and then entered into a voxel-wised multiple regression general linear modeling (GLM) analysis. Age, gender and global CBF were included in the GLM as the nuisance covariates. ROI analyses were also conducted.

Fig.1. Brain areas correlated with self-esteem.

Results The voxel-wise GLM analysis revealed three clusters significantly correlating with self-esteem scores, including the PCC/PCu, left inferior parietal cortex extending to the post-central cortex, and the right inferior parietal cortex (Fig.1, $p < 0.05$ with AlphaSim correction). The ROI analysis confirmed positive correlations (all $p < 0.001$) between regional CBF in the DMN regions and self-esteem (Fig.2).

Conclusions Our study showed that resting CBF in the DMN regions predicts individual differences in self-esteem. This finding is in line with the previous findings that DMN is associated with mind wandering during self-referential mental processing (9), supporting that DMN plays an important role in self-introspective processes when the brain is at rest.

Fig.2. Correlations between DMN CBF and self-esteem.

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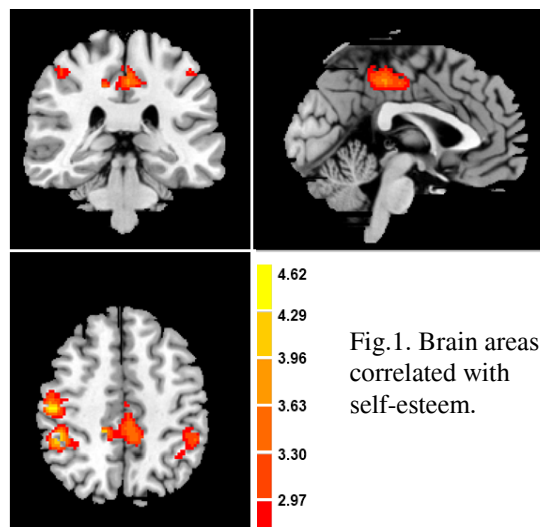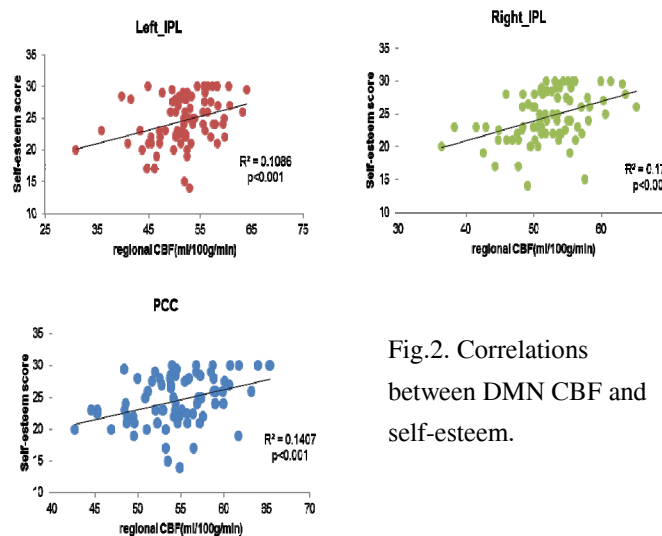9. Mason MF et al. Science 2007, 315, 393-395.