Effect of Lithium on Structure and Composition of Brain in Bipolar Disorder

Fiona Tay Quan Yi* . B150487995 . Bsc Biomedical Science (Hons) . F.Tay1@newcastle.ac.uk

Bipolar Lithium Imaging and Spectroscopy Study

Aims of Study

To investigate the effect of therapy with lithium on brain morphology and composition in bipolar disorder (BD) patients.

Introduction

- Bipolar Disorder is a psychiatric illness that mainly affects your mood. Patients are likely to experience episodes of manic or depression or potentially some psychotic symptoms.
- Lithium is a natural mineral, not a manufactured drug that occurs in the environment. It is used as an effective mood stabiliser in treating Bipolar Disorder.
- Magnetic Resonance Imaging (MRI) is a medical imaging technique enabling the structure, function and composition of the brain to be probed in vivo.
- CAT (Computational Anatomy Toolbox) is an extension of SPM12 (Statistical Parametric Mapping version 12) to provide computational anatomy. The set of structural MRI data was previously analysed using SPM8 and SIENA, concluding that the GM changed following lithium might be an artefact of the VBM technique. CAT is used to observe whether it would yield the same finding or one of greater magnitude.
- SPSS is a software package used for statistical analysis.

Grey Matter (GM)

White Matter (WM)
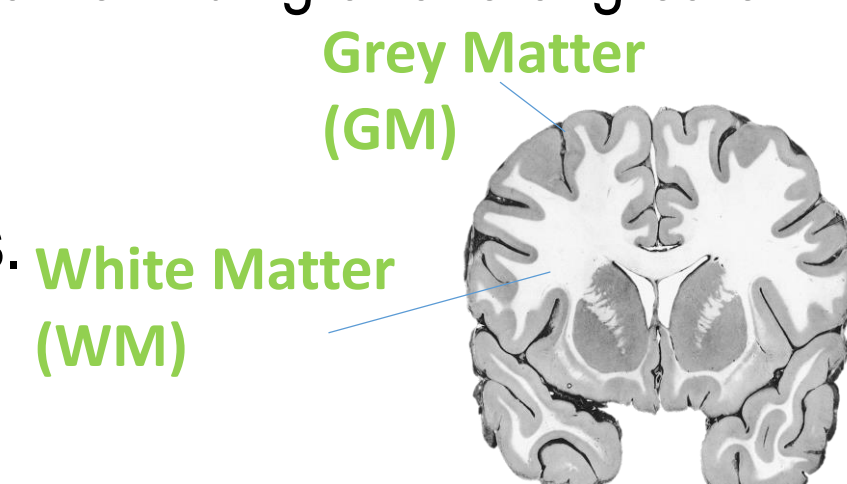
Methods

Structural MRI data from 25 BD (Lithium group) and 6 placebo subjects were used and preprocessed in the study.

- The subjects are all healthy male volunteers and no regular smoker.
- The MRI data of lithium group were collected before and 11 days after the treatment with lithium.
- Each MRI data was normalized and segmented into grey matter (GM), white matter (WM), and cerebrospinal fluid (CSF) using CAT and VBM (voxel-based morphometry) mode of SPM12 ,accessed through the MATLAB command-line. The total intracranial volumes (TIV) were calculated by summing the voxel values over segmented image.
- Segmented images were smoothed with a Gaussian kernel of 12mm FWHM prior to voxel-wise comparison.

The smoothed images of the subjects of the lithium and placebo group underwent a voxel-wise comparison such as descriptive analysis and paired T-test in SPSS.

Results
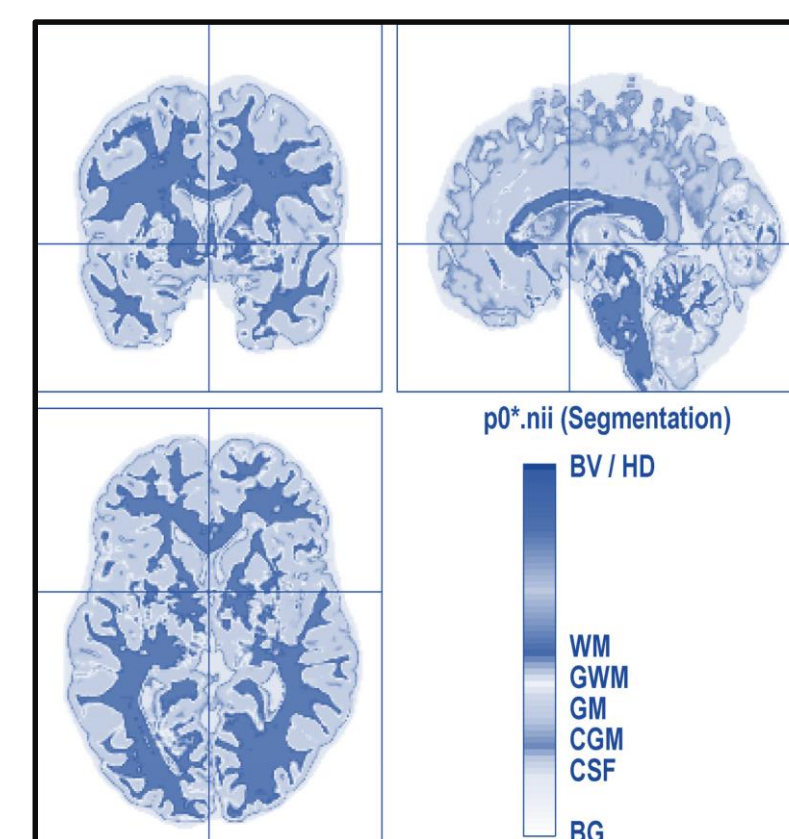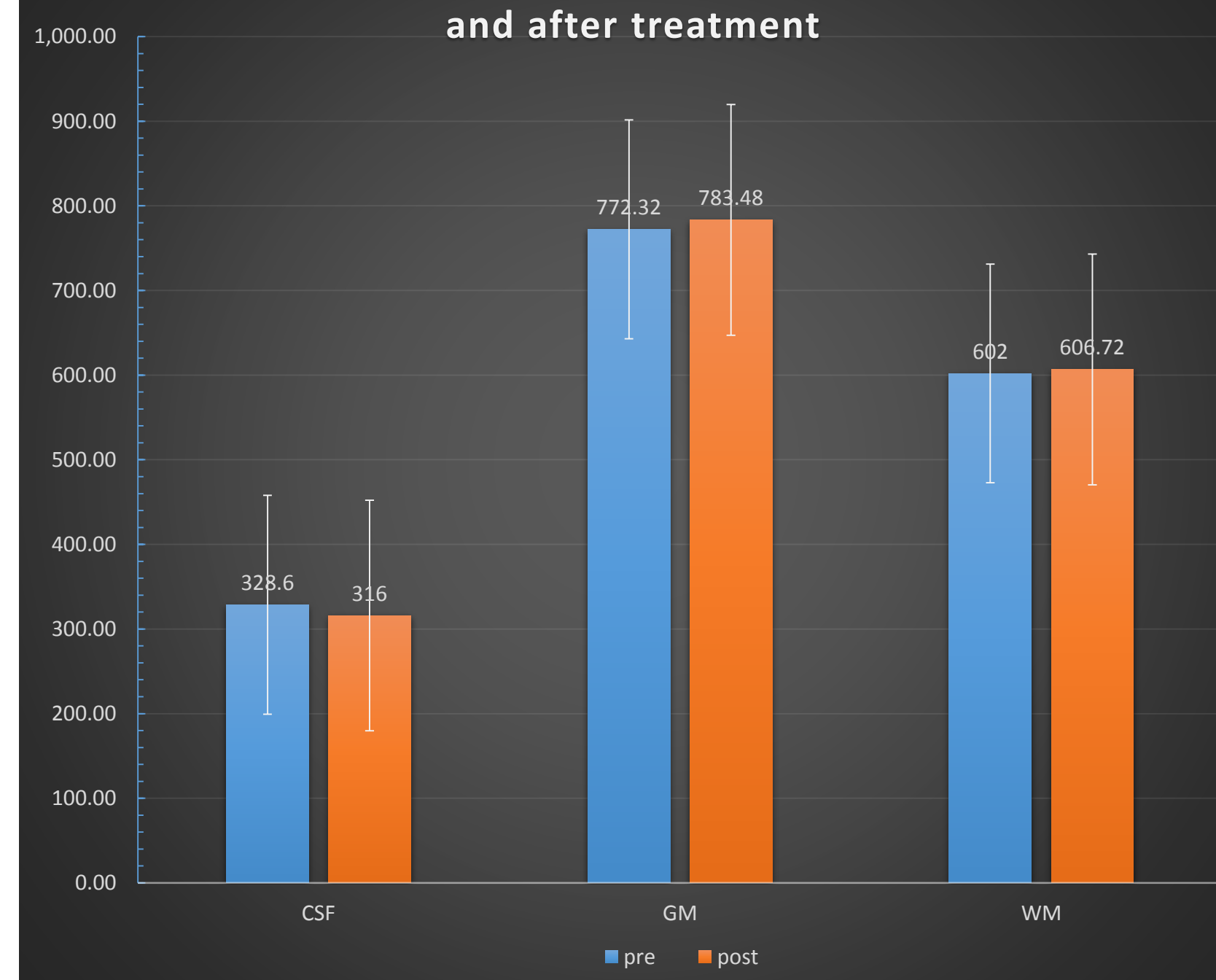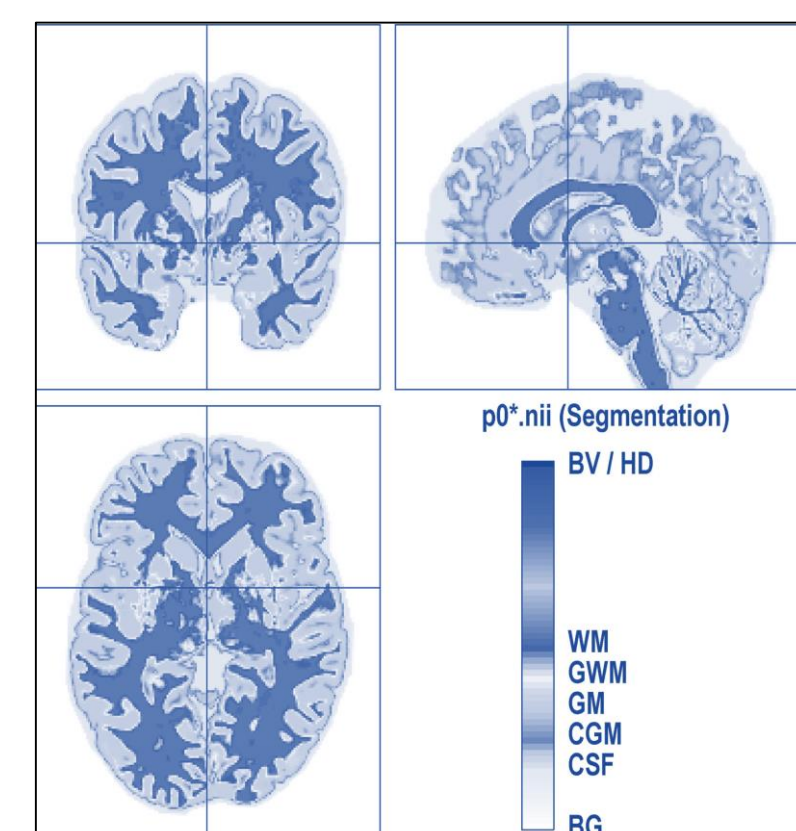
Lithium Group

Before Lithium
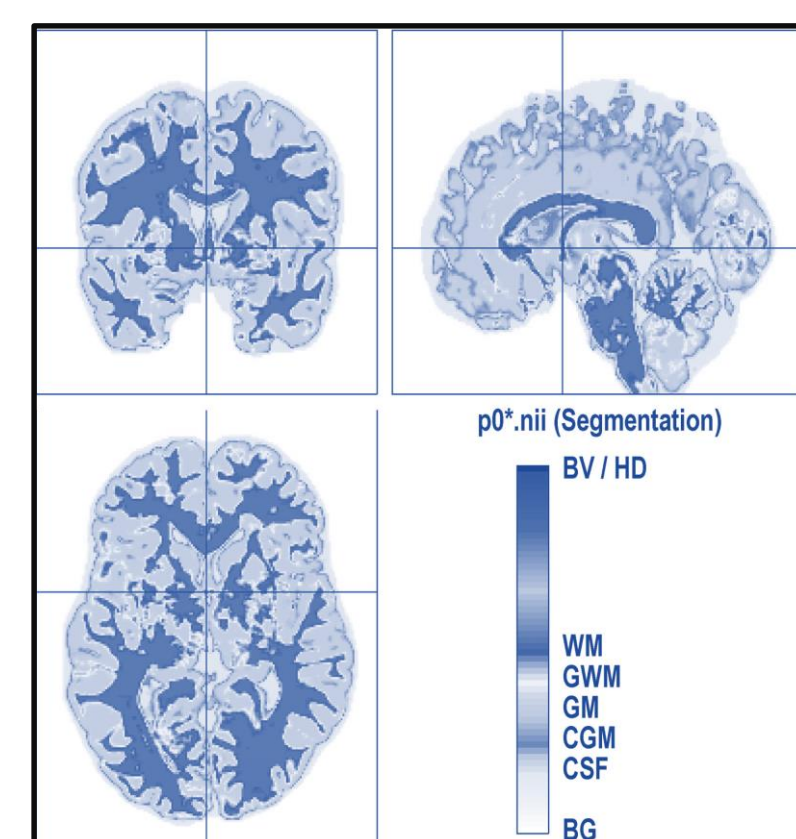
After Lithium

Mean of Tissue Volume of Lithium Group before and after treatment

Placebo Group

Before

After
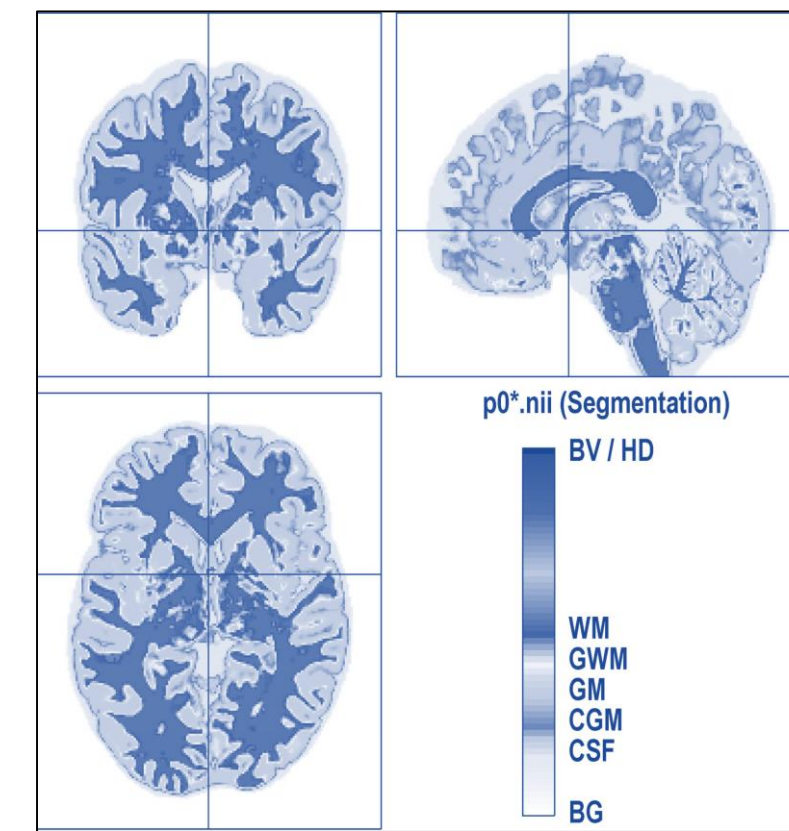
Paired T-test Results

Paired Samples Test								
				Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	CSF_pre - CSF_post	12.60000	13.51542	2.70308	7.02111	18.17889	4.661	24	.000

Paired Samples Test								
				Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	GM_pre - GM_post	-11.16000	13.84341	2.76868	-16.87428	-5.44572	-4.031	24	.000

Paired Samples Test								
				Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	WM_pre - WM_post	-1.28000	6.52253	1.30451	-3.97237	1.41237	-.981	24	.336

Paired Samples Test								
				Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	TIV_pre - TIV_post	.16000	4.64292	.92858	-1.75650	2.07650	.172	24	.865

Discussion

The null hypothesis for T-test is that the mean volume between the pre and post treatment are equal. According to the outcome of paired T-test at significance level of 0.05, the p-value for CSF 0.00, which is less than 0.05. Thus, this is a strong evidence against the null that the mean volume of CSF pre and post treatment are not equal. Moreover, the p-value for GM is 0.000, which is less than 0.05. This is a strong evidence against the null hypothesis that the mean volume of GM pre and post treatment are not equal. On the other hand, the p-value for both WM and TIV are higher than 0.05. This suggested that the null hypothesis is accepted which their mean volume for both WM and TIV pre and post treatment are equal.

My data has suggest that lithium treatment results in the increase of GM volume. However, there is no significant change in the TIV and WM volume. This suggest that the lithium has no effect to the total volume of brain and WM but only to the GM. Furthermore, the decrease in the mean volume of CSF is believed to compensate the gain of volume in GM, so that the TIV volume does not change.

In conclusion, the CAT seems similar to the SPM 8 algorithm; thus, the concerns regarding the artefact effects of lithium on GM volume are relevant for future studies using this technique.