Evaluation of Nutritional Status and Its Relationship to Academic Achievement among University Students

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Abstract: The development of any nation or community depends largely on the quality of education of such a nation. It is generally believed that the basis for any true development must commence with the development of human resources. It has been argued that health is an important factor for academic achievement at school and in higher education. Consequently, in the context of universities or colleges, promoting the health and well-being of all members means promoting effective learning. Understanding the nature of the causal relationship between health and education is important to determine the exact relation between them. The present study was undertaken to study the relationship of academic achievement with the nutritional status of university students. Samples of 150 students enrolled in Taif University, Faculty of Design and Home Economics, Nutrition and Food Science Department were taken. Objectives of the study were to evaluate the food intake of university students with energy, carbohydrates, proteins and fats, to find out relation between socioeconomic status and academic achievement of university students, to find out the anthropometric measurements like weight and height, to find out dietary assessment by using a 7 day dietary recall to find out relation between food intake and anthropometric measurements, to assess the nutritional status of university students, to find out the effect of nutritional status and anthropometric measurements on academic achievement of university students.

1. Introduction

Good eating habits are an essential part of a healthy lifestyle. Healthy nutrition is an important factor in preventing many specific health problems of young people such as vitamin A deficiency, iron deficiency anemia, and excess body weight. Also, eating behavior can affect long term health. Unhealthy eating habits such as skipping breakfast and excessive intake of foods with high carbohydrate and fat contents are the main factors causing nutritional problems. Risk of chronic diseases including obesity, cardiovascular disease, osteoporosis, and cancer may increase as a result of unhealthy nutrition **(Wahlqvist, 2004).** Adolescents often do not have sufficient knowledge and experience to make appropriate decisions, and tend to develop unhealthy eating habits. These habits include skipping breakfast, replacing lunch meals with snack foods, and increasing soft drink intake, all of which can lead to inadequate nutrient intake. It was reported in a study in Greece that students living away from home developed more unfavorable eating habits than students living at the family home **(Papadaki et al., 2007).** It was found that unbalanced eating is an important health problem for Turkish university students with a mean age of 21.28 ± 2.32 years **(Ergulen et al., 2001).** In a study with university students, according to BMI classification, 23.5% were underweight and 10.5% were overweight. The percentage of people having breakfast every morning was found to be 55.6% **(Sağlam and Yörükçü, 1996).** In another study, it was found that the use of energy drinks is quite common among college students, but their knowledge of ingredients and potential health hazards of such drinks is very limited **(Attila and Çakir, 2011).**

The intakes of fiber, total fat, saturated fatty acids, cholesterol, and sodium among Turkish adolescents were found to be high; however, their vitamin E, vitamin B_6, and foliate intakes were found to be low according to the American Heart Association. Turkish adolescents' fruit and vegetable intakes were also found to be low **Baş et al. (2005).** More than 50% of the responders were meeting 2/3 of the RDAs for niacin, riboflavin, vitamin B_6, vitamin C, phosphorus, and zinc **(Sanlier and Unusan, 2007).** A population of girls studied in Japan showed insufficient intakes of energy, protein, and minerals such as calcium and iron **(Shimbo et al., 2004).**

The important finding here is that knowledge, attitudes, and behaviors all affect a university student's nutrition. Desire for a thin body size is another factor that especially affects nutritional status

in women. Half of the students were concerned about their body size, and > 60% was dissatisfied with their weight **(Brook and Tepper, 1997). (Nowak, 1998),** concluded that weight-conscious adolescents, especially girls, exhibited restrictive eating practices and a preoccupation with a slim image. Adolescents need a food culture based on foods to eat rather than foods to avoid, and an understanding of suitable weight-control measures.

Nutritional status is the combination of an individual's health as influenced by intake and utilization of nutrients and determined from information obtained by physical, biochemical and dietary studies **(Durning and Fidanza, 1985).** Information on the nutritional status and dietary habits of the adolescent population in Nigeria is however scanty.

Academic performance were influenced by multiple factors **(Ong et al., 2010)** includes breakfast habit **(Kim et al., 2003)** eating behaviors, environmental factors, familial, genetic, emotional and social influences. Apart of that, iron deficiency is also one of the problems that were associated with global health of schoolchildren which can impaired their cognitive development **(El Hioui et al., 2008).** Eating behavior might relate to the academic achievement and self esteem of the students and balanced diet is important not only in maintaining physical health but also in promoting emotional well being and psychosocial functioning **(Fu et al., 2007).** There is might be relationship between eating behaviors, self esteem and academic achievement among students.

The objectives of this study are to study the relationship between nutritional status and academic achievement among university students as follows:

1- Assessment of daily foods consumed by the students.

2- Estimation of the adequacy of nutrients intake as compared to the recommended dietary allowances.

3- Assessment of socioeconomic status, anthropometric measurements.

4- Obtaining the academic achievement of university students.

Study the relationship between nutritional status, socioeconomic status, anthropometric measurements and academic achievement of university students.

2. Subjects and Methods
Subjects:

Subjects consisted of 150 students (75 students at level 5 and 75 students at level 7) enrolled in Taif University, Faculty of Design and Home Economics.

- To evaluate the food intake of university students with energy, carbohydrates, proteins and fats.

- To find out the anthropometric measurements like weight and height.

- To assess the nutritional status of university students

- To find out the effect of nutritional status and anthropometric measurements on academic achievement of university students.

Data on general information, socioeconomic status, and eating habits were obtained by the administration of structured questionnaires in Taif College Students Designs and Home Economics at Taif University, department of Nutrition and Food Science at level 5 and 7.

Methods:
Anthropometric measurements

The body weights of students wearing minimal clothing without shoes were measured to the nearest 0.5 kg with a portable scale. Height to the nearest 0.1 cm was measured with a fiber-glass tape. All measurements were obtained as previously described **Lohman et al. (1988).** Body Mass Index (BMI: weight/height^2, kg/m^2) was calculated for each subject according to the World Health Organization **WHO (2000)** carried out according to the method of **Scrimshaw and Gleason (1992).**

Economics status:
(1) The educational level of the father or husband:

Educational level was measured on a scale Arrange consists of seven degrees is my mother, and reads and writes, primary, and average, and a secondary, and university degree, and graduate.

(2) Function or work for father or husband:

Function was measured for the father or husband arrange on a scale consists of eight degrees are not working, dealer, employee, teacher, doctor and so on.

(3) The income which is income of the father or husband:

Income was measured with less than 2000 riyals, from 2000-3000 riyals, more than 3000-4000 riyals, more than 5000-6000 riyals, more than 6000-7000 riyals, more than 8000 riyals, and finally other sources of income to remember. Has been divided into (a low income was less than 3000 riyals), and (medium income from 3000 to less than 6000 riyals), and (high income from 6000 to less than 9,000 riyals), and (income distinct from 9000 riyals and older).

(4) The social level:

Equation was used to measure the level of social research sample for the students and it calculates the

level of education, type of work or employment for family members.

Education father or husband + Action = father or husband social level to be predictable, and after it is collected and the points are split on the social level, as follows:

The social low level was 4 degree or less, the medium social level was 5 – 9 degree and the high level of social was 10-14 degree

Dietary habits and nutrition awareness:

Which are about six questions to get to know your dietary habits by the student? Determine where the student answers from multiple outlines the dietary habits of each student, such as the number of daily meals and meal which shares with her family in the handling and food and beverage intake between meals and the date of tea and the amount of both salt and sugar as their favorite and usual in terms of dining out and food intake of the cafeteria **(Shin et al. 2012).**

It is nineteen questions to get to know the student's awareness of the importance of food and its nutritional value. In addition to the six questions to measure the awareness of the student prepares foods and cooked the right way. Students choose between multiple answers or choose between yes or no, and given the correct answer (1) and false (zero) and then collect the answers and corrected according to **Lee and Nieman (2003).**

Data collection and dietary intake

Data were collected by face to face interviews using a standard questionnaire. The questionnaire consisted of questions on students' socio-demographic characteristics, and eating habits.

Food intake was assessed by 24 hours recall dietary records maintained for one day by using a photographic atlas of food portion sizes **(Rakıcıoğlu et al., 2009).** Energy and nutrient intakes were calculated separately for breakfasts, lunches, dinners, and snacks, and also as a total daily intake using food composition tables by a computer program **(Bebis, 2004).** Results were compared with recommended daily allowances (RDAs) according to age and gender **(National Research Council, 1989).** Nutrient intakes < 67% of the RDA were accepted as deficient. Depending on the reference cut off points for the estimations of nutritional adequacy were suggested as follows: high, $1^{1/2}$ RDA; medium, $1^{1/3}$-$1^{2/3}$ RDA; low, 2/3 RDA or below **(Jelliffe and Jelliffe, 1989).**

Academic achievement

Academic achievement was assessed based on the student's final test results, were obtained from student's academic records for the final examination **(Ong et al., 2010).**

Statistical analysis

Statistical evaluation of results was performed using Statistical Packages for Social Sciences **(SPSS, 2010).**

3.Results and Discussion
Anthropometric measurements:

The mean height of the normal group was 161.20 ± 3.95 cm^2 but overweight and obese groups being 160.11 ± 4.66 cm^2 and 159.9 ± 4.96 cm^2 respectively. The difference in height among groups was statistically non significant (p >0.05). At the start of study, the overweight and obese groups had higher mean weight at p< 0.01 and 0.001 as the values 76.96 ± 3.44 kg and 103.22 ± 5.44 kg, respectively compared with the mean weight of normal group (60.25 ± 2.76 kg). While at the end of study, the values reduced significantly by $12.61\pm$ 1.11and $19.81\pm1.21\%$ respectively compared with corresponding values at the start of study. Body mass index (BMI) values of overweight and obese groups were significantly increased at p< 0.05 and 0.001 as the values 30.06 ± 3.40 and 40.47 ± 3.21 kg/ m^2, respectively at the start of study than the value of normal group (23.17 ± 2.88kg/m^2). At the end of study, the values of BMI were reduced significantly by $4.93\pm$ 0.55and $7.77\pm 0.76\%$ respectively compared with corresponding values at the start of study.

Obesity means having too much body fat. It is different from being overweight, which means weighing too much. The weight may come from muscle, bone, fat, and/or body water. The prevalence rates of overweight and obesity have widely recognized globally as pandemic and have become a major public health challenge in developed countries especially in the Arab world **(Ogden et al., 2003).**

There are more than 250 million obese adults and about 1.1 billion overweight people worldwide Environmental and behavioral changes brought about by economic development, modernization and urbanization has been linked to the rise in global obesity. The variation in prevalence of obesity epidemic in various races and communities of the world may be attributed to heredity, age, sex, diet, eating patterns, life style and/or behavior **(Epstein and Higgins, 1992).**

Economics status:

From data in Table (2) illustrated that the economic level of the students research sample in the educational levels of the three levels in the Department of Nutrition and Food Science, where most of the students research sample found in the level 5 and 7 of economic outstanding any for income outstanding (9000 riyals and over) with a rate of 8%and 12%, respectively. While it was 14.7 and 13.3% in the fifth level and the level seventh

consecutive located in the level of high economic any higher incomes from (6000 to 9000 riyals), while female students with medium income of (3000 to less than 6000 riyals) percentage was 62.7 and 50.7% in the fifth and seventh levels, respectively. The rates were 14.7 and 24% in the fifth and seventh levels, respectively, of female students with low incomes (less than 3000 riyals). Therefore, it may be find that the monthly income of the families of the students' research sample is located mostly in income

outstanding then medium, low, high and finely distinct was the lowest percentage of students belonging to them. This may be due to the highest proportion of respondents to the medium levels of economic to the social level was high.

Through the analysis statistical became clear that there was no clear indication in the department for two levels of income for the families of the students.

Table (1): The average of anthropometric measurements to subject groups at the start and end at the levels 5 and 7.

Groups variable	Normal	Overweight		Obese after study	
	Volume	At start	End	At start	End
High (cm)	161.20 ± 3.95	160.11 ± 4.66	160.11 ± 4.66	159.9 ± 4.96	159.9 ± 4.96
Weigh (kg)	60.25 ± 2.76	76.96 ± 3.44**	64.35 ± 2.96	103.22 ± 5.44***	83.41 ± 2.16
BMI (kg/cm)	23.17 ± 2.88	30.06 ± 3.40*	25.13 ± 3.29	40.47 ± 3.21***	32.70 ± 4.21

Significant with normal group * $P<0.05$ ** $P<0.01$ *** $P<0.001$

Table (2). Distribution of the research sample of students at levels 5 and 7 in accordance with the economic situation in the College.

Economic	level	Normal		Overweight		Obesity		Sum	
		Level 5	Level7	Level 5	Level7	Level 5	Level7	Level 5	Level7
Low	Number	10	15	1	2	-	1	11	18
	%	15.9	22.4	8.3	33.3	-	50.0	14.7	24.0
Medium	Number	38	34	9	3	-	1	47	38
	%	60.3	50.7	75.0	50.0	-	50.0	62.7	50.7
High	Number	9	10	2	-	-	-	11	10
	%	14.3	14.9	16.7	-	-	-	14.7	13.3
Distinct	Number	6	8	-	1	-	-	6	9
	%	9.5	11.9	-	16.7	-	-	8.0	12.0
Sum	Number	63	67	12	6	-	2	75	75

Nutrition awareness and dietary habits:

From Table (3) it can be seen that the level of awareness of food for the students of the seventh level between excellent, very good, good, pass and week were 37.3, 26.7%, 2.8,6.7 and 1.3%, respectively. While the awareness of food for the students of the fifth level were 22.7, 17.3, 42.7, 12.0 and 5.3%, respectively.

From the above results it may be noticed that the best nutrition awareness among the students was the seventh level, than the fifth level. These results may explain that the third level students at the beginning of the scientific study of the nutrition material in the section, while level fifth and seventh were more in-depth study.

It turned out after the analysis, there were statistical significant differences at the level of 1% for the distribution of the level of awareness of the students in the sample purely two levels.

Although there is insignificant association between the nutritional knowledge and dietary behavior of the studied adolescent school girls, their deficient nutritional knowledge is likely to have a negative impact on their nutritional status as future

mothers as well as the nutritional status of their children to come **Shaaban et al. (2009).**

From Table (4) it could be observed the dietary habits for students fifth and seventh levels, Department of Nutrition and Food Science. It can be noticed that the proportions of female students with converged habits accepted where the percentage of 29.3 and 14.7% for students level fifth and seventh level respectively.

The dietary habits were recorded 42.7% of good for the seventh level students, followed by the students of the fifth level of 34.7%, the proportion of female students. The very good habits were 42.7% in the level seventh, followed by the fifth level of 29.3%. Moreover, it can be noted that the students of women with very good and good dietary habits is the highest percentage and the majority of students in seventh level of 42.7% both of them. This may be due to a great result curriculum learned seventh level compared to the fifth level, but that did not change habits with degree required when most of the students and this is what calls for the development of curricula offered and focus on the practical part.

Table (3). Awareness nutrition for students at levels 5 and 7 in the Department at Nutrition and Food Science.

Nutritional	awareness	Normal		Overweight		Obesity		Sum	
		Level 5	Level7	Level 5	Level7	Level 5	Level7	Level 5	Level7
Week	Number	3	1	1	-	-	-	4	1
	%	4.8	1.5	8.3	-	-	-	5.3	1.3
Pass	Number	7	4	2	1	-	-	9	5
	%	11.1	6.0	16.7	16.7	-	-	12.0	6.7
Good	Number	25	18	7	1	-	2	32	21
	%	39.7	26.9	58.3	16.7	-	100	42.7	28.0
Very good	Number	11	17	2	3	-	-	13	20
	%	17.5	25.4	16.7	50.0	-	-	17.3	26.7
Excellent	Number	17	27	-	1	-	-	17	28
	%	27.0	40.3	-	16.7	-	-	22.7	37.3
Sum	Number	63	67	12	6	-	2	75	75

Table (4). The dietary habits of the students at levels 5 and 7 in the Department at Nutrition and Food Science.

Dietary	habits	Normal		Overweight		Obesity		Sum	
		Level 5	Level7	Level 5	Level7	Level 5	Level7	Level 5	Level7
Pad	Number	3	-	2	-	-	-	5	-
	%	4.8	-	16.7	-	-	-	6.7	-
Pass	Number	18	9	4	2	-	-	22	11
	%	28.6	13.4	33.3	33.3	-	-	29.3	14.7
Good	Number	23	27	3	3	-	2	26	32
	%	36.5	40.3	25.0	50.0	-	100	34.7	42.7
Very good	Number	19	31	3	1	-	-	22	32
	%	30.2	46.3	25.0	16.7	-	-	29.3	42.7
Sum	Number	63	67	12	6	-	2	75	75

Daily nutrition intake:

Table (5) showed that the measurement at the level five had contained energy , total fat and total carbohydrate intakes of overweight group were significantly higher at $p < 0.01$ and 0.001. The higher intake of energy, total fat and carbohydrate were represented 129.79±8.86, 139.91±13.25 and 134.01± 12.13%, respectively of the recommended daily allowance (RDA). Whereas, total protein was significantly lower at $p < 0.01$ compared with the intakes of normal group and also, the lower intake of total protein represented 96.07± 9.11 % of the RDA.

The same Table illustrated that the measurement at the level seven for the energy and total fat intakes of overweight group were in non significant increase at $p > 0.05$ compared to the intakes of normal group as the values of the energy and total fat intakes were within normal and represented103.84± 8.61 and 116.76± 11.21% of the RDA. Total protein intake of overweight group was significantly increased at $p < 0.01$ and 0.001 but carbohydrate intakes was significantly decrease at $p < 0.001$ compared with the intakes of normal group as the values of the total protein and carbohydrate intakes were represented 138.45± 12.40 and 89.81± 8.77% of the RDA.

Table (6) showed that the measurement at the level five had contained energy, animal fat, total fat and carbohydrate intakes of obese group were significantly higher at $p < 0.001$ but plant and total protein were significantly lower at $p < 0.05$ and 0.001 compared to the intakes of normal group. The higher intake of energy, total fat and carbohydrate represented 155.50± 17.10, 158.85± 15.16 and 170.46±17.31% of the RDA but the lower intake of total protein represented 90.10± 9.21% of the RDA.

The same Table reported that the measurement at the level seven for the energy, plant protein, animal protein and total protein intake of obese group at level five were significantly increase at $p < 0.05$, 0.01 and 0.001compared to the intakes of normal group as the values of the energy and total protein intake were 110.03± 9.66 and146.70± 10.24% of the RDA. Animal fat intake of obese group was significantly increase at $p < 0.05$ in compared to the intakes of normal group but decrease compared to the value at the start while plant fat intake of obese group was significantly decrease at $p < 0.001$ compared to the intakes of normal group. The values of the total fat and carbohydrate intakes were within normal and represented120.19±11.71and 96.78± 9.80% of the RDA.

On the basis of previous research evidences, low-fat diets have long been known as the key to a healthy weight and to good health. In fact, study volunteers who follow moderate- or high-fat diets lose just as much weight, and in some studies a bit more, as those who follow low-fat diets. Low-fat diets problem is that they are often high in

carbohydrate, especially from rapidly digested sources, such as white bread and white rice. And diets high in such foods increase the risk of weight gain, diabetes, and heart disease **(Sacks et al., 2009)**. In the diet and lifestyle change study, people who increased their consumption of fries, potatoes and potato chips, sugary drinks, and refined grains gained more weight over time but people who decreased their intake of these foods gained less weight **(Mozaffarian et al., 2011)**. Higher protein diets seem to have some advantages for weight loss. People consumed high-protein diets tend to feel fuller, on fewer calories and take more energy to metabolize and store protein than other macronutrients, and this may help people increase the energy they burn each day. Higher protein, lower carbohydrate diets improve blood lipid profiles and other metabolic markers, so they may help prevent heart disease and diabetes **(Halton and Hu 2004 and Westerterp-Plantenga et al., 2009).**

Table (5): Energy and macronutrient intake of normal and overweight groups at the level five and seven.

Nutrition intake	Normal		Overweigh at level 5		Overweigh at level 7	
	Mean ±SD	%RDA	Mean ±SD	%RDA	Mean ±SD	%RDA
Energy (kcal)	2160.77 ± 160.41	102.89 ± 6.14	2725.65± 181.81**	129.79 ± 8.86*	2180.77± 190.14	103.84 ± 8.61
Animal protein(g)	59.66 ± 6.22		55.34 ± 5.19		78.88 ± 7.11**	
Plant protein(g)	22.48 ± 2.61		20.32 ± 2.10		30.15 ± 3.71**	
Total protein(g)	82.14 ± 9.40	104.29 ± 11.50	75.66 ± 6.08**	96.07 ± 9.11**	109.03± 9.95***	138.45± 12.40***
Animal fat(g)	37.11 ± 3.12		51.14± 4.20***		40.21 ± 4.41	
Plant fat(g)	25.08 ± 2.14		30.02 ± 2.96**		27.90 ± 2064	
Total fat(g)	62.22 ± 6.50	106.66 ± 11.15	81.61± 8.19***	139.91± 13.25***	68.11 ± 6.17	116.76 ± 11.21
Total carbohydrates(g)	318.05 ± 30.21	100.96 ± 10.11	422.13± 52.11***	134.01± 12.13***	282.91± 29.77***	89.81 ± 8.77**

Significant with normal group * P<0.05 ** P<0.01 *** P<0.001
RDA: Recommended daily allowance

Table (6): Energy and macronutrient intake of normal and obese groups at the level five and seven.

Nutrition intake	Normal		Obese at level 5		Obese at level 7	
	Mean ±SD	%RDA	Mean ±SD	%RDA	Mean ±SD	%RDA
Energy (kcal)	2160.77 ± 160.41	102.89 ± 6.14	3265.68± 200.13***	155.50± 17.10***	2310.66± 209.66*	110.03 ± 9.66*
Animal protein (g)	59.66 ± 6.22		52.99 ± 4.21		85.91± 5.41***	
Plant protein(g)	22.48 ± 2.61		17.97 ± 1.90*		29.21 ± 2.30**	
Total protein(g)	82.14 ± 9.40	104.29 ± 11.50	70.96 ± 7.16***	90.10± 9.21***	115.03± 9.17***	146.70± 10.24***
Animal fat(g)	37.11 ± 3.12		63.18 ± 6.17***		49.61 ± 4.13*	
Plant fat(g)	25.08 ± 2.14		29.48 ± 3.11		20.51 ± 2.12**	
Total fat(g)	62.22 ± 6.50	106.66 ± 11.15	92.66 ± 9.11***	158.85± 15.16***	70.11 ± 7.19	120.19 ± 11.71
Total carbohydrates(g)	318.05 ± 30.21	100.96 ± 10.11	536.97± 30.17***	170.46± 17.31***	304.88 ± 35.61	96.78 ± 9.80

Significant with normal group * P<0.05 ** P<0.01 *** P<0.001.

Relationship dietary intake level of academic achievement at levels five and seven.

The relationship of these nutrients consumption data with that of their academic achievement provides valuable insight into the role of various nutrients in academic achievement of these students. It was found that BMI and fat consumption levels are negatively correlated with academic achievement. Though the correlation of BMI with academic achievement is weak, fat consumption is strongly correlated with

academic achievement. This may be due to the fact that fats form a crucial part of the neuronal circuitry. All other nutrients are positively correlated with academic excellence.

The World Health Organization (WHO) recommends 55-75% of humans' calories obtained from carbohydrate; however, the recommendation for carbohydrate intake based on the Dietary Guidelines for Americans, at 45-65%, is slightly lower. Likewise, U.S. dietary guidelines recommend a higher ratio of calories coming from fat (25-35%) and protein (10-30%) than those of the WHO **(U.S. Department of Health and Human Services [USDHH] and U.S. Department of Agriculture [USDA], 2005).** The minimum carbohydrate intake required for fundamental brain function is 130 grams (roughly 520 calories) per day **(Davis et al., 2010).**

Food also fortifies the body with micronutrients (vitamins and minerals) that are involved with a variety of processes that promote "neuronal survival" **(Paus, 2010).** In addition, micronutrients synthesize brain chemicals called neurotransmitters that are responsible for carrying information across synapses, and support efficient transmission along these pathways **(Gomes-Pinilla, 2008).** Neurotransmitters "influence mood, sleep patterns, and thinking. Deficiencies or excesses of certain vitamins or minerals can damage nerves in the brain, causing changes in memory, limiting problem-solving ability, and impairing brain function" **(Gustafson, 2010).**

Table (7): Cumulative grade point average (CGPA) for students at the levels five and seven.

CGPA		Level five	Level seven
Pass	Number	-	-
	%	-	-
Good	Number	16	-
	%	21.33	-
Very good	Number	59	75
	%	78.67	100
Excellent	Number	-	-
	%	-	-
Sum	Number	75	75

From the above study it can be observed that food is essential to academic performance because it provides the energy necessary for cognition. Improving students' diet quality by increasing their consumption of fruits, vegetables, and whole grains, and reducing their intake of saturated fats and extra-calorie foods will provide more adequate energy and nutrients for the brain.

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