Using fMRI to assess the impact of Mandolean training on the neural control of obesity in young people.

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Background

• Adolescent obesity is increasing in prevalence
• Evidence for interventions to treat childhood obesity is limited.

• A trial of a new device, the Mandolean, demonstrated a reduction in body mass index (BMI SDS) in children when used with a weight-management programme.

Ford et al., 2010
Background – The Mandolean

• A weighing scale that measures rate of eating and satiety
• Provides feedback to help children change their eating behaviours.
Background

- Retraining adolescents to eat more slowly significantly impacted on gastrointestinal response to carbohydrate load.

Galhardo et al., 2012
Objective

• The objective of this ongoing pilot randomised trial is to investigate the underlying physiological basis of the Mandolean intervention by using functional Magnetic Resonance Imaging (fMRI).

• We hypothesise that:
  • Brain response to food cues will differ between obese and control participants
  • Weight reduction, changes in eating rate and perception of satiety will be associated with long-term changes in brain activity in response to food cues
Design

- The target population are obese adolescents (age 11-18 years), referred to the Care of Childhood Obesity clinic at Bristol Royal Hospital for Children.

Participant recruitment and screening

Pre-intervention: Test session and fMRI

Intervention (6 months)

Group O (n = 20)
- Mandolean Training
- Standard care (n = 10)

Mandolean Training + standard care (n=10)
- 6/10

Group C (n = 10)
- No intervention (one imaging session only)
- 9/10

Post-intervention: Test session and fMRI

Follow up to measure BMI maintenance (6 months later)
Neuroimaging sessions

Blood sample (1, baseline) and appetite ratings (1)
Baseline fMRI (resting perfusion with ASL)
Food cue reactivity fMRI (BOLD)

out of scanner
Ingestion of glucose (drink) ~5mins
Blood sample (2, time 30) and appetite ratings (2)
repositioning in scanner

Post-glucose resting fMRI (ASL)
Blood sample (3, time 60) and appetite ratings (3)
Food cue reactivity fMRI (BOLD)

Structural scan

Post-glucose resting fMRI (ASL)
Blood sample (4, time 90) and appetite ratings (4)
Food cue reactivity fMRI (BOLD)
Food cue reactivity task

- Food images tailored to each participant’s preferences
- Each image displayed for 3 seconds with variable null events for jitter
- Non-food images included as a control
- Incidental task to determine whether image is on the left or right of the screen
Preliminary results
Preliminary results

Initial BMI SDS of participants scanned to date:

<table>
<thead>
<tr>
<th></th>
<th>Mando+</th>
<th>Standard</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>8</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>M/F</td>
<td>2/6</td>
<td>2/4</td>
<td>4/5</td>
</tr>
<tr>
<td>Mean age</td>
<td>13.1</td>
<td>13.6</td>
<td>15.6</td>
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</tbody>
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Error bars show standard deviation
Preliminary results

Change in BMI SDS from time 1 to time 2:

- Mean change in BMI SDS = -0.09 (n = 9)
- Mandolean group (n = 4) = -0.07
- Standard care group (n = 5) = -0.10
Preliminary results

Sample mean for comparison between Food and Non-Food images:

Whole brain analysis
P (uncorrected) < 0.001

Insula

Orbitofrontal cortex

Visual cortex

Nucleus accumbens

Hypothalamus

Region of interest analyses  P (uncorrected) < 0.05

Amygdala

Other regions tested: caudate*, putamen
Preliminary results  Group differences (Food and Non-Food images)

Orbitofrontal cortex
Left (pink) Control > Obese
Right (yellow) Obese > Control

Control > Obese*

Hypothalamus
Amygdala

Insula
Left (yellow) Obese > Control
Right (blue) Control > Obese

Obese > Control

Caudate
Putamen

Region of interest analyses  P (uncorrected) < 0.05
Future analysis

- Complete data collection
- Incorporate measures from the Mandolean intervention
  - Change in eating rate and perception of satiety from baseline to 6 months
- Resting perfusion data
- Correlate changes in plasma levels of ghrelin and PYY with neuroimaging data within and between scan sessions
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