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Relationship of Cardiac-Induced Cerebral Pulsatility, Brain Structure, and Cognition

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Changes of pulsatility in local cerebral vessel can be associated with specific regions of brain volumetric changes, of which e.g., hippocampal atrophy is a highly replicated finding that is linked to risk for cognitive decline. Thus, the mapping of cardiac-induced pulsatility over the entire brain can be helpful to assess these relationships.108 subjects (age: 66.5 8.4 years, 68 females, 52 healthy control, 11 subjective cognitive decline, 17 impaired without complaints, 19 MCI and 9 AD) participated. The whole brain pulsatility was obtained directly from resting-state functional MRI time-series data at 3T. Regional volumes are segmented from anatomical images. The sparse partial least square (SPLS) method, which is desirable to better interpret high-dimensional variables, was applied for the relationship between the entire set of pulsatility voxels and segmented brain volumes. The sparsity for the SPLS model was automatically determined by grid search with the training and validation dataset. The multiple holdout framework was used to improve generalizability and reproducibility. The pulsatility was significantly associated with the segmented brain volumes (least p-value = .0001); mostly correlated with lateral ventricle volume, followed by 3rd ventricle and choroid plexus, and negatively correlated with hippocampus, followed by amygdala volume. The spatial distribution of correlated pulsatility was observed in major feeding arteries to the brain regions, ventricles, and sagittal sinus. The indirect mediating pathway of the volumes was statistically significant between the pulsatility and cognitive score ($p < .001$). Thus, the cerebral pulsatility, along with volumetric measurements, could be a potential marker for better understanding of early pathophysiology and monitoring disease progression in age-related neurodegenerative disorders.

Keywords: Cerebral pulsatility; resting-state functional MRI; brain volume atrophy; cognitive decline