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## Evaluating the Relationship Between Breakfast Pattern and Short-Term Memory in Junior High School Girls

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**Abstract:** The aim of this study was to evaluate the relationship between breakfast pattern and short-term memory in guidance-school students. Memory improves for subjects who have eaten breakfast. It appears that breakfast consumption influences cognition via several mechanisms. What children eat for breakfast before going to school is very important. A total of 150 junior high school girls were taken from a subject pool in four schools in Shiraz (capital of the Fars Province in Iran). They filled out the socio-economic questionnaires as well as food frequency questionnaires for breakfast and provided two-three day breakfast records in two different seasons and their short-term memories were evaluated by Weksler test socio-economic conditions and dietary intakes were analyzed. The results of the study showed that there was no correlation between parents job, students mean age and their school grades with their memory scores. Dietary analysis demonstrated a negative correlation between local soup consumption in breakfast and memory scores. Food record analysis showed no correlation between fat, cholesterol, protein, vitamin B6, B12, calorie and iodine intake in breakfast and memory scores, but there was a positive correlation between carbohydrate, iron and vitamin B3 intake in breakfast and memory scores, similarly there was a positive correlation between B12 intake in the breakfast and students' average school grades during the year.

**Key words:** Short-term memory, food frequency questionnaire, dietary records

### INTRODUCTION

Many researchers have reported that memory improves for participants who have eaten breakfast (Benton and Sargent, 1992). It appears that breakfast consumption influences cognition via several mechanisms, including an effect on blood glucose (Benton and Parker, 1998). Fasting had an adverse effect on the accuracy of responses in problem solving (Pollitt *et al.*, 1981). Cognitive functions are more vulnerable to missing breakfast in poorly nourished children (Simeon and Grantham, 1998). Results of other studies have significant practical implications, suggesting the importance of what children consume for breakfast before going to school (Mahoney *et al.*, 2005). A review of the school breakfast program in the United States revealed that it significantly improved school performance and reduced absenteeism.

On a number of occasions, better memory was associated with lower blood glucose levels. These findings support previous observations that better glucose tolerance was associated with better memory

(Singleton, 2001). Promotion of habitual and healthful breakfast eating behaviors may promote population health and academic performance and reduce health and educational inequalities (Moore *et al.*, 2007).

In Sweden, 10 year old school children who ate larger breakfasts exercised for a longer time in a morning gymnastics class scored better on a test of verbal fluency (Wyon *et al.*, 1997). Pollite explained when well-nourished middle-class 9-11 year-old Americans ate breakfast, performance was better on a test that correlates with academic achievement (Pollitte *et al.*, 1981; Pollit and Mathews, 1998). Therefore, present aim was to evaluate the relationship between breakfast pattern and short-term memory in guidance-school students.

### MATERIALS AND METHODS

A total of 150 guidance school girls were selected from a subject pool in four schools in Shiraz (capital of Fars Province in Iran) from December 2006 to September 2007. First of all, four schools in four distinct socioeconomic areas of the city were chosen from schools

lists, then the students were selected by systematic random selection from the students lists in schools. The participants were healthy students, who had resided there for the previous year and those, who usually eat breakfast. The study was conducted in two seasons. A memory test was performed by asking the students to repeat some numbers directly and in the reverse order. The numbers became longer in the following steps, then they were graded by a special grading system in which each step of their repeatings were graded, their grades have been calculated from 28, then, they have filled out the questionnaires (socio-economic and food frequency questionnaires) for breakfast which contained 33 foods including: bread, cheese, coffee, tea, butter, biscuits, cake, grapes, walnuts, watermelon, oil, egg, salt, sugar, fruit juice, cucumber, tomato, ash and halim (traditional foods in Iran), honey, jam and organ meat (g). Food consumption were taken into consideration by calculating each consumption as servings in a day. Then subjects provided a 3 day breakfast record and then the short-memory Weksler test was taken (Shahim, 1992) at 9 o'clock three days in two different seasons. Students average grades during the year were also asked.

**Statistical analysis:** Data were analyzed using SPSS 13 for windows and the Iranian food processor software and difference between groups tested using student t-test. ANOVA was performed to determine the most significant correlation between variables. Statistical significance was defined as  $p < 0.05$ .

## RESULTS AND DISCUSSION

In the present study, there was no correlation between parents job, students' mean age and their school grades with their memory scores. Dietary analysis showed a negative correlation between local soup consumption (containing fatty meat, legumes, rice, oil and a little vegetables) called ash in breakfast and memory scores but there wasn't any correlation between other foods with memory scores.

Dietary analysis showed no correlation between calorie, fat, cholesterol, protein and vitamin B6, B12 and iodine intake in breakfast and memory scores, but there was a positive correlation between carbohydrate (g), iron (mg) and vitamin B3 ( $\mu\text{g}$ ) intake in breakfast and memory scores (Table 1). There was a positive correlation between B12 ( $\mu\text{g}$ ) intake in the breakfast and students average school grades during the year (Table 2).

Promotion of habitual and healthful breakfast eating behaviors may promote population health and academic

Table 1: Correlation between nutrients intake in breakfast and memory score

First variable	Second variables	Correlation coefficient	p-value
Memory score	Iodine	1.000	-
	Iron	0.228	0.049
	Vitamin B3	0.238	0.039
	Vitamin B12	1.000	0.500
	Vitamin B6	0.984	0.050
	Cholesterol	0.612	0.500
	Calorie	0.656	0.330
	Protein	0.281	0.300
	Fat	0.650	0.052
	Carbohydrate	0.249	0.031

Table 2: Correlation between nutrients intake in breakfast and students average grades during the year

First variable	Second variables	p-value
Students average grades	B12	0.018
	B3	0.594
	B6	0.319
	Cholesterol	0.287
	Fat	0.298
	Protein	0.131
	Carbohydrate	0.318
	Calorie	0.217
	Iron	0.404
	Iodine	0.365

performance and reduce health and educational inequalities (Wyon *et al.*, 1997). It has been documented that many nutrients have important roles in cognition and memory promotion. In other studies, consuming special kinds of foods have been suggested for improving participants memory, or eating or not eating breakfast have been taken into consideration, while in this study the whole breakfast pattern has been evaluated.

Iron is an essential trace element which has an important role for many enzymes responsible for neurotransmitter biosynthesis in humans body such as tryptophan hydroxylase that is responsible for serotonin biosynthesis or tyrosine hydroxylase, responsible for dopamine and norepinephrine biosynthesis. Norepinephrine is important for activating protein synthesis cascade and dopamine is important for cognitive functions and can improve consciousness. Serotonin can have an important role in short-term memory and it's conversion to long-term memory (Almaguer-Melain, 2003).

The present study demonstrated a positive correlation between iron intake in breakfast with short-term memory. These data support the earlier studies by Braner in African-American girls (Bruner and Joeff, 1996) and by Pollite in Egypt (Pollitt and Mathews, 1998).

Carbohydrate is an important macronutrient that forms part of human calorie requirements and have a high metabolism in human's body. They are the most important sources of brain energy by providing one with enough blood glucose which will benefit one's brain activities such as memory.

In some studies, it is possible that carbohydrates have not been shown to affect memory but the present study revealed a positive correlation between carbohydrate intake in breakfast with short-term memory. This discrepancy may be explained by the fact that in those studies carbohydrates were not studied independently but with fat and protein, therefore it is possible that they haven't been able to show the direct effects of carbohydrates.

Vitamin B family have important roles in metabolism. Most of them act as coenzymes in many chemical reactions in body especially in neurotransmitter biosynthesis, such as Flavin Adenine Dinucleotide (FAD), Pyridoxal Phosphate (PLP), Nicotinamide Adenine Dinucleotide (NAD), cobalamine, etc. They also have important roles in deamination, decarboxylation, hydroxylation and many other reactions. Present study showed a positive correlation between niacin intake in breakfast with short-term memory and B12 intake in breakfast with students average grades during the year. But, there was no correlation between vitamin B12 and B6 intake with memory. This may be because of poor sources of these two vitamins in breakfast (Whaley and Sigman, 2003).

In the present investigation, dietary analysis demonstrated a negative correlation between local soup intake with memory. More studies are needed to assess the effect of this type of local food on short-term memory.

In many studies (Pollitt and Mathews, 1998; Richter, 1997; Powell and Walker, 1998; Zhang, 2005), the importance of breakfast intake has been evaluated. However, we evaluated breakfast pattern and its components in students who eat breakfast.

Results of this study have significant practical implications for families and policy surrounding the feeding of children. Doing such studies in a large scale can provide good guidance for families and policy that can result in improvement in children's breakfast and their performance and learning. Poor dietary quantity and quality and micronutrient deficiencies, can cause adverse effects on memory and learning. As food habits are built at early years of life, education to our school children and their parents for eating healthy foods especially for breakfast can have a significant impact on their school performance by affecting many sides especially their memories especially the foods that contains carbohydrate, vitamin B3 and iron. An alternative way is to convince government to supply students with healthy breakfasts and to do more studies about breakfast pattern and composition in the future.

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