# Resting state network changes in pediatric OCD

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## Introduction

Obsessive-compulsive disorder (OCD) is an anxiety disorder characterized by distressing, irrational thoughts and repetitive behaviors. Although pediatric OCD is similar to OCD in adults, the content of obsessions and compulsions can be influenced by developmental factors such as age, gender, and genetics [1,2]. Ritualistic washing, repetitive checking, ordering, counting and hoarding are common compulsions in children and adolescents. Neuro-imaging studies have contributed to our understanding of the neurobiological basis of pediatric OCD [3]. The purpose of this study was to use resting state fMRI to explore disease affected brain networks in pediatric OCD patients compared to healthy volunteers.

## Subjects and Methods

Two groups were investigated using resting state fMRI. The first group included 23 pediatric OCD patients with a mean age of 14.3± 2.1 and the second group included 23 age-matched controls with a mean age of 14.2± 2.2. All images were acquired on a 3T clinical scanner. T1-weighted structural images were acquired with TE = 3.02 ms, TR = 7.832 ms, TI = 650 ms, slice thickness = 1 mm, FOV = 24 cm, matrix = 256 x 256, 216 slices. Resting state scans were 5 min in duration, 150 volumes, TE = 30 ms, TR = 2 s, slice thickness = 3 mm, FOV = 24 cm, matrix = 64 x 64, 40 slices. During the data acquisition for resting fMRI, the subjects were instructed not to engage in cognitive or motor activity and to keep their eyes closed. Preprocessing resting fMRI consisted of motion correction, brain extraction, spatial smoothing with kernel FWHM of 8 mm and first registering to the structural images and then to the MNI template. Preprocessing was carried out using FSL software [4]. The data were then intensity normalized by dividing the time series of each voxel by its time averaged intensity. Data were then decomposed into functional networks using spatial group independent component analysis (ICA) by GIFT software [5, 6]. In this analysis, the data set was decomposed into 36 components, in which the model order was estimated using minimum description length criteria. Subject spatial maps and temporal dynamics were estimated using the dual-regression approach [5]. For each component, we computed subjects' expression scores [7] by taking the dot product of the mean group and subject's spatial map. Nominal logistic fit (JMP software, SAS Institute Inc., Cary, NC) was used to identify a subset of independent components (ICs) that yielded a maximum separation between control and pediatric OCD groups.

## Results

We performed a 36-component group ICA using resting-state fMRI data from 46 subjects. Four ICs including the frontal and anterior cingulate network (IC1), visual network (IC 8), cingulate network (IC 19) and sensorimotor network (IC 25) as shown in Fig. 1 were determined to obtain maximum separation between the two groups using a nominal logistic model. A linear combination of these four networks (disorder pattern) was computed using estimated parameters for the nominal logistic model. Disorder pattern expression scores in pediatric OCD patients were lower than healthy volunteers. The average disorder pattern expression scores for the two groups and the post-hoc *p*-value (2-sample t-test) are provided in the table below.

| Control (n=23) | OCD (n=23) | p < |
|---|---|---|
| 0.471 ± 0.648 | -0.365 ± 0.543 | 0.0001 |

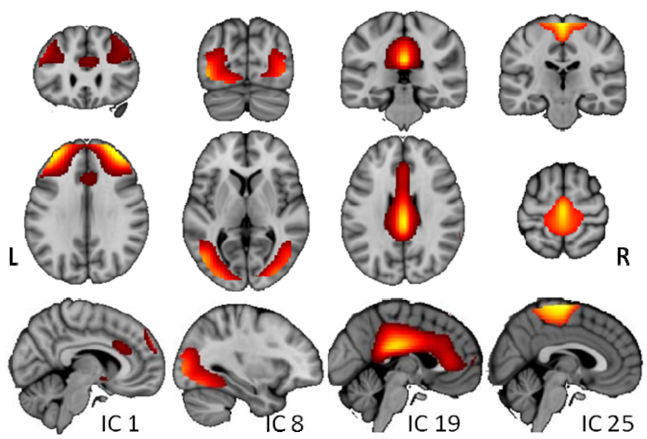


Figure 1: Four selected resting state networks provide a maximum separation between control and OCD groups.

## Discussion/Conclusions

We found a decrease in subjects' disorder pattern expression scores in the OCD group compared to the control group using resting state fMRI. The changes in frontal and cingulate network may relate to anterior cingulate dysfunction [8] in this disorder. The anterior cingulate has been hypothesized to play a role in detecting and signaling conflict during information processing, especially when there is a high likelihood of making an error [8]. Abnormalities in anterior cingulate network could conceivably activate brain regions comprising basal ganglia-thalamo-cortical circuits [9, 10] without any associated input causing certain behaviors to be completed compulsively. Our findings indicate that abnormal functional connectivity networks may provide considerable insight into the pathophysiology of pediatric OCD disorder.

## Acknowledgments

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## References

1) Franklin ME et al., Pediatric Obsessive Compulsive Disorder, Oxford University Press, Chapter 13, 381-386, 2004. 2) Snider LA, et al. J. of Child and Adolescent Psychopharmacology 13, S81-S88, 2003. 3) Huyser C et al. Neuroscience & Biobehavioral Reviews 33(6), 818-830 (2009). 4) http://www.fmrib.ox.ac.uk/fsl/ . 5) http://icatb.sourceforge.net/groupica.htm. 6) Calhoun VD et al. NeuroImage, 45, 163-172, 2009. 7) Eidelberg D et al, Annals of Neurology, 44(3), 303-312, 1998. 8) Cohen RA, et al. J. of Neuropsychiatry and Clinical Neurosciences 11, 444-453 (1999). 9) Leckman JF, *et al*. Psychiatric Clinics North America 20, 839-861 (1997). 10) Greenberg BD, *et al.* Neurology 54, 142-147 (2000).