



## Association between Breakfast Intake and Short-Term Memory, Performance and Mood among Saudi Female Adolescents

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### ARTICLE INFO

#### Article history:

Received 18 June 2018

Accepted 30 August 2018

Available online 06 September 2018

#### Keywords:

Breakfast intake

Mood

Short-term memory

Performance

Saudi female adolescents



### ABSTRACT

**BACKGROUND:** Breakfast consumption is labelled as the most important meal of the day. It might be of significant importance for adolescent students as it might influence their short-term memory, performance, and mood. However, the prevalence of skipping breakfast, among adolescents, in Saudi Arabia is high. **AIMS:** To investigate the association between breakfast intake and short-term memory, performance, and mood, among Saudi female adolescents. **SUBJECTS and METHODS:** A Cross-sectional study was conducted in a secondary female School (Riyadh) involving 170 students (15-19 years). Structured questionnaires on breakfast eating habits, student performance at school, a standardized questionnaire mood and feeling, and a standardized short-term memory test were used for data collection. Statistical analysis used Chi<sup>2</sup> test and ANOVA test to assess the association between breakfast intake and the studied parameters. **RESULTS:** Only 39% of participants keep their daily breakfast. Frequency of breakfast intake was strongly and positively associated with improved performance ( $R^2=0.87$ ,  $p<0.001$ ), and to short-term memory score ( $R^2=0.5$ ,  $p<0.05$ ). However, no correlation between daily breakfast intake and mood was obtained. **CONCLUSIONS:** This study confirmed the high rate of skipping breakfast among Saudi female adolescents, and provides further evidence on the beneficial effect of breakfast intake on student's short-term memory as well as the school performance. Nutrition education program targeting this population should be implemented to enhance its awareness on the importance of breakfast intake.

Article edited by: Dr. Farah NAJA and Dr. Onyinye EZEH MASON

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### 1. INTRODUCTION

Breakfast has been studied extensively over last few years as the most important meal of the day by several nutritionists. Being usually consumed between 5 a.m. and 9 a.m. [1], breakfast is considered as a primary source of energy needed for the brain to function and perform morning tasks properly [2]. The effect of breakfast intake and short-term memory, performance and mood on students is controversial. In one hand, a Germanic study has shown that breakfast intake had a positive impact on

cognitive functioning and self-reported alertness in high school students [3]. In addition, several studies reported that breakfast is associated with improvement in short-term memory, mood, long-term memory, and attention span [4-7]. With this regard, Adolphus *et al.* [8] reported that there is a relationship between the type of nutrient intake consumed by students and their performance in school. For instance, in breakfast, protein intake is correlated with improving memory in students, whereas

carbohydrates consumption increased their short-term memory function. In contrast, an Iranian study indicated that there was no relationship between calorie, fat, cholesterol, protein, vitamin B12, B6, and iodine intake in breakfast and memory scores among students [9].

It is well established that skipping breakfast may result in an insufficient nutrient intake; which cannot be compensated later on during the day [10]. In fact, eating a breakfast meal is essential for appropriate performance during the day, especially for adolescents. This age group has high nutritional requirements due to rapid physical growth and brain development. Even though, it has been found that adolescent population appears to have the highest rate of breakfast skipping among school-aged children [11-12]. Indeed, in Saudi Arabia, Farghaly *et al.* [13] reported that breakfast is often skipped by 28% of students in various grades. They showed too, that 17% of secondary school female students regularly skip breakfast. However, consequence of this unhealthy food habit on short-term memory, performance, and mood is not studied. Thus, the aim of the current study was to determine the weekly frequency of breakfast intake among Saudi female adolescents (15-19 years) and its association with short-term memory, performance, and mood.

## 2. SUBJECTS AND METHODS

### 2.1 Study design and subjects

A cross-sectional study was conducted in Alrowad secondary female School in Riyadh (KSA), from September to November 2016. A purposive sampling was used targeting all the students at secondary level (n=170), aged between 15 to 19 years old. Two students were excluded due to their learning difficulties; which might interfere with the studied parameters. All students participated voluntarily in the study and signed an informed consent before taking part of it. The study research was approved by the Ethic Committee of the College of Health and Rehabilitation Sciences (Princess Nourah Bint Abdulrahman University, Riyadh). The approval to conduct the study within the Alrowad school was obtained from the principal of the school.

### 2.2 Research instrument

Socio-demographic data and breakfast habits (frequency and reasons of eating or skipping breakfast) were collected using a self-administered questionnaire. Short-term memory was measured using a standardized test [14]. It consisted of reading for each student a series of digits that was progressively increased in length (begins with 2 until 9 digits) and asked them to repeat the same sequence of digits in the order that was read out. The

higher the digit score means the higher short-term memory. The mood was assessed using the Mood and Feeling Questionnaire (MFQ) [15]. Mood was categorized according the obtained score as follows: very positive 0-8, positive 9-18, neutral 19-24, negative 25-32, and very negative 33-40. Student's performance, during the first sessions before the morning snack break which takes place at 9 am, was assessed. To this end, a questionnaire, containing the list of students' names, was distributed to the teachers who were asked to determine the frequency of good performance (participation and interaction) during the 5 days of the week (always, usually, sometimes, rarely, or never) for each participant. Clear instruction and explanation were provided to teachers aiming to avoid any subjective assessment. A student was scored "always" if she participated and interacted during the morning session on the 5 days of the week. Score "never" was allocated to a student who did not participate or interact at any of the morning session of the week. Usually, sometimes and rarely were scored based on participation and interaction during 4, 3 and 2 morning sessions, respectively.

### 2.3 Statistical analysis

Results are presented as mean  $\pm$  SD (Standard Deviation) and or in percentages. SPSS program (version 24.0) was utilized in all statistical analysis. ANOVA test was conducted to assess the difference of means, while Chi<sup>2</sup> test was conducted to assess the association between the studied parameters (mood, performance and short-term memory score) and frequency of breakfast intake. The test is considered as significant when *P*-value <0.05.

## 3. RESULTS

### 3.1 General characteristics

General characteristics of the studied population (n= 168 students) are summarized in Table 1. Mean age was 16.5 $\pm$ 0.9 years. Most of female adolescent students live with their both parents (95%). Thirty three percent (33%) and sixty percent (60%) of students stated that both parents and their father only work, respectively. Ninety seven percent of parents do leave for work at the same time or after their children leave for school.

**Table 1:** General characteristics of the studied population (n=168)

| General characteristics       | N   |                 |
|-------------------------------|-----|-----------------|
| Age (yrs.) (average $\pm$ SD) | 168 | 16.49 $\pm$ 1.1 |
| Parent living with            |     | %               |
| • Both parents                | 160 | 95              |
| • Mother only                 | 3   | 2               |
| • Father only                 | 1   | 1               |

|   |     |    |
|---|-----|----|
| • Other                                     | 4   | 2  |
| Working parent                              |     |    |
| • Both parents                              | 56  | 33 |
| • Mother only                               | 2   | 1  |
| • Father only                               | 100 | 60 |
| • Other                                     | 10  | 6  |
| When the parent leaves for work             |     |    |
| • Before I get up in the morning            | 2   | 1  |
| • Before I eat breakfast                    | 3   | 2  |
| • Same time as I when am leaving for school | 62  | 37 |
| • After I leave for school                  | 98  | 60 |

### 3.2 Breakfast eating patterns

Breakfast eating patterns are presented in Table 2. On the day of the survey, only 39% of the students reported that they had their breakfast before coming to school. In terms of frequency, 39% of students consume regularly breakfast, whereas 45% consume it either 3-4 times/week or less. Forty percent (40%) of the students reported that they have breakfast because they feel consider it is important and 25% because it provides them better feeling. Not having enough time and not feeling hungry were the two main reasons of skipping this meal, as reported by 42% and 37% of our students, respectively.

**Table 2:** Breakfast eating patterns in the studied population (n=168)

| Breakfast eating patterns                                   | N   | %  |
|---|-----|----|
| Have eaten breakfast today ( <i>the day of the survey</i> ) |     |    |
| - Yes   | 66  | 39 |
| - No  | 102 | 61 |
| Weekly frequency of breakfast consumption                   |     |    |
| - Never   | 13  | 8  |
| - 1-2 days per week   | 22  | 13 |
| - 3-4 days per week   | 41  | 24 |
| - 5-6 days per week   | 26  | 16 |
| - Everyday  | 66  | 39 |
| Reasons of breakfast consumption (155 students)             |     |    |
| - I am hungry in the morning                                | 34  | 22 |
| - I feel better if I eat breakfast                          | 38  | 25 |
| - My parents make me  | 8   | 5  |
| - I enjoy eating  | 13  | 8  |
| - I feel it is important to eat breakfast                   | 62  | 40 |
| Reasons of breakfast skipping                               |     |    |
| - I don't feel hungry                                       | 62  | 37 |
| - I don't have enough time                                  | 71  | 42 |
| - I don't like what was available to eat                    | 12  | 7  |
| - I'm not like to eat alone                                 | 3   | 2  |
| - No one prepared anything for me                           | 2   | 1  |
| - Other   | 18  | 11 |

### 3.3 Association between mood and academic performance with frequency of breakfast consumption

Table 3 shows that 49% of students have a positive mood score, and 40% of them have a high positive mood score. The weekly frequency of breakfast intake seems to have

an effect on the mood of the studied population. Indeed, everyday consumption of breakfast has the highest percentage of high positive (17.3%) and positive (18.5%) mood score. However, no significant correlation between weekly frequency of breakfast consumption and mood was noticed ( $R^2=0.1$ ,  $p>0.05$ ). In terms of the student performance frequency in class, during the first sessions before the morning snack break, results demonstrated that the highest two percentages were 43% and 35% for "always" and "usually" performing well in class respectively as shown in Table 3. When correlated to frequency breakfast intake, a strong positive correlation was obtained ( $R^2=0.87$ ,  $p<0.001$ ) (Table 4).

**Table 3:** Mood score, frequency of good performance in class and short-term memory score of the studied population (n=168)

| Studied parameters             | N  | %  |
|--------------------------------|----|----|
| Mood status                    |    |    |
| - High Positive (0-8)          | 67 | 40 |
| - Positive (9-18)              | 82 | 49 |
| - Neutral (19-24)              | 17 | 10 |
| - Negative (25-32)             | 2  | 1  |
| - High Negative (33-40)        | 0  | 0  |
| Student's Performance in class |    |    |
| - Never                        | 2  | 1  |
| - Rarely                       | 6  | 4  |
| - Sometimes                    | 29 | 17 |
| - Usually                      | 58 | 35 |
| - Always                       | 73 | 43 |
| Short-term memory score        |    |    |
| - 1                            | 0  | 0  |
| - 2                            | 1  | 1  |
| - 3                            | 21 | 13 |
| - 4                            | 76 | 45 |
| - 5                            | 42 | 25 |
| - 6                            | 25 | 15 |
| - 7                            | 3  | 2  |

### 3.4 Association between short term memory score and breakfast consumption

According to the results presented in table 3, 45% of the students scored 4 in the short-term memory test, followed by 25% who scored 5.

Table 4 shows that the percentage of students scored 5, 6, and 7 was higher among students who have taken their breakfast on the day of the test, however the difference was not significant. Instead, a significant correlation was found between daily breakfast intake and short-term memory score ( $R^2=0.497$ ,  $p<0.05$ ).

## 4. DISCUSSION

The prevalence of skipping breakfast among children and adolescents in Saudi Arabia is high. Farghaly *et al.* [13] reported that breakfast is often skipped by 28% of students in various grades and always skipped by 17% of

**Table 4:** Distributions of mood score, frequency of good performance and short-term memory test of students based on weekly frequency of breakfast intake (n=168)

| Parameters            |               | Weekly Frequency of Breakfast Intake |      |                 |      |                 |      |                 |      |                  |      | R <sup>2</sup> , P-value        |
|-----------------------|---------------|--------------------------------------|------|-----------------|------|-----------------|------|-----------------|------|------------------|------|---------------------------------|
|                       |               | Never (n=13)                         |      | 1-2 days (n=22) |      | 3-4 days (n=41) |      | 5-6 days (n=26) |      | Every day (n=66) |      |                                 |
|                       |               | Count                                | %    | Count           | %    | Count           | %    | Count           | %    | Count            | %    |                                 |
| Mood                  | High Positive | 3                                    | 23.1 | 11              | 50   | 15              | 36.6 | 9               | 34.6 | 29               | 43.9 | R <sup>2</sup> =0.1<br>P=0.12   |
|                       | Positive      | 8                                    | 61.5 | 9               | 40.9 | 21              | 51.2 | 13              | 50   | 31               | 47.0 |                                 |
|                       | Natural       | 1                                    | 7.7  | 2               | 9.1  | 5               | 12.2 | 3               | 11.5 | 6                | 9.1  |                                 |
|                       | Negative      | 1                                    | 7.7  | 0               | 0    | 0               | 0    | 1               | 3.8  | 0                | 0.0  |                                 |
|                       | High Negative | 0                                    | 0.0  | 0               | 0    | 0               | 0    | 0               | 0.0  | 0                | 0.0  |                                 |
| Student's Performance | Never         | 3                                    | 23.1 | 11              | 50   | 15              | 36.6 | 9               | 34.6 | 29               | 43.9 | R <sup>2</sup> =0.87<br>P<0.001 |
|                       | Rarely        | 8                                    | 61.5 | 9               | 40.9 | 21              | 51.2 | 13              | 50   | 31               | 47.0 |                                 |
|                       | Sometimes     | 1                                    | 7.7  | 2               | 9.1  | 5               | 12.2 | 3               | 11.5 | 6                | 9.1  |                                 |
|                       | Usually       | 1                                    | 7.7  | 0               | 0    | 0               | 0    | 1               | 3.8  | 0                | 0.0  |                                 |
|                       | Always        | 0                                    | 0.0  | 0               | 0    | 0               | 0    | 0               | 0.0  | 0                | 0.0  |                                 |
| Short-Term Memory     | 1             | 0                                    | 0    | 0               | 0    | 0               | 0    | 0               | 0    | 0                | 0    | R <sup>2</sup> =0.497<br>P<0.05 |
|                       | 2             | 0                                    | 0    | 0               | 0    | 0               | 0    | 0               | 0    | 1                | 1.5  |                                 |
|                       | 3             | 1                                    | 7.7  | 2               | 9.1  | 5               | 12.2 | 2               | 7.7  | 11               | 16.7 |                                 |
|                       | 4             | 6                                    | 46.1 | 9               | 41   | 12              | 29.3 | 9               | 34.6 | 40               | 60.6 |                                 |
|                       | 5             | 3                                    | 23.1 | 6               | 27.2 | 13              | 31.7 | 12              | 46.2 | 8                | 12.1 |                                 |
|                       | 6             | 1                                    | 7.7  | 4               | 18.2 | 11              | 26.8 | 3               | 11.5 | 6                | 9.1  |                                 |
|                       | 7             | 2                                    | 15.4 | 1               | 4.5  | 0               | 0    | 0               | 0    | 0                | 0    |                                 |
|                       | 8             | 0                                    | 0    | 0               | 0    | 0               | 0    | 0               | 0    | 0                | 0    |                                 |

secondary school female students. Similarly, our results demonstrated that only 39% of female students have their breakfast daily. Thus, studies to explore whether skipping of breakfast influences on short-term memory, performance, and mood, among Saudi female adolescents, were needed. The results of the current study showed a positive effect of breakfast intake on short-term memory and performance, however, there was no effect on mood.

The current study showed that 65%, among students who regularly consumed breakfast, considered it as an important meal or feel better if they do. As for the 45% of students who consume it either 3-4 times/week or less, possible reasons of skipping breakfast were either they do not enough time to eat breakfast (42%) or they do not feel hungry (37%). In contrast, some authors reported that adolescents tend to be self-conscious about their appearance enough that skipping breakfast could be practiced as a measure to lose weight [16]. In our study, the majority of parents leave home at the same time (37%) or after their children leave to school (60%). This indicates that parents are not involved in promoting breakfast intake among their children. Different results were obtained in a Netherlands' study [17] in which, authors reported 95% of children having breakfast at home, suggesting an effort on the part of parents to ensure that their children consider this meal.

In the present study, there was no correlation between breakfast intake frequency and mood. These findings contradict a number of studies that have shown breakfast consumption to have a positive effect on mood [6, 3,18]. The possible explanation may be the appropriate environment provided for the students from the private school; which was awarded the "International Quality Certification" and "Certificate of excellence in the educational performance" for five consecutive years from the Saudi Ministry of Education. Therefore, it would be interesting to enlarge the sample size of the target population by including students from other schools in order to obtain better representativeness on mood scores and its correlation with breakfast intake among female Saudi students.

Our study revealed that frequency of breakfast intake was consistently and positively associated with improved performance. This result is consistent with findings reported by Hoyland *et al.* [11] who suggested that skipping breakfast might lead to reduced attention and consequently decreased school performance. In addition, previous studies reported that usual breakfast intake has significant changes in school performance by an increased ability to recall information during lessons [16]. Besides, a previous research showed that children, who have breakfast, had improved attention in late morning performance tasks, regained information more quickly

and precisely, made fewer errors in problem-solving activities, and performed complex tasks [19]. Additionally, some authors found direct association between poor diet and lowered school performance in students [20].

The results of the current study demonstrated too that there is a significant correlation between daily breakfast intake and higher short-term memory score. Ahmadi *et al.* [9] showed that there was a positive correlation between iron intake in breakfast and short-term memory. However, no relationship was observed between calories, fat, protein, vitamin B6-B12, Iodine, and cholesterol consumption in breakfast with the short-term memory score. Thus, further investigations are recommended to assess nutrients intake during breakfast meal and their effect on short-term memory score.

## 5. CONCLUSION

The evidence, from the current study, revealed that breakfast intake is associated with a better student's performance and short-term memory. However, the prevalence of skipping breakfast is high among secondary female students aged (15 - 19 years old). It is recommended to inform and make parents and students more aware about the importance of breakfast consumption and its positive effect on performance and short-term memory at school. It would be valuable too that the school promotes eating breakfast by students and be involved in creating a supportive environment to it. It could be achieved by providing time for breakfast intake, making healthy food for breakfast available, and increasing awareness among staff members.

### Limitations

The research limitation could be the purposive sampling thus results of current study could not be generalized.

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Cite this article as: Alrayes A, Alwayshiq H, Altamimi H, Alangari R, and Benajiba N. Association between Breakfast Intake and Short-Term Memory, Performance and Mood among Saudi Female Adolescents. *Nor. Afr. J. Food Nutr. Res.* July - December (2018); 02 (04): 75-80. <https://doi.org/10.5281/zenodo.1409193>