Medicine, Nursing and Health Sciences

Regional brain volumes in body dysmorphic disorder

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Background

Body dysmorphic disorder (BDD) is a mental disorder characterised by a preoccupation with an imagined defect in physical appearance. Individuals with BDD often engage in repetitive and ritualistic behaviours, including skin picking, camouflaging their supposed defect, and checking their appearance in the mirror. BDD and obsessive compulsive disorder (OCD) have been linked in terms of symptomatology, familial prevalence and the high degree of comorbidity (Marazziti et al., 2006).

Neuropsychological research has revealed a range of deficits in BDD, including, executive function (Hanes, 1998) and inhibitory control of emotional responses (Buhlmann et al., 2002).

Several neuroimaging studies have directly investigated structural and functional brain abnormalities in BDD. The right amygdala has been shown to have increased activation in response to visual stimuli in a functional magnetic resonance imaging (fMRI) study (Feusner, et al., 2007). Other abnormalities in areas related to emotion, such as the anterior cingulate cortex suggest that there are deficits in the limbic system (Atmaca et al., 2010). The orbitofrontal cortex has been shown to be reduced in volume compared to controls using structural MRI (Atmaca, et al., 2010). The findings of abnormalities in the anterior cingulate cortex and orbitofrontal cortex parallel the findings in OCD, and are thought to contribute to the repetitive thoughts and behaviors and inflexibility after negative feedback (reverse learning). This neurobiological model of OCD is well established but more neuroimaging evidence is needed in BDD.

Aim

The current study's aim was to provide further robust evidence to support the frontostriatal model of BDD by investigating volumetric differences in gray matter regions using brain imaging. We developed specific hypotheses based on past neuroimaging findings, focusing our regions of interest on frontostriatal circuitry.

We hypothesised BDD would have smaller volume in the:

- orbitofrontal cortex
- anterior cingulate cortex
- thalamus
- hippocampus
- amygdale

Method

Twenty participants with BDD and 20 healthy controls matched on age, sex and handedness underwent magnetic resonance imaging using a Siemens 3T scanner. The BDD participants were recruited from the St Vincent's Hospital Body Image Clinic in Melbourne, Australia.

The MRI data was subjected to cortical reconstruction and volumetric segmentation analyzed using the Freesurfer software package (Version 4.5) based largely on automated steps.

The volumes in the orbitofrontal cortex, anterior cingulate cortex, thalamus and amydgale were statistically analysed using SPSS. In addition to performing an ANOVA, an ANCOVA was conducted in order to adjust for global brain volume differences and determine if volumes changed independently from whole brain changes.

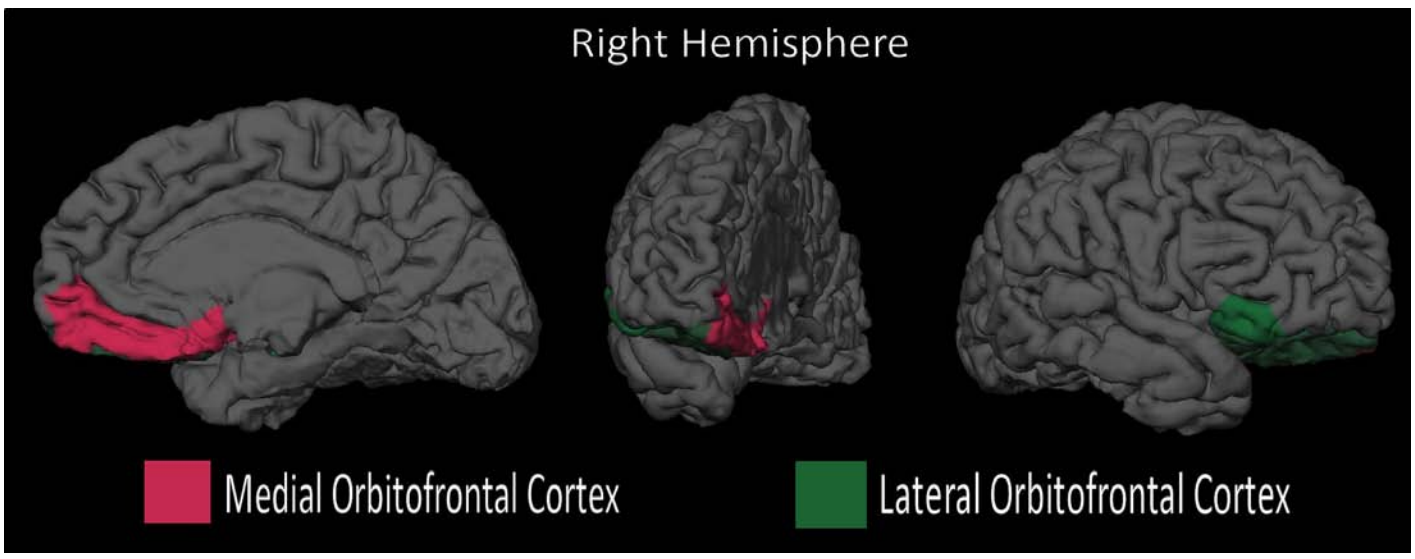

Figure 1. Reduced right orbitofrontal cortex in BDD, lateral and medial regions

Results

The bilateral orbitofrontal cortex, left anterior cingulate cortex, bilateral thalamus, left hippocampus and amygdala were significantly smaller in the BDD sample. When covarying for total brain differences the significant differences remained for the right oribitofrontal cortex and left anterior cingulate cortex, indicating that these areas were smaller in BDD participants independent of reduced global brain volumes. Figure 1 shows the orbitofrontal cortex broken into medial and lateral regions, and Figure 2 shows rostral and caudal areas of the anterior cingulate cortex. In addition to the right orbitofrontal cortex being smaller in the BDD group, duration of illness significantly correlated with volumes even after covarying for age (r=-.537, *p*=.032), as shown in Figure 3.

Table 1. Volume differences in regions of interest across groups

Brain Region		BBD Mean	BBD SD	Control Mean	Control SD	Raw *p*	Covaried *p*
Orbitofrontal Cortex	Left	12.5	1.5	13.2	1.4	.152	.722
	Right	11.8	1.1	13.3	1.5	**.002***	**.007***
Anterior Cingulate	Left	4.43	0.67	5.10	081	**.007***	**.040***
	Right	4.20	0.79	4.39	0.74	.438	.797
Thalamus	Left	6.99	0.82	7.50	0.70	**.041***	.225
	Right	7.15	0.77	7.64	0.58	**.028***	.165
Hippocampus	Left	4.19	0.32	4.44	0.36	**.025***	.143
	Right	4.33	0.35	4.52	0.39	.109	.577
Amygdale	Left	1.59	0.19	1.70	0.14	**.049***	.238
	Right	1.61	0.20	1.69	0.14	.134	.702

Volumes represented as cm³. * indicates significance at .05

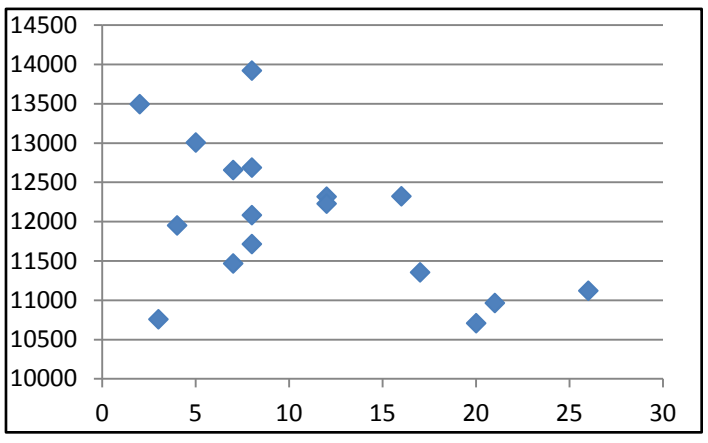

Figure 3. Right OFC volume (mm³) vs Illness Duration (years)

Discussion

This is the largest volumetric neuroimaging study in BDD to date, which provides robust findings of smaller regional volumes compared to controls. The main findings were reduced volumes in the right orbitofrontal cortex and left anterior cingulate cortex.

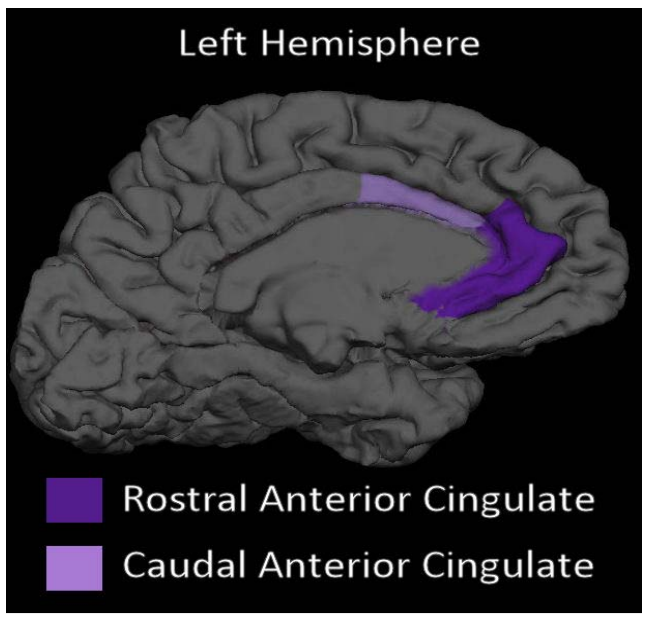

Figure 2. Reduced anterior cingulate cortex in BDD, rostral and caudal regions

Discussion continued

Anterior Cingulate Cortex (AAC)

The ACC has an important inhibitory effect on emotional responses and other executive tasks, skills that BDD participants demonstrated deficits in through emotion stroop tasks (Buhlmann *et al.,* 2002). Reduced inhibitory control mediated by the ACC has also been conceptualized as being of central importance in the pathogenesis of OCD (Venkatasubramanian *et al.,* 2012).

Oribitofrontal Cortex (OFC)

The OFC is involved with decision-making, emotion regulation, and reward expectation. It facilitates behavioural flexibility after negative feedback (reverse learning), reducing rumination.

Taken together, the OFC and ACC are both important to frontostriatal circuits that mediate inhibitory control, flexibility in response, and guide thoughts and behaviour. Thus, BDD patients may have difficulty with top-down regulation of amygdale reactivity to control negative affect and mediate threat perception, explaining BDD symptompatology. Our evidence supports the frontrostriatal explanation of BDD and the neurocognitive basis for ruminative symptoms.

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