

## **Beyond the Headlines: Information about our clinical study**

The importance of breakfast is not breaking news - there are years of research and countless studies that prove breakfast is important. Now there's a new headline worth paying attention to: Research shows children who ate ***Kellogg's® Frosted Mini-Wheats®*** cereal for breakfast demonstrated better attentiveness and quality of memory throughout the morning when compared to kids who didn't eat breakfast.

If you're looking for more information about our clinical study, you've come to the right place. Take a few minutes to go beyond the headlines to learn more about the study and the results.

### **How was attentiveness and memory studied?**

In order to determine if kids had better attentiveness and better quality of memory, cognitive performance was measured. You can think of cognitive performance as being able to remember and apply what you've learned. It is important to know that cognitive function is an important "gauge" because it is critical in all of our everyday activities. Cognition describes the mental processes involved in acquiring, storing, retrieving and manipulating information. Strong cognitive processes are essential to physical, mental and emotional well being. It is, of course, important to remember that each child is different, which means the effects of eating (or skipping) breakfast can vary.

### **How were the kids tested?**

The study was conducted by an independent research group and then reviewed by third-party cognition experts. A series of cognitive tests were conducted in 8 – 12 yr old children from various backgrounds. Children were tested prior to eating breakfast to get a base measurement. Then, children were either provided a breakfast of ***Kellogg's® Frosted Mini-Wheats®*** cereal or water. Next, the children were given a series of tests (the same tests and measurements as prior to the breakfast) each hour for three consecutive hours. The results were taken for three hours after breakfast since this is most likely when children may start to feel hungry, which may lead to distraction and decreased ability to retain and recall what they are being taught. A description of the actual tests taken is found below.

The study used a computerized assessment system, which is the most common type of testing today. The computerized system is quite similar to the traditional "pencil and paper" testing and is most commonly used today. The advanced technology of computerized testing offers more accurate measures in both the response time as well as speed and accuracy of the response.

### **What types of tests did the kids take that showed “better attentiveness”**

In order to measure attentiveness, the accuracy of responses was measured on tests that required sustained attention. After all, if children are accurate, it means they were able to keep their mind on a single task for a prolonged period – or, be attentive. The following is a brief description of the two tests used to measure attentiveness:

#### *Digit Vigilance*

A look at the meaning of the words “digit” and “vigilance” can help you understand what this test is all about. “Digit” refers to a figure, number or symbol. “Vigilance” can be defined as attentiveness, acuity and alertness. A “digit vigilance” test is designed to measure the ability to concentrate (or be attentive) on a series of rapidly changing letters or numbers (digits) without being interrupted.

Here is how it worked: A single letter or number appears on the right hand side of the screen and remains there for the length of the task. Additionally, a continuous series of letters or numbers appears, one at a time, in the middle of the screen. Every time the letter or number in the middle of the computer screen matches the one on the right, the child is instructed to press the right arrow key as quickly as possible.

As you can see, this task requires sustained vigilance (i.e.; attentiveness). If the child’s attention wanders, then their response may be delayed or inaccurate.

#### *Choice Reaction Time*

This test measures accuracy of reaction time on the computer on a task that is prolonged (meaning lengthy!). If the child isn’t paying attention, he or she will not be able to react quickly or accurately. Here’s how it worked: Either the word ‘NO’ or the word ‘YES’ appears in on the screen. The child is instructed to press a corresponding key (ie: the right arrow key for YES and the left arrow key for NO) as quickly as possible.

This test is quite lengthy, providing 50 trials. As you can imagine, this test assess the child’s ability to pay attention. Both the response time is measured as well as accuracy of the responses.

### **What type of tests did the kids take that showed “better quality of memory”**

In order to measure quality of memory, the accuracy of responses were measured on tests that required kids to retain information and then recall it. What follows is a brief description of the tests used to measure quality of memory.

### *Immediate Word Recall*

A list of words is presented to the child, then they are challenged to see how many they can remember immediately after being exposed to the words. Here's how it worked: one word appeared on the screen at a time, with a new word appearing every 2 seconds. Once a total of 15 words had been displayed, the child was then given 1 minute to recall as many of the words as possible. At a later time in the testing period, the child was again given 1 minute to recall as many of those 15 words as possible, without repeating the entire exercise. The researchers refer to this second test as "*Delayed Word Recall*."

### *Spatial Working Memory*

In this test, the child is shown an illustration and then is tested to see how well they remember the picture they were shown. Here's how it worked: A picture of a house appeared on the screen. The house had 9 windows and 4 of those windows were "lit." The child was asked to memorize the position of the lit windows. Then, the child was shown 36 more illustrations of the house ... each with just one window lit (a different window each time). The child was asked whether or not that was one of the 4 windows that was lit in the original illustration of the house. In this test, the child was asked to respond as quickly as possible by using "yes" or "no" buttons.

### *Numeric Working Memory*

Numeric Working Memory is similar to the *Spatial Working Memory* test, only it uses numbers instead of pictures. In this test, a series of 5 digits (numbers) is presented to the child. They are asked to memorize those digits. Then, the child is shown a series of 30 digits. Their job is to decide if that digit was in the original series shown. Again, the children were asked to respond as quickly as possible by using "yes" or "no" buttons.

### *Delayed Word Recall*

The child is given the same 15 words given in the *Immediate Word Recall* test that was conducted earlier in the cognitive testing. They are again given one minute to recall as many of the words as possible.

### *Word Recognition*

In this test, the child is given the same 15 words as in both the *Immediate Word Recall* and *Delayed Word Recall* tests. However, in this test, there are also 15 extra words (called "distracter" words) added. Children are randomly presented with one word at a time and the child is asked to indicate whether or not it is from the original list of words. The child is asked to press a "yes" or "no" button as quickly as possible.

### *Picture Presentation and Picture Recognition*

Similar to *Word Recall*, a series of 20 pictures are presented to the child, at a rate of 1 every three seconds. Then, later in the testing, the 20 pictures originally shown are mixed with 20 "distracter" pictures. The pictures are presented one at

a time (in a random order) and the child is asked to indicate whether or not they recognize the picture as being from the original series. They are asked to press a 'yes' or 'no' button as appropriate, as quickly as possible.

### **What did we find?**

This study showed that kids who ate a filling breakfast of **Kellogg's® Frosted Mini-Wheats®** cereal had improved their attentiveness 11% more compared to kids who didn't eat breakfast. The study also showed that kids who ate a **Kellogg's® Frosted Mini-Wheats®** breakfast had 23% better retention and recall of words, numbers or visuals – again, when compared to kids who didn't eat breakfast.

While individual responses can vary to eating (or skipping) breakfast, this study showed that kids may demonstrate better attentiveness and quality of memory by eating a breakfast of **Kellogg's® Frosted Mini-Wheats®** cereal.

### **What else do I need to know?**

While this is the first research to study how a breakfast of **Kellogg's® Frosted Mini-Wheats®** cereal may affect cognitive performance, many studies suggest that breakfast plays an important role in learning and memory. Research has also shown that the type of food consumed at breakfast may play a role in memory and attention tasks. Take a look:

- A number of studies show that eating breakfast is associated with improved memory skills, better test grades and greater school attendance rates. Additionally, children who don't eat breakfast may feel tired and hungry, and find it difficult to concentrate and learn.<sup>1</sup>
- Breakfast consumption has been shown to affect cognitive and academic performance in children<sup>2</sup>
- Positive effects of breakfast consumption have been reported in several aspects of cognitive function including memory, attention, problem solving, and logical reasoning<sup>3</sup>
- Recent evidence suggests children consuming a high fiber, slowly digested breakfast performed better on short-term memory and auditory attention tasks compared with a lower fiber, more rapidly digested meal<sup>4</sup>
- Similarly, a high fiber ready-to-eat (RTE) cereal reduced the decline in certain attention and memory tasks that is typically observed throughout the morning in school-aged children<sup>5</sup>

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<sup>1</sup> Rampersaud MS, Pereira MA, Girard BL, et al. Breakfast habits, nutritional status, body weight, and academic performance in children. *J Am Diet Assoc.* 2005;105:743-760.

<sup>2</sup> Pollitt & Matthews 1998; Rampersaud et al. 2005; Murphy, 2007

<sup>3</sup> Mahoney et al. 2005; Pollitt & Matthews 1998; Rampersaud et al. 2005

<sup>4</sup> Mahoney et al 2005

<sup>5</sup> Ingwersen et al. 2007; Wesnes et al. 2003

With approximately 25% of the daily recommended intake of fiber and approximately 85% of the recommended daily amount of whole grains per serving, **Kellogg's® Frosted Mini- Wheats®** cereal “fits the bill.” The 8 layers of whole grains help slow digestion and the 5 to 6 grams of fiber per serving helps contribute to a feeling of fullness. This winning combination of whole grain and fiber can help your little one stay full and focused.

And get this – when served with 1 cup skim milk and a fresh banana, a **Kellogg's® Frosted Mini-Wheats®** breakfast provides<sup>6</sup> 31% of the recommended daily value of calcium, 36% fiber, 12% vitamin A, 17% vitamin C and 30% magnesium ... in less than 400 calories (20% of the recommended daily intake) and 1 gram of fat. Now that's a great start!

Most importantly, remember that children who see their parents eat breakfast may be more likely to eat breakfast, too. So take time to start the morning together with **Kellogg's® Frosted Mini-Wheats®** cereal. For more information on the benefits of breakfast as well as quick and nutritious breakfast ideas, visit [www.kelloggsnutrition.com](http://www.kelloggsnutrition.com).

## DEFINITIONS

**Cognition:** The process which supports everyday behavior. It helps us to process information, organizes our thoughts and actions, helps us store and retrieve information, and enables us to plan and execute tasks.

**Cognitive Performance:** The application of learning and memory. Some examples of this are accuracy and preciseness, correctness.

**Learning:** The act or experience of one that learns; knowledge or skill acquired by instruction or study

**Memory:** The process of reproducing or recalling what has been learned and retained

**Digit:** Refers to a figure, number or symbol

**Vigilance:** Can be described as attentiveness, acuity or alertness

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<sup>6</sup> Based on **Kellogg's® Frosted Mini-Wheats®** Original cereal as calculated by the Kellogg breakfast builder tool found at [www.kelloggsnutrition.com](http://www.kelloggsnutrition.com)