Cognitive and emotional processing in Anorexia Nervosa: An fMRI study - ACE Study

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Introduction

Over the past three decades, information processing styles have become of interest in studying eating disorders. Studies have highlighted, for example, difficulties in flexibility of thinking, a detail-oriented attentional bias, and problems in emotion processing in people with Anorexia Nervosa (AN). However, little was known about the underlying neurocognitive profile of AN as most imaging studies focused on processes associated with food and body imagery [1].

The identification of cognitive inefficiencies in those with AN has also led to the development of tailored interventions such as Cognitive Remediation Therapy (CRT). A systematic review of randomized treatment studies found that CRT successfully addresses cognitive problems present in AN and this is reflected in improvements in performance on cognitive tasks and in low attrition rates [2].

This study investigated the neural correlates of cognitive and emotional processes, as well as examining brain structure, in adult females with AN using magnetic resonance imaging (MRI). In addition, a longitudinal pilot study was carried out to explore the influence of CRT on cognitive performance in a subgroup of patients who had undergone CRT since their first scan.

To examine brain structure, we compared patients to healthy controls in terms of brain volume. Assessment of set-shifting, central coherence, working memory, and emotion processing was carried out by examining performance and changes in brain response during cognitive tasks using functional magnetic resonance imaging (fMRI). Following CRT, central coherence was examined again to explore potential changes.

Methods

Patients and controls were optimally matched in terms of age and estimated IQ and two equal-sized groups of 33 participants each were utilized in cross-sectional comparisons. For the longitudinal assessment, individuals were rescanned 8 weeks after their first scan. Ten patients with AN received CRT and ten controls underwent no intervention.

Set-shifting was assessed using the Wisconsin Card Sorting Task (WCST) where individuals have to adjust their response to continually changing rules to sort the cards. Central coherence was measured using the Embedded Figures Test (EFT), where a small geometric shape has to be identified in a larger figure. The n-back task was used to measure working memory and requires participants to give a response if the letter they see is the same as the one they saw *n*-trials prior. To measure emotional processing, a Facial Expression Processing (FEP) task was used where individuals have to guess the gender of faces with a neutral or happy expression.

Results

An assessment of brain structure found an overall decrease in brain volume and a specific decrease in grey matter volume as well as a decrease of volume in the cerebellum and mesencephalon that correlated with greater duration of illness [3].

There were no differences in performance or brain response between groups in terms of working memory function on the n-back task [4]. During the WCST, those with AN demonstrated aberrant signaling in brain regions associated with visual attention and visuospatial processing, including the angular gyrus and precuneus during trials that required cognitive flexibility [5]. Similarly, performance on the EFT was similar between AN and HC but localized changes in brain response were present in the fusiform gyrus, associated with visual processing, as well as the posterior cingulate cortex when the geometric shape was hidden in more complex figures [6]. Alongside small differences in reaction time, individuals with AN showed a consistently stronger response in occipital brain regions, regardless of the facial expression, and a linear increase in signal in response to moving from neutral to prototypically happy faces was found to be greater in those with AN [7].

The longitudinal assessment of central coherence found that both groups had improved on the EFT, indicative of a practice effect, but in those with AN there was a stronger decrease in task-related occipital regions of the brain including the fusiform gyrus [8].

Conclusions

This study demonstrated differences between structural and functional aspects of the brain in adult females with and without AN. These findings suggest that inefficient cognitive processing in AN is characterised by increased recruitment of regions associated with visual attention and visuospatial processing, suggesting greater neuronal effort by individuals with AN to perform the task to a similar standard. This was also present during implicit emotion processing, but was found to increase more strongly with the intensity of the emotion in those with AN compared to controls. These findings are in agreement with the idea of cognitive inefficiencies rather than impairments and illustrate subtle differences that could play a role in the successful treatment of AN. Importantly, successful completion of CRT led to changes in recruitment of these brain regions and could suggest that a more efficient style of processing was adopted. However more research is needed on the effects of CRT on brain function. Finally, little is known about atypical neural activation in different stages of AN and more research is needed in younger age groups to make these results clearer and more generalizable.

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