

# Volumetric morphometry and multivariate pattern analysis of white matter architecture in obsessive-compulsive disorder

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**Target Audience:** Those who are interested in translational research of utilizing MR techniques in mental disorders.

**Purpose:** Obsessive-compulsive disorder (OCD) is one of the most common disabling psychiatric disorders [1]. White matter (WM) is suggested to play an important role in pathology of OCD [2]. The present study aims to explore the neuroanatomical alterations of white matter volume (WMV) in OCD patients using a relatively new whole brain morphometric method---the Voxel-Based Morphometry (VBM) with Diffeomorphic Anatomic Registration Through Exponentiated Lie (DARTEL) algebra algorithm. Moreover, we utilize multivariate pattern analysis (MVPA) technique known as support vector machine (SVM) to examine whether WMV could be used to distinguish OCD patients from healthy controls (HCs) at individual level.

**Methods:** The study was approved by the local ethical committee and written informed consent was obtained from all subjects. A total of 33 right-handed OCD patients and 33 age, sex, handedness and years of education well-matched HCs were recruited in current study. The diagnoses of OCD patients were determined using the structured clinical interview patient edition according to DSM-IV. Clinical symptoms were evaluated using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS). All subjects were scanned on a 3T magnetic resonance scanner (EXCITE, General Electric, Milwaukee, USA) with a spoiled gradient recall sequence to obtain high-resolution T1-weighted volumetric 3D images (156 continual axial slices, TR/TE: 8.5/3.4msec, Flip angle: 12 degree, Matrix: 256×256, slice thickness 1mm, voxel size: 0.47×0.47×1.00 mm<sup>3</sup>). DARTEL in Statistical Parametric Mapping 8 (SPM8) was used to calculate the alterations of WMV in OCD. Statistical threshold were set at  $P_{\text{cluster-level}} < 0.05$  (FWE-corrected). Areas showing group differences were extracted as region-of-interest for correlation with clinical measurements. SVM classification was used to calculate the sensitivity, specificity and accuracy for distinction of OCD patients from HCs on volumetric features of WM by Probid software. The significance was set at  $P < 0.001$  after permutation testing.

**Results:** OCD patients exhibited significantly decreased WMV in bilateral external capsules compared to HCs (left:  $p=0.000$ ,  $k_E=241$ ; right:  $p=0.004$ ,  $k_E=35$ ) (Figures 1). No regions of significantly increased WMV were identified at this threshold. No correlation was found between WMV of the two regions and clinical measurements. The MVPA classification yielded an accuracy of 81.82% (75.76% sensitivity, 87.88% specificity) with  $P < 0.001$  after permutation testing (Figure 2, Left). The most discriminating regions of WMV were identified by setting the threshold to the top 30% of the weight vector scores (Figure 2, Right).

**Discussion & Conclusion:** To the best of our knowledge, this is the first study integrating VBM-DARTEL analysis with SVM classification approach to evaluate structural alterations of WM in OCD. Decreased WMV was firstly revealed in bilateral external capsules of OCD patients, while discriminative regions were mainly involving the left middle frontal WM and bilateral temporo-parieto-occipital junction. As a relative high accuracy was identified by SVM classification approach with WM volume, the current study supported the potential translational role of WM as imaging marker for individual level diagnosis in OCD.

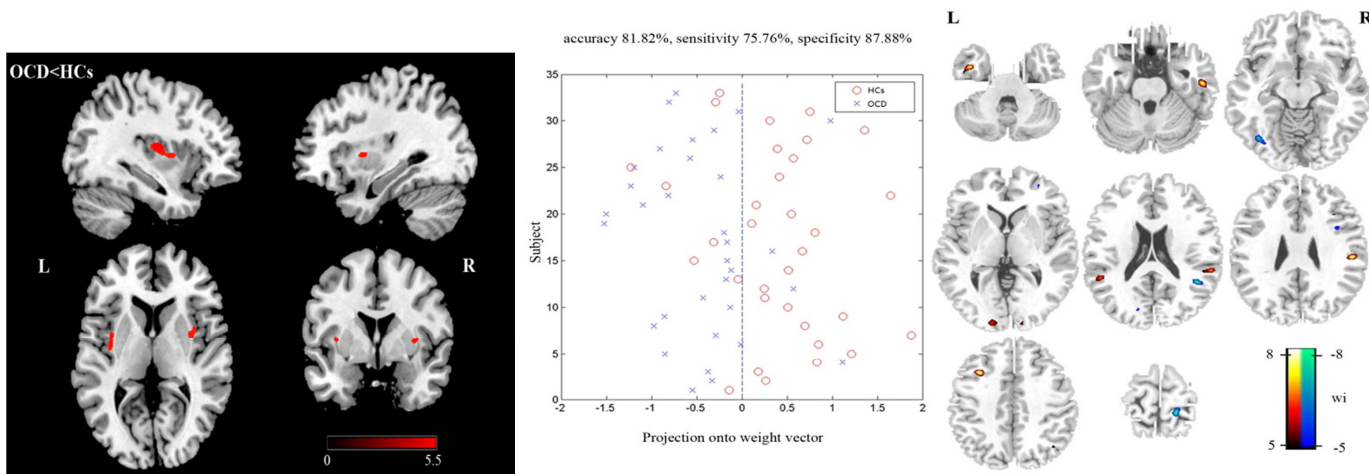


Figure 1. Two-sample  $t$ -test analyses showed decreased WMV in bilateral external capsules in OCD patients comparing to HCs ( $P < 0.05$ , FWE-corrected at cluster level).

Figure 2. The left figure demonstrated the classification plots of SVM. The right figure showed the most discriminating regions identified by setting the threshold to the top 30% of the WMV weight vector scores. Red indicated higher values in the HCs, while blue indicated higher values in the OCD. ( $w_i$ : weight of each cluster's centroid  $i$ .)

**References:** 1. Stein, D.J., 2002. Lancet 360, 397-405. 2. Piras, F., Caltagirone, C., Spalletta, G., 2013. Neurosci Biobehav Rev. doi: 10.1016/j.neubiorev.2013.10.008.