



International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirccce.com

Vol. 5, Special Issue 3, April 2017

Comparing the Brain Regions of Healthy Controls and ADHD

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ABSTRACT: Attention Deficit Hyperactivity Disorder (ADHD) is a mental disorder which affects the brain regions. Therefore, some brain regions will have more activated blood flow compared to other regions i.e., the regions do not have required amount of blood flow. This project investigated the brain regions differences between ADHD and healthy controls using fMRI. fMRI technique is a better technique for accurate results and subject's safety because radiation is not involved in this technique. 7 healthy and 7 ADHD subject's data set were gathered on the same scanner. Then these data were pre-processed using Statistical Parametric mapping tool (SPM). After performing pre-processing Independent Component Analysis (ICA) has been done using GIFT tool. The ICA results shows the Blood Oxygen Level Detection (BOLD) signal for both healthy and ADHD subjects. As expected, parietal regions of ADHD subjects have more activated blood flow.

KEYWORDS: ADHD, SPM, ICA, BOLD.

I. INTRODUCTION

Brain is a main organ for all living things. It controls central nervous system. Brain has left and right hemispheres. Both hemispheres of brain perform different functions. The right hemisphere involves verbal functions and left hemisphere involves non-verbal functions. Some functions are more activated in one hemisphere than the other.

The brain activity can be viewed by some techniques like MRI, PET, fMRI. The anatomical structures only view by (Magnetic Resonance Imaging) MRI. fMRI (functional Magnetic Resonance Imaging) technique can view metabolic structures so it gives more accurate values than MRI. Brain activity is measured through BOLD signal in fMRI. The more activated areas in brain consumes more oxygen using this fact fMRI technique works.

Attention Deficit Hyperactivity Disorder (ADHD) is a chronic psychotic illness which affects from childhood and continue through adolescence and adulthood. The people who are affected by ADHD have problems in paying attention. They do all the things urgently without thinking about the results. They cannot even sit in one place. This hyperactivity disorder cannot be recovered but treatment may help. They require a medical diagnosis.

The fMRI technique can view the over activated and under activated brain regions of ADHD subjects. By comparing the results with healthy control's brain activity, the medical researchers can find some medicines to cure ADHD.

II. CONCEPTS AND METHODOLOGY

Data were collected from the 3-Tesla Trio Scanner. 7 healthy subjects and 7 ADHD subjects were collected. Each healthy subject has 195 scan images and ADHD subjects have 261 scan images. All images have the matrix size of 64×64×34, and the voxel size of -3×3×4 mm. during scanning all the subjects were instructed to open their eyes which helps network delineation.

A. DATA PRE-PROCESSING

All the images which are going to perform statistical comparison must be pre-processed. Pre-processing helps to

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remove noise and correct the sampling error. Here we use Statistical Parametric Mapping (SPM) software for analysing the brain imaging data sequence. This data sequence can be a series of images from the same subjects in different time series.

SPM has three different steps to perform pre-processing. First each subject was realigned. While perform scanning due to slight head motion major problems may occur. To overcome that realignment process is performed. After that all the realigned data were normalised. To correct the minor differences in overall brain size normalization process used. Finally, the normalized data were smoothed. To increase statistical power and to improve signal to noise ratio smoothing process is used.

B. INDEPENDENT COMPONENT ANALYSIS

ICA is a method to find underlying components from multivariate data. Separating multidimensional data into independent component is a main objective of ICA.

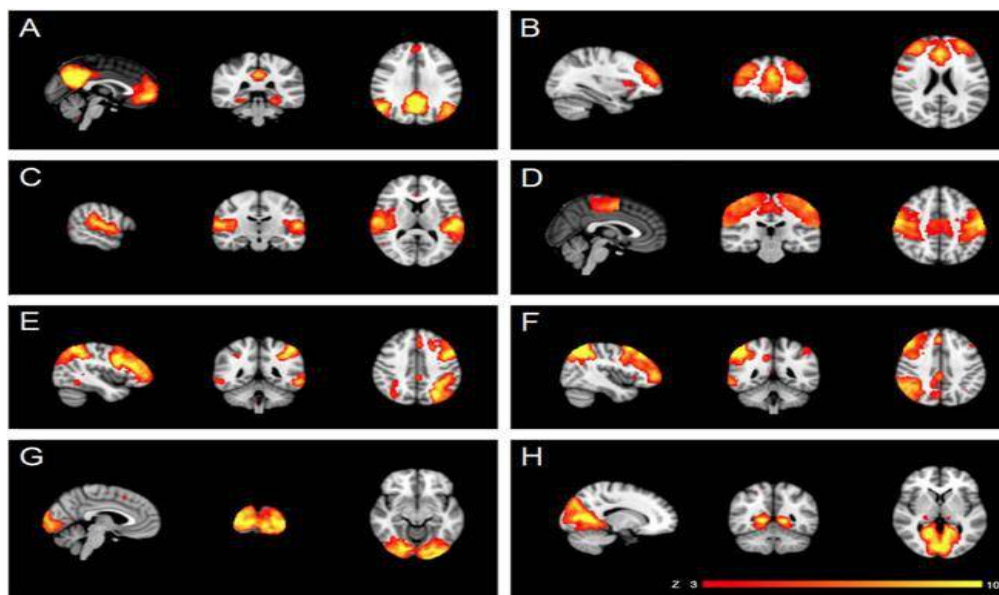


Fig 1: Resting State Networks

- A. Default mode network
- B. Executive control network
- C. Auditory network
- D. Sensory-motor network
- E. Left fronto-parietal network
- F. Right fronto-parietal network
- G. Medial visual network
- H. Lateral visual network

For accurate results Infomax ICA algorithm and ICASSO gICA algorithm were used. GICA back reconstruction type is selected for reconstructing the components. Expectation Maximization PCA is used and 20 repetitions is selected in ICASSO. ICA performs parameters initialization, group data reduction, calculate ICA, back reconstruction, calibrate components and group statics.

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III. RESULTS

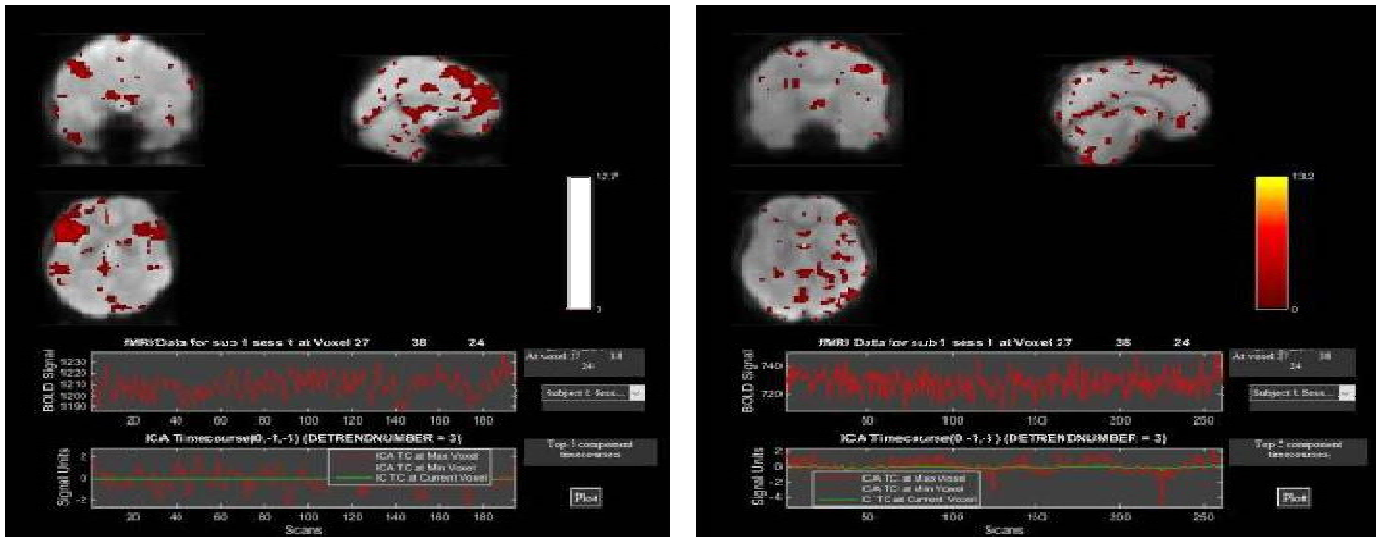


Fig 2: Left fronto parietal regions of healthy controls and ADHD

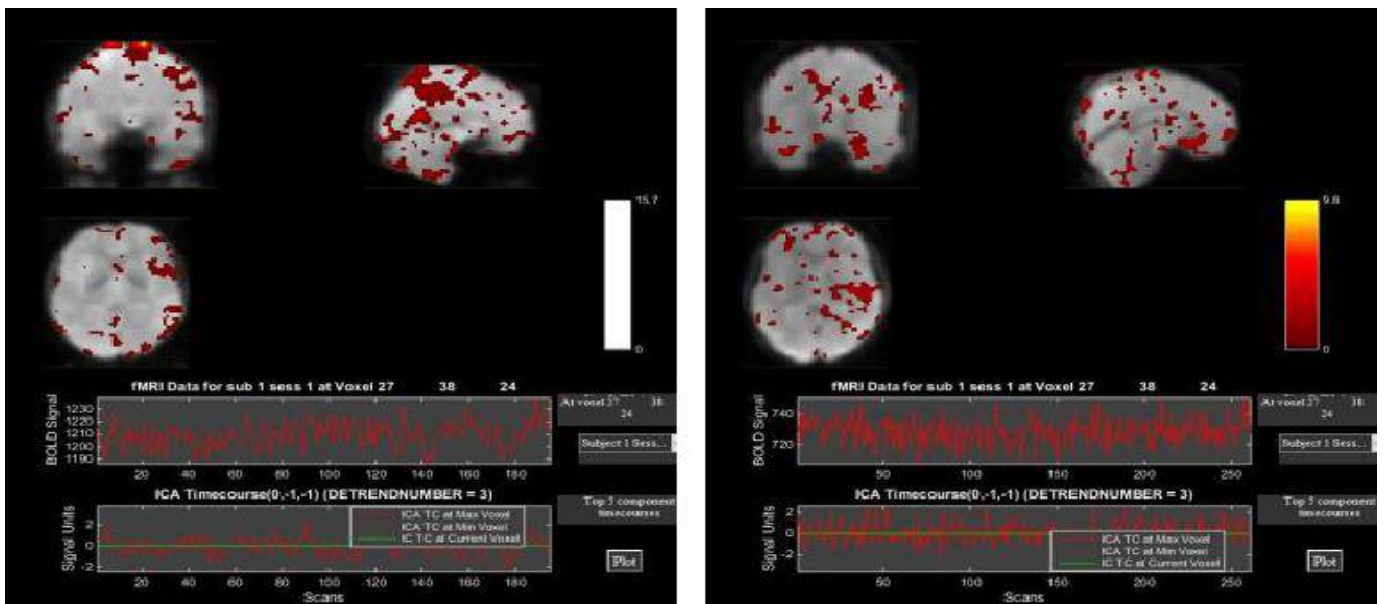


Fig 3: Right fronto parietal region of healthy controls and ADHD

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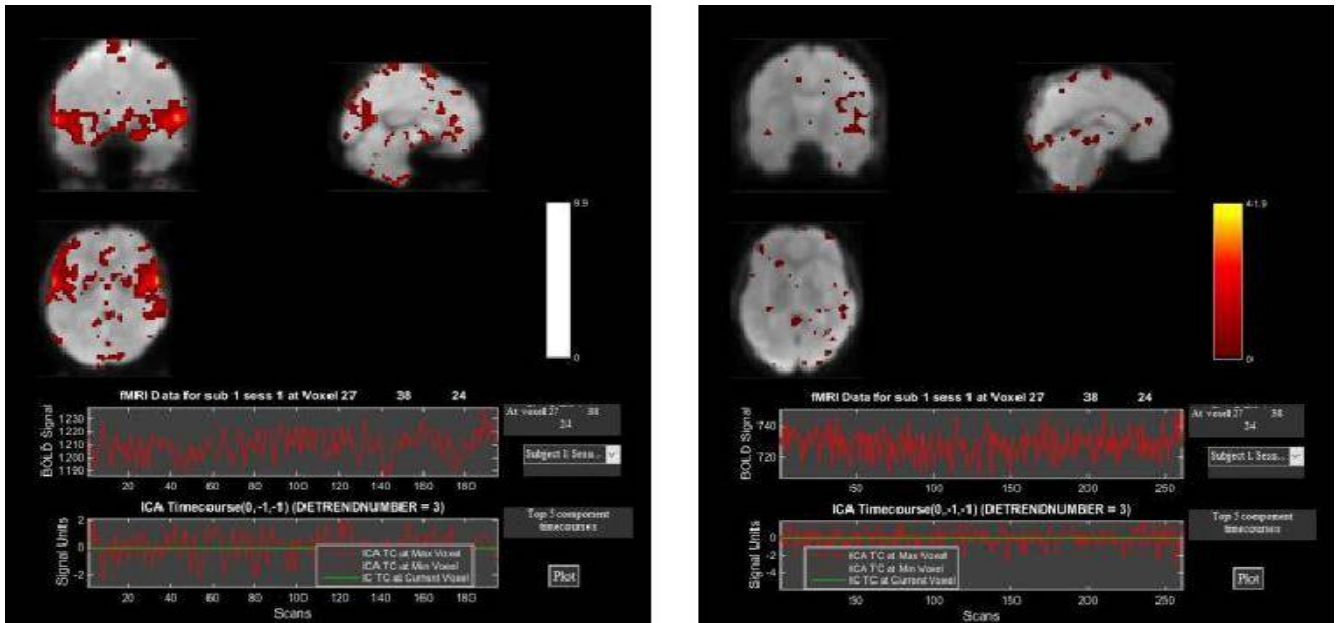


Fig 4: Auditory region of healthy controls and ADHD

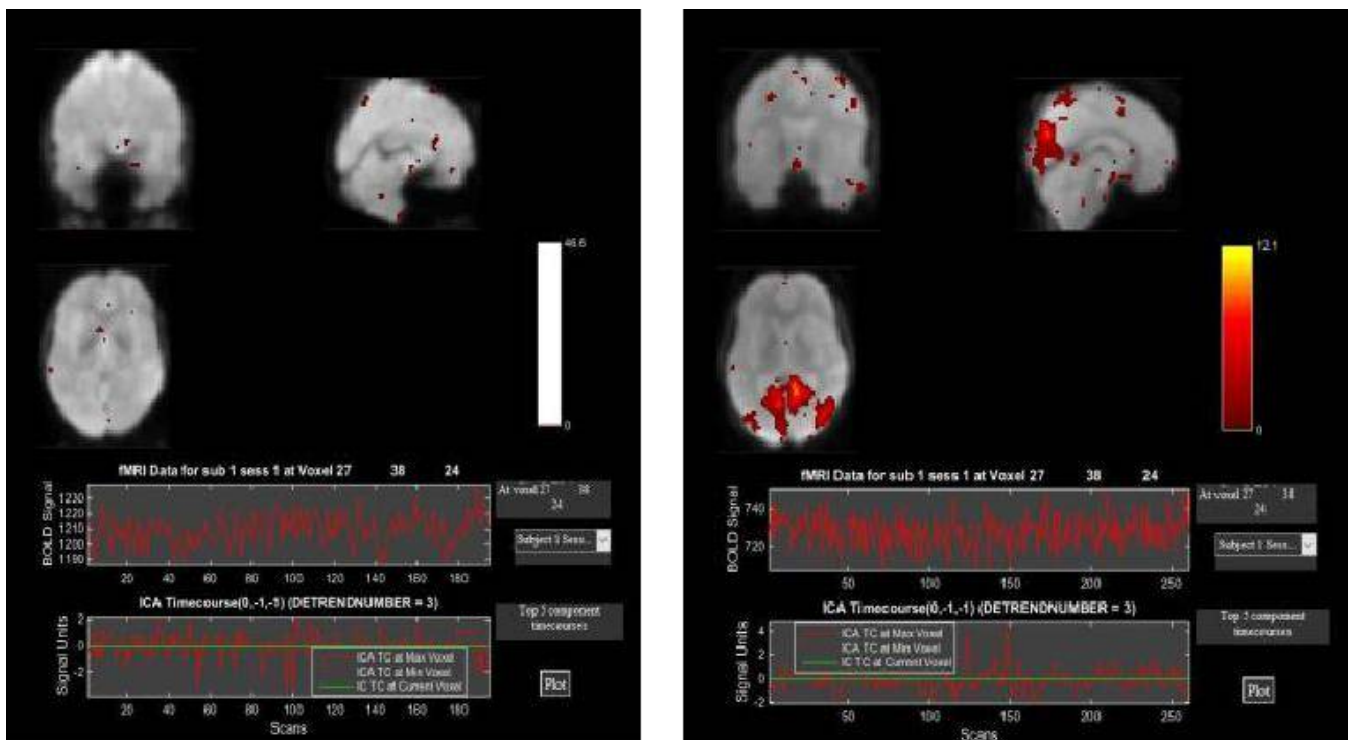


Fig 5: Lateral Visual Network of healthy controls and ADHD

The results show that the parietal networks are under activated and the occipital lobes like visual functions are more activated in ADHD subjects compared with healthy controls.



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IV. CONCLUSION

The results for ICA showed that the left fronto parietal and right fronto parietal regions has limited amount of blood flow whereas the occipital lobes like lateral visual network has maximum amount of blood flow. We recommended the further studies to perform lateralization to find out the accurate results about the brain activity.

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ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

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Website: www.ijircce.com

Vol. 5, Special Issue 3, April 2017

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