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The effect of glycaemic index of breakfast cereal on children's cognitive performance

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Background

• Rising demand on cognitive and intellectual performance

• Imbalanced diet

• The effects of *diet* on cognitive performance

• The effects of *breakfast* on children's cognitive performance
• Iowa Breakfast Studies.
  Tuttle et al (1949; 1950; 1952; 1954)

• Indicate that the consumption of breakfast can enhance cognitive performance

• Surge of research into the effects of breakfast on cognitive performance
Background

- Skipping breakfast has detrimental effects (e.g. Smith et al, 1994)

- Consumption of breakfast has positive effects (e.g. Pollitt et al, 1998)

  - 9- to 16-year-olds
  - Cheerios, Shreddies, glucose drink or no breakfast
  - Computerised tests of attention and memory
  - Prior to and at 30, 90, 150 and 210 minutes after breakfast
Background

- **Glucose Drink & No Breakfast:**
  Decline in Focused Attention and Episodic Memory

- **Cheerios & Shreddies:**
  Decline seen in Focused Attention and Episodic Memory was significantly reduced

- **Breakfast in the form of cereal can have a positive effect on cognitive performance in school children**
Background

• Breakfast compared to no breakfast

• Composition of breakfast

• The brain’s main source of energy is glucose

• Increased blood glucose has positive effect on cognitive performance (e.g. Martin & Benton, 1999; Sünram-Lea et al., 2002)
• The body’s main source of glucose is carbohydrates

• Carbohydrates exerts its effects on blood glucose in two ways
Background

- **High Glycaemic Index (GI > 70)**
- **Low Glycaemic Index (GI < 40)**

Fig. 1: Blood glucose response after intake of high and low GI carbohydrates
Present Study

Aims

a) Does the glycaemic index of breakfast have an effect on cognitive performance?

*Prediction:* low rather than high GI breakfast more beneficial to performance, particularly in late morning.

b) Are the effects found across all cognitive functions or restricted to particular processes?
Participants

- 6- to 11-years (N = 64)
  Mean age 9:3 (range 6:8 -11:7); 38 females, 26 males

- Three age groups:
  - 7-year-olds (N = 18)
    Mean age 7:2 (range 6:3-7:11); 10 females, 8 males
  - 9-year-olds (N = 23)
    Mean age 9:1 (range 8:2-9:11); 10 females, 13 males
  - 11-year-olds (N = 23)
    Mean age 11:0 (range 10:0-11:7); 18 females, 5 males
## Procedure

- Two consecutive days
- High GI: Coco Pops  
  (35g with 125ml semi-skimmed milk)
- Low GI: All Bran  
  (35g with 125ml semi-skimmed milk)

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Breakfast</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>9:00</td>
<td>9:30</td>
<td>9:40</td>
<td>10:40</td>
<td>11:40</td>
</tr>
</tbody>
</table>
**Procedure**

Cognitive Drug Research (CDR)
Computerised Assessment Battery (Wesnes et al, 2003)

- Word Presentation
- Immediate Word Recall
- Picture Presentation
- Simple Reaction Time
- Digit Vigilance
- Choice Reaction Time
- Spatial Working Memory
- Numeric Working Memory
- Delayed Word Recall
- Delayed Word Recognition
- Delayed Picture Recognition

Fig. 2: CDR Test Battery
Analysis of Data

- Focused Attention
- Sustained Attention
- Working Memory
- Episodic Memory
- Speed of Memory
Analysis of Data

- Change from Baseline
  
  Test 1/2/3 - Baseline

- \((3 \times 2 \times 3)\) ANOVA
  
  (assessment x breakfast x age group)
Results

• Older children perform better than younger children

• Decline in performance throughout the morning
Results

Episodic Memory

Main effect of Breakfast
\( F(1,61) = 5.313, \ p < 0.05 \)

Significantly smaller decline in performance after consumption of low GI All Bran compared to high GI Coco Pops

Fig. 3: Performance on Episodic Memory
Results

Sustained Attention

Breakfast * Assessment Time
$F(2,122) = 3.820, p < 0.05$

Significantly decline in performance on Test 3 after consumption of high GI Coco Pops compared to low GI All Bran

Fig. 4: Performance on Sustained Attention
Aims

a) Can the Glycaemic Index of breakfast affect children’s cognition?

b) Are the effects found across all cognitive functions or restricted to particular processes?
Discussion

- Significantly less decline on Episodic Memory and Sustained Attention across the morning after consumption of Low GI (All Bran) compared to high GI (Coco Pops)

- Changes in cognitive performance may be a reflection of changes in blood glucose levels, in this case triggered by glycaemic index
Discussion

- Effect of GI may be different for different cognitive processes

- Micronutrients and other macronutrients can also influence cognitive performance (Lieberman et al, 1986)

Plans for Future Research:

- To investigate the effects of lunch and mid-morning snack
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