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Impact of Breakfast Eating Pattern on Nutritional Status, Glucose Level, Iron Status in Blood and Test Grades among Upper Primary School Girls in Riyadh City, Saudi Arabia

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Abstract: The aim of the study was to examine the effect of breakfast eating pattern (between breakfast consumers and non consumers), on nutritional status (body mass index), glucose level, iron status and test grades (school performance) among Saudi school children (girls). A total of 120 female students aged 9-13.9 years from Riyadh city, Saudi Arabia Participated in this cross-sectional study. A pre-designed questioner was used to collect information on their breakfast eating habits. Body weight and height of the girls were measured and Body Mass Index (BMI) was calculated. Tests for blood Glucose (GLU), Hemoglobin (HG), Hematocrit (HT), Serum Iron (SI), serum ferritin were performed and Total Iron Binding Capacity (TIBC) was calculated. School marks of the previous semester were also collected (used). The results shows that 23.33% of girls ate breakfast only once a week or less often, whereas (40.83%) of the girls ate breakfast daily. Skipping breakfast increased with age. Breakfast skipping was significantly noticed among over weight-obese students compared to lean students, the mean level of HB, HCT, SI, TIBC and ferritin of the girls who ate breakfast regularly was the highest with no significant difference. Regular habit of eating breakfast had beneficial impact on nutritional status.

Key words: Breakfast, school children, nutritional status, performance

INTRODUCTION

Children require an adequate supply of nutrients for growth, energy and to maintenance of body functions. Their brains rely on a constant supply of nutrients in order to function properly. Eating breakfast provides children with energy for their brains as it improves their learning skills. However, without breakfast, body energy reserves become depleted over night. A gap of about to 12 h between dinner and breakfast causes a decline in blood glucose levels, which may lead to glucose deprivation. If this happens in sufficient degree, it can result in a rapid disturbance in cerebral function (Wurtman *et al.*, 1977). Habitually missing breakfast can adversely affect cognitive performance. The gradual decline of insulin and glucose levels could cause a stress response, which interferes with different aspects of cognitive function, such as attention and working memory. It is plausible that the decline in cerebral iron level, likely to result from diet that is deficient in heme, intensifies the stress associated with overnight and morning fast (Center on Hunger, Poverty and Nutrition Policy, 1995). This is why breakfast is commonly referred to as the most important meal of the day. The consumption of breakfast has many benefits for children, such as its positive effects on daily nutritional intake (Peter Williams, 2007; Uma Chitra and Radha Reddy, 2007; Noela *et al.*, 2006; Theresa *et al.*, 1993), body weight (Fabritius and Rasmussen, 2008; Henríquez Sánchez *et al.*, 2008) and macro and micro-

nutrients (Ruxton and Kirk, 1997; Cueto, 2001). Breakfast consumption may improve cognitive function reflected on memory, better marks and school attendance (Rampersaud *et al.*, 2005; Kleinmana *et al.*, 2002). Children who do not eat breakfast have reduced memory function, poorer attention spans and reduced performance in tasks requiring concentration when compared with those who consume an adequate breakfast. Therefore, consuming a healthy breakfast improves cognitive function and learning outcome (Mahoney *et al.*, 2005). Habitually consuming an inadequate breakfast in quality and quantity is associated with poorer test scores (Lo ´pez-Sobaler *et al.*, 2003). Effects of macro-nutrients on cognitive performance may be dependent on their effects on glucose metabolism, metabolic activation, or serotonin. Other factors that modify effects include time of day, habitual diet and vulnerability of the population (Louise Dye *et al.*, 2000). Yet, young people are more likely to skip breakfast than any other meal. Those who skip breakfast are more likely to be overweight than those who don't, skipping breakfast means probably feeling very hungry by morning tea-time. Studies have found that children who skip breakfast are more likely to have a higher intake of sugar and fat in their diets. They are also more likely to be lacking essential vitamins and minerals in their diet, such as calcium, iron and zinc (Williams, 2007; Friedman and Hurd-Crixell, 1999). Food behaviors and food choices established in childhood

may track into adulthood (Mikkila *et al.*, 2004). In Saudi Arabia a previous study has shown that failure to eat breakfast or lack of nutritious food for breakfast is common in childhood (Abalkhail and Shawky, 2002). A study carried in Jeddah city (western province) shows that the increase in BMI among Saudi Arabian children and female adolescents aged 10-20 years is apparent in all age groups (Abalkhail, 2002). Another study in Al-khobar city (Eastern province) showed that the prevalence of overweight and obesity among female school-aged children and adolescents was very high (Al-Saeed *et al.*, 2006). The limited number of studies on this field triggered us to perform this study to recognize the relationship between eating/skipping breakfasts and the nutritional status, glucose levels, iron status in blood and test grades, among upper primary school girls in Riyadh city.

MATERIALS AND METHODS

Riyadh city is divided into four educational districts (north, south, east and west). One local governmental school was chosen randomly from each district. A total of 120 female students aged 9-13, 9 years (studying in 4th, 5th and 6th grades) participated in this cross-sectional study, by completed a questionnaire. A pre-designed questioner was used to collect the information about breakfast eating habits. Breakfast consumption is categorized as usual/always, often and rarely/never (5-7, 2-4 and 0-1 times/week, respectively). Anthropometric measurements including height and weight has been used to assess the nutritional status by calculation Body Mass Index (BMI) using the formula: $BMI = \text{Weight (in kg)} / \text{Height (in m)}^2$. And an early-morning blood sample of 5 ml has been taken by trained physicians. Blood Glucose (GLU), Hemoglobin (HG), Hemotocrit (HT), Serum Iron (SI), serum ferritin were performed and Total Iron Binding Capacity (TIBC) has been calculated. Blood Glucose level has been tested using BM-Test 1-44 blood glucose test strips, following the manufacturer's procedure and then measured with a Prestige Medical Healthcare Ltd. HCl digital Blood Glucometer. Hemoglobin and hemotocrit has been measured by using Culter S+4 according to Dacie and Lewis (1975), serum iron by the method of Williams and Conrad (1966) and Ferritin has been measured according to Addison *et al.* (1972). According to the following formulae: $(TIBC = \text{Transferrin} \times 24)$. Transferrin has been measured first in order to calculate the TIBC; the assay of transferrin has been carried out using the Cobas Mira plus Analyzer. A school mark of the first semester has been collected, and the questioner was filled at the first week of the second semester. Data analysis was done using Statistical Package for Social Science (SPSS) for means and (MNOVA) test was employed to analyze the data and study the association of the eating pattern of breakfast and other variables. Statistical inferences were made at sig. ≤ 0.05 .

RESULTS

Table 1 shows the breakfast eating frequencies of the study sample. Although the majority of girls think that eating breakfast at home is very important, Breakfast skipping was relatively common: 23.33% of girls ate breakfast only once a week or less often, whereas (40.83%) of the girls ate breakfast daily. 7.14% subjects had completed 9 years of age, 30.0% had completed 10 years of age, 35.83% subjects had completed 11 years of age, 23.33% had completed 12 years of age and 6.67% had completed 13 years of age. Skipping breakfast increased with age. Mean age of the study sample who ate breakfast daily was 10.82 ± 1.05 which is less than the mean age of girls who ate breakfast Some times or rarely.

The mean height of the girls who habitually consume breakfast was 141.26 ± 9.28 cm, while the mean weight was 37.89 ± 12.94 kg. Their mean BMI was 18.63 ± 4.28 which is less than the mean weight and the mean BMI of the girls who did not consume breakfast but the difference does not reach statistical significance (Table 2).

Table 3 shows nutritional status according to BMI. Of the study sample, 66.67% were normal (lean), 13.33% were overweight while 12.5% were found to be obese and 7.5% were under weight. Most of the girls who ate breakfast daily (71.4%) were normal while 20.4% were overweight or obese and 8.3% were found to be under weight, the highest percentage of obesity and under weight were found among the girls skipping breakfast 25.0%, 10.7% consecutively. There was a significant association between eating breakfast and nutritional status for the benefit of normal students.

The mean level of glucose and iron in blood are shown in Table 4, level of glucose was proximate for the three groups. The mean level of HB, HCT, SI, TIBC and ferritin of the girls who ate breakfast regularly was the highest and no significant difference was noticed.

The mean grade tests for girls consuming breakfast regularly was the highest between the study sample groups in all subjects but the difference was not significant (Table 5).

DISCUSSION

Girls in Saudi Arabia do not involve in any physical activity at schools (sport is not included in curriculum) or at outside (due to the hot weather), yet food habits and nutritional status is a very important factors for growth and health maintenance. This study shows that about 40.83% eat breakfast daily while 23.33% do not eat it at all or once a week. These results are much higher than the results of previous studies that were conducted in Saudi Arabia. In Riyadh city, a study shows that 16, 5% of the girls age 7-14 years do not eat breakfast (Al-Othaimen *et al.*, 1999) And in Jeddah city skipping breakfast is reported by 14.9% of school students

Table 1: Distribution of study sample according to breakfast consumption and age

Age group (years)	Daily		Sometimes		Rarely or never		Total	
	No	%	No	%	No	%	No	%
9-9.9	3	2.5	1	0.83	1	0.83	5	7.14
10-10.9	19	15.83	11	9.17	6	5.0	36	30.0
11-11.9	15	12.5	14	11.67	14	11.67	43	35.83
12-12.9	8	6.67	13	10.83	7	5.83	28	23.33
13+	4	3.33	4	3.33	-	-	8	6.67
Total	49	40.83	43	35.83	28	23.33	120	100.0
Mean age	10.82±1.05		11.19±1.01		10.96±0.79		10.98±0.99	

Table 2: Distribution of study sample according to breakfast consumption and anthropometric measurements

	Daily n = 49	Sometimes n = 43	Rarely or never n = 28	F	Sig.
	Mean±SD				
Height (cm)	141.26±9.28	142.05±8.16	141.13±8.24	3.382	0.918
Weight (kg)	37.89±12.94	40.29±12.02	41.01±14.37	0.432	0.166
BMI	18.63±4.28	19.68±4.35	20.18±5.31	0.379	0.144

Table 3: Distribution of study sample according to breakfast consumption and nutritional status

Nutritional status	Daily		Sometimes		Rarely or never		Total		F	Sig.
	No	%	No	%	No	%	No	%		
Normal	35	71.4	31	72.1	14	50.0	80	66.67	3.153	0.046*
Overweight	7	14.3	5	11.6	4	14.3	16	13.33		
Obese	3	6.1	5	11.6	7	25.0	15	12.5		
Under weight	4	8.2	2	4.7	3	10.7	9	7.5		
Total	49	100.0	43	100.0	28	100.0	120	100.0		

*Significant differences between groups (Sig. <0.05)

Table 4: Distribution of study sample according to breakfast consumption and glucose level, iron status in blood

	Daily	Sometimes	Rarely or never	F	Sig.
	Mean±SD				
GLU (mmol/L)	100.46±15.90	101.81±20.56	98.45±19.19	1.620	0.202
HB (g/dl)	13.18±0.91	12.91±1.67	12.89±0.96	1.379	0.256
HCT (%)	39.00±2.16	38.09±2.44	38.32±3.58	0.597	0.674
SI (mmol/L)	90.98±26.54	84.53±32.83	90.85±27.92	0.298	0.743
TIBC (mmol/L)	346.59±74.64	335.06±68.82	330.10±75.97	0.382	0.683
Ferritin (µg/L)	17.54±12.44	17.09±12.52	16.53±9.64	0.219	0.804

Table 5: Distribution of study sample according to breakfast consumption and subjects test grades

	Daily n = 49	Sometimes n = 43	Rarely or never n = 28	F	Sig.
Math (% of the marks)	≥90	> 80 to < 90	≥70	0.355	0.132
Science (% of the marks)	≥90	> 80 to < 90	≥70	0.313	0.401
Reading (% of the marks)	>90	> 80 to < 90	<80	0.290	0.264

(Abalkhail and Shawky, 2002). But these findings are lower than those reported in Abha, Southwestern region of Saudi Arabia, where breakfast is a regular meal for 72% of primary school students (Nadia *et al.*, 2007). Another study involving 124 girls, age 9-10 years in Qatar (Gulf Region) has found that 89.5% eat breakfast daily (Abdelmonem and Al-Dosari, 2008). In another study in India 62.3% of the children age 11-13 years habitually consume breakfast, 33.8% consume it irregularly, skipping it 2 or 3 times a week and 3.9% do not consume breakfast at all (Gajre *et al.*, 2008). In Hong Kong 30.5% of the student age 10-14 years old reported skipping breakfast for at least 1 day in a school week (Tereza Cheng *et al.*, 2008). Skipping breakfast increase with age, these findings are consistent with other

studies (Pearson *et al.*, 2009; Williams *et al.*, 2008; Abalkhail and Shawky, 2002). Girls who eat breakfast regularly have the lesser mean body mass index; whereas girls who do not eat breakfast have the highest mean weight and body mass. These findings are similar to some other studies (Fabritius and Rasmussen, 2008; Albertson *et al.*, 2007; Lo ´pez-Sobaler *et al.*, 2003). In this study breakfast consumption has an important impact on nutritional status; obese girls are more likely to skip breakfast than their normal peers and are at higher risk for growth deficits and health problems. These results are not different from other studies (Tereza Cheng *et al.*, 2008; Amin *et al.*, 2008; Arash Rashidi *et al.*, 2007). Levels of glucose in blood are convergent either due to the quality and/or quantity of

breakfast eaten or due to time of testing. Eating breakfast before 1.5-2 h prior to testing registers as not eating breakfast. That may explain the findings, since there appears to be no significant difference between groups. Healthy breakfast should contain whole grain cereals, fruit and/or vegetables, milk or fresh juice, whole grain foods are high in fiber which helps in feeling full and helps to slow the release of energy into the blood. Energy, therefore, lasts longer throughout the day. However, little research has been published on the types of foods and beverages consumed by Saudi school children for breakfast. One study shows that 23.9, 22.8, 18.2 and 18.8% of the anemic school children do not eat green vegetables daily, do not eat fruits at school as snack between meals, do not eat junk food between meals as snack and do not eat junk food at school respectively (Abalkhail and Shawky, 2002). In the USA, African-American children still had mean intakes of most nutrients below recommended levels (Williams *et al.*, 2008). Although the mean biochemical tests for iron status in blood were within tolerable levels for all the groups but the highest level was for girls consuming breakfast regularly. The lack of information about using supplements and about the content of other meals consumed throughout the day by the study samples may explain the significant differences between groups in level of HG, HCT and TIBC. Results of a study in Peru (Jacoby *et al.*, 1996) shows that children in the school breakfast programme improved their average daily intake of energy, protein and iron by 15, 16 and 60%, respectively. Similar results have been reported in developing countries (Mathews, 1996). The mean level of HB in this study is higher than that reported in a study in Peru (Cueto and Chinen, 2008) where they have found that the average hemoglobin level in a group of children having school breakfast is 12 g dl⁻¹, while in the comparison group it is 11 g dl⁻¹. That's probably due to the high consumption of meat, poultry and eggs by the population in Saudi Arabia. Breakfast quality is an important component in the complex interaction between lifestyle factors and mental health (O'Sullivan *et al.*, 2008). Habitually consuming an inadequate breakfast in quality and quantity is associated with poorer test scores (Barbara Radcliffe *et al.*, 2004; Lopez-Sobaler *et al.*, 2003). In Rural Peru, a school breakfast programme shows a significant and positive effect on short-term memory, arithmetic and reading comprehension (Cueto and Chinen, 2008). Indian students who regularly consume breakfast achieve higher scores on the immediate recall memory test and perform significantly better on the letter cancellation test (attention-concentration) (Gajre *et al.*, 2008). In the present study, eating breakfast has no effect on tests grades. The design of this study does not distinguish whether children who habitually have better breakfasts have better test grades. Breakfast quality and quantity need to

be taken into account when designing future studies. Further research is needed to investigate the relationships between consuming breakfast (including quality and quantity) and mental function in Saudi schoolchildren.

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