The effects of breakfast on cognitive and academic performance in children: Findings from two systematic reviews

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Background: Why bother with breakfast?

- Modifiable
- Higher brain glucose metabolism
- Longer overnight fast
- Dietary habits
Science

Breakfast isn't the most important meal of the day, says scientist

"Breakfast is associated with improved memory and helps children to retain what they learn in the classroom. It is key to maximising exam performance."
Breakfast or no breakfast: What does the evidence show?
Systematic reviews of the literature: Overview

**Breakfast & Cognitive Performance**

**SRR 1:** Effects of breakfast consumption vs. omission and breakfast type on cognitive performance in children and adolescents

1. Acute effects of breakfast vs. no breakfast on cognitive performance
2. Acute effects of breakfast composition on cognitive performance
3. Chronic effects of SBPs on cognitive performance

**Breakfast & Academic Performance**

**SRR 2:** Effects of breakfast consumption vs. omission and breakfast type on academic performance in children and adolescents

1. Association between habitual breakfast consumption and academic performance
2. Chronic effects of SBPs on academic performance
Results:
Acute effects of breakfast vs. no breakfast
24 Studies
Results: Acute effects of BF vs. no BF

Overall advantage of breakfast vs. no breakfast
• Transient beneficial effect on cognitive function
• Post-ingestion effects +10 min to +210 min
• Range of energy loads (95 Kcal – 590 Kcal) and foods
• Observed effects: enhancement and maintenance of performance

Domain specific effects
• Attention, memory, and executive function

Undernourished children
• Positive effects more apparent in undernourished children
Results: Acute effects of BF vs. no BF

Examples from the literature

Cooper et al. (2011)

- UK
- School-based
- Crossover RCT
- n=96
- 12-15 year olds
- 55% HBC
- Ad-libitum breakfast: RTEC, bread, yoghurt, fruit, juice
- Mean intake: 500 kcals, 90g CHO; 11.6g PRO; 9.5g FAT

Effect: Maintenance of performance
Results: Acute effects of BF vs. no BF

Examples from the literature

Defeyter & Russo (2013)

- UK
- School-based
- Crossover RCT
- n=40
- 13-15 year olds
- Breakfast skippers
- Fixed RTEC breakfast: All bran and milk
- 162 kcals, 22.7g CHO; 9.4g PRO; 1.2g FAT

Effect: Enhancement of performance

![Hard word recall % correct](chart)

Time:
- 8:00am
- 10:45am

Breakfast 8:30am
Results:
Acute effects of breakfast composition
15 studies
Results: Acute effects of BF type

Inconclusive

Comparisons: differing GI/GL, energy, high CHO vs. high PRO

Possible GI effects?

Emerging evidence that low GI/GL is more beneficial

Suggests that the post-prandial blood glucose profile may mediate the effects

But problematic study designs, few and inconsistent findings

TABLE 3  Summary of findings for the acute effects of breakfast composition on cognition in children and adolescents (n = 15 studies)¹

<table>
<thead>
<tr>
<th>Cognitive domain</th>
<th>Total studies</th>
<th>GI/GL Advantage of higher energy</th>
<th>No effect</th>
<th>GI/GL Advantage of lower energy</th>
<th>No effect</th>
<th>Energy Advantage of higher</th>
<th>No effect</th>
<th>Energy Advantage of lower</th>
<th>No effect</th>
<th>High carbohydrate Advantage of higher protein</th>
<th>No effect</th>
<th>High carbohydrate Advantage of high protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>14</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td></td>
<td>0</td>
<td>2</td>
<td>1</td>
<td></td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Memory</td>
<td>12</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Executive function</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Psychomotor function</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
<td>0</td>
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<tr>
<td>Language</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>4</td>
<td>14</td>
<td>12</td>
<td></td>
<td>2</td>
<td>4</td>
<td>1</td>
<td></td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

¹ Studies assessed >1 cognitive domain and/or administered >1 measure within the same domain. GI, glycemic index; GL, glycemic load.
Results: Acute effects of BF type

Ingwersen et al. (2007)

- GI comparison, not isocaloric
- UK
- School-based
- Crossover RCT
- n=40
- 6-11 year olds
- Coco-pops (HGI) and milk: 133 kcal, 1.6g PRO, 0.9g fat, 29.8g CHO
- All bran (LGI) and milk: 98kcal, 4.9g PRO, 1.6g fat, 16.1g CHO
Results:
Chronic effects of SBPs
11 studies
Results: Chronic effects of SBPs

Inconclusive

- Few studies and inconsistent findings
- Limited effects on cognitive outcomes
- Unclear if effects are related to breakfast or the SBP regimen. Not a true test of breakfast *per se.*
Results: Chronic effects of SBPs

Cueto and Chinen (2008)

- Peru
- Matched school comparison – 20 schools
- n=590, 12 year olds
- 70% undernourished
- Government SBP
- Fortified milk-like drink and 6 biscuits
- 600 kcal, 19.5 g PRO, 20 g fat
- 60%-100% of daily requirement of various micronutrients

Fig. 1. Memory test: Interaction between treatment and type of school.

Picture recognition (immediate recall)
Breakfast & Cognitive Performance

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Breakfast & Academic Performance

**SRR 2**: Effects of breakfast consumption vs. omission and breakfast type on academic performance in children and adolescents

1. Association between habitual breakfast consumption and academic performance
2. Chronic effects of SBPs on academic performance
Results: Associations between HBC and academic performance
15 studies
Results: HBC and academic performance

Positive association between HBC and academic performance

- HBC frequency was positively associated with academic performance
- Some evidence that HBC composition is related to academic performance

Subject specific effects

- Mathematics grades or test scores

Consistent across all socio-demographic groups

- The effects were not modulated by socio-demographic characteristics
Results: HBC and academic performance

Lien (2007)

- Norway
- Cross-sectional study
- n=7306, 15-16 years
- Questionnaire to assess HBC frequency (days/week)
- Self report school grades

Table 4 Crude and adjusted* association between school grades and eating breakfast across gender

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude</td>
<td>Adjusted</td>
</tr>
<tr>
<td>Eating breakfast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seldom/never</td>
<td>3.5 (2.5–4.8)</td>
<td>2.0 (1.3–3.1)</td>
</tr>
<tr>
<td>1–2 times a week</td>
<td>3.1 (2.0–4.1)</td>
<td>1.9 (1.3–2.8)</td>
</tr>
<tr>
<td>3–4 times a week</td>
<td>2.2 (1.4–3.0)</td>
<td>1.1 (0.7–1.7)</td>
</tr>
<tr>
<td>5–6 times a week</td>
<td>1.5 (1.1–2.2)</td>
<td>1.1 (0.7–1.7)</td>
</tr>
<tr>
<td>Every day</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Adjustment made for parental educational level, family structure, dieting, smoking and drinking soft drinks.
Results:
Chronic effects of SBPs
10 studies
Results: Chronic effects of SBPs

SBPs have a positive effect on children’s academic performance

- SBPs tended to have positive effects on academic performance
- However, few good quality studies
- Can not attribute the effects directly to the breakfast meal

Advantageous effects were not universal

- Type of school
- SBP model
Take away messages

Cognitive performance
• Breakfast consumption (vs. no breakfast) has a modest short-term beneficial effect on cognitive function measured within 4 hours post-ingestion.

Academic performance
• Habitual breakfast consumption frequency is positively related to academic performance

• SBPs are associated with better academic performance.

• The findings need to be treated with caution until they are supported by further observational studies or well controlled RCTs to verify possible causal relationships.
Thank you

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