Middle East Journal of Applied Sciences
Volume: 15 | Issue: 03| July – Sept. | 2025

EISSN: 2706 -7947 ISSN: 2077- 4613
DOI: 10.36632/mejas/2025.15.3.14
Journal homepage: www.curresweb.com
Pages: 170-178

A comparative Study Between the Cultural Level of Dietary Patterns on the Immune System Among Girls of PAAET at the College of Basic Education in Kuwait and the Faculty of Specific Education, Mansoura University, Egypt

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Received: 01 June 2025 **Accepted:** 16 June 2025 **Published:** 30 August 2025

ABSTRACT
Supporting immune function requires a healthy lifestyle, adequate water intake, and essential minerals like magnesium and zinc, as well as vitamin C, D, and E. The purpose of this study was to examine the impact of dietary patterns on the immune system by assessing whether undergraduate students met the recommended dietary intake. The research focused on students from the College of Basic Education in Kuwait and the Faculty of Specific Education at Mansoura University, Egypt, during the academic year 2024–2025. This cross-sectional study involved 150 undergraduate students from the two universities mentioned above. Students completed a 72-hour dietary recall and a questionnaire at (0, 6, and 12 week). A self-administered questionnaire was used to collect data, which included questions on anthropometric measures and eating habits. Results indicated in students' subjects at (0, 6, and 12 weeks) and demonstrated that the mean intakes of water, total fiber, magnesium, calcium, vitamins (B_6, E, D) folate, and all essential amino acids were lower than dietary reference intake. Moreover, the university population consumed a diet with too many calories, carbohydrates, proteins and fats as compared to dietary reference intake at (0, 6, and 12 weeks). Moreover, the results show that overweight and obesity were common among students, with more than 20% classified as overweight or obese, and the majority having unhealthy eating habits. These results increased the probability of developing dysfunction in the immune system and noncommunicable diseases. Thus, it is necessary to introduce an organized nutrition education program aimed at new students.

Keywords: BMI, overweight, obesity, DRI, Immune system.

1. Introduction

The immune system is an exceptionally complex structure. It is the protection that defends humans from pathogens such as microbes, fungi, viruses, and parasites that occur in the ecosystem. It consists of various cells, tissues, and organs. The immune system also contains thymes, bone marrow, other secondary organs such as lymph nodes, spleen, and gut-associated lymphoid tissues (Marshall *et al*., 2018). Consuming an optimal diet is associated with improving the quality of human life (McNaughton, 2015). More importantly, it reserves a healthy immune system that can protect the host from any infection or illness. An ideal diet supplies the body with the extreme amount of necessary nutrients needed to develop, sustain, and enhance the immune reaction (Martinez-Lacoba *et al*., 2018).

In the last 20 years the prevalence of obesity in developing countries increased by three times due to urbanization with increased consumption of high calorie foods and sedentary lifestyle (Hu, 2008; Popkin *et al*., 2012). According to WHO, (2021), at least 2.8 million adults die each year because of being overweight or obese (WHO, 2019). Deterioration of health is associated with inadequate nutrition. The term 'nutritional disorders' covers a wide range of conditions that are primarily nutritional or nutrition is an important factor in their etiology (Hanaa and Lobna, 2017). They may include deficiencies or excesses in the diet, chronic diseases that have been stimulated by a dietary component, as well as developmental abnormalities in which diet has no role in etiology, but for which specific

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dietary intervention is an essential part of management (e.g., phenylketonuria), the interaction of foods and nutrients with drugs, food allergies. Eating disorders are not primarily nutritional disorders, but have important nutritional effects and significant metabolic consequences (Ayling 2014). Recent studies have found associations between overweight/obesity among university students and certain unhealthy lifestyle such as a high preference for high-fat and high-sugar food (Jiang *et al*., 2019; Al Sabbah 2020), a lack of exercise (Al Sabbah 2020 and Balgoon *et al*., 2019). Diet associated with chronic conditions and consider as one of the most public health concern in the Middle East (Elhadd *et al.,* 2007 and Musaiger 2004). The nutritional transition in the Middle East introduced energy-dense, refined carbohydrates and fat-saturated cuisine (Musaiger and Hazzaa 2012). This transition has paralleled the increase in lifestyle-related chronic conditions, such as obesity (Amuna and Zotor 2008). Taking in mind that diet is the most important energy resource for daily activities. However, the dysregulation of energy homeostasis caused by excess and unbalanced diets leads to metabolic disorders, such as obesity (Kahn *et al.,* 2006). High caloric intake increases the risk of obesity by increasing body weight (Parillo and Riccardi 2004). Refined carbohydrates, which are high in fructose, may increase the risk of obesity and insulin resistance (Gross *et al.,* 2004). The consumption of sugar sweetened beverages showed a positive association with obesity, this association is mediated by increased body weight which disrupts obesity (Hu and Malik 2010 and Wang *et al.,* 2008). Dietary energy density is correlated with obesity by increasing body weight, and energy dense foods (Mendoza *et al.,* 2007).

Both unbalanced diet and physical inactivity are strongly associated with obesity. Physical and social environments are important influences on diet and physical activity behavior along with interrelated economic, psychological and cultural factors (Roberts *et al.,* 2013). Furthermore, Diet, a lifestyle behavior, has been reported as a management domain with very low compliance among obesity (Peyrot *et al.,* 2005 and Thanopoulou *et al.,* 2004). Analyzing food consumption as dietary patterns may provide a comprehensive approach to disease prevention or treatment. It can enhance conceptual understanding of human dietary practice, and provide guidance for nutrition intervention and education. (Committee DGA, 2020 and Hu 2002). As a healthy diet should be adequate, varied, moderate, and balanced as excessive intake of certain nutrients has proven to impact human immunity in some cases (Gwamaka *et al*., 2012). At the same time, poor nutrition can affect the immune system adversely as well. Unfortunately, dual nutritional problems highly prevalent across many countries, including obesity and malnutrition

The aim of the present study was therefore to the effect of dietary patterns on the immune system by examining whether subjects meet the recommended dietary intake among undergraduate students from the college of Basic Education in Kuwait and the Faculty of Specific Education, at Mansoura University, Egypt, in order to identify the best strategies to combat obesity within this population.

2. Subjects and Methods

2.1. Subject of Design

Intervention study will be performed in 150 undergraduate students (70) from the college of Basic Education in Kuwait and (80) from the Faculty of Specific Education, Mansoura University, Egypt, students >= 20 years of age.

2.2. Design of work:

Before starting the field work, interviews were held with subjects using a questionnaire sheets were designed to collect data concerned about food habits, attitudes and anthropometric measurements as follows:

2.2.1. Daily dietary data

The 72 hours record and dietary history were used, the subjects were asked about all food items, the amount, frequency of consumption and also asked about food items taken during the last 72 hours in semi quantitative method. For each food calculation were made of the contribution of food energy, protein, carbohydrate, fat and important vitamins and minerals. The nutritive value of the diet was then compared with the calculated total of the (RDA, 1998) appropriate for the individuals in the study.

2.3. Characteristics and laboratory investigations

The tested characteristics are carried out as following:

2.3.1. Body Weight: This was measured using a spring type scale to the nearest 1.0 kg with light clothing without shoes.

2.3.2. Body Height: Height was taken to the nearest 0.5 cm using the vertical measuring rod. The subjects stood on a flat floor of the scale with feet parallel and with heels, buttocks, shoulders and back of head touching the upright board. The head had been hold comfortable create, with the lower border of the orbit in the same horizontal plane. The arms were hanging at the sides in natural manner.

2.3.3. Body Mass Index (BMI): This index was obtained by calculating weight in kilograms/square height in meters (kg/ m^2) and in the case of the obesity a body mass index was greater than 27 (J.N.C. 1997). Underweight (less than 18.5 Kg/m2); normal weight (18.5 to 25 Kg/m2) and over weight (more than 25 Kg/m2).

2.4. The questionnaires

Two forms of questionnaires were used: the first one was for through 3-day food records at 0, 6, and 12 wks. The second one for the food habits it includes, food likes, dislikes, all the characteristics related to the subject meals, and the possible suggestion of the target for improvements meals served.

2.5. Statistical analysis

Data were analyzed using SPSS (Statistical Package for the Social Sciences) version 14. Results are presented as mean ± SD been using analysis of variance (ANOVA) to test the difference between groups, were analyzed by comparing the averages of groups with significance level 0.05 (SPSS 2000).

3. Results

3.1. Nutritional status

3.1.1. Mean and standard deviation of nutrient at (0, 6 & 12 weeks) compared with dietary reference intake (DRI)

It is clear that the daily intake of water by students subjects at (0, 6 & 12 weeks) were less than recommended food (DRI) allowances with (29.87%, 36.01% & 48.85% of DRI, respectively) (Table 1). In addition, it is noticed that total fiber for students groups at (0, 6 & 12 weeks) were lower than of recommended intake (29.78%, 31.53% & 34.10% respectively of DRI). On the other hand, the calorie intake were high for students groups at (0, 6 & 12 weeks) which recorded (113.69%, 115.91% & 119.11% respectively) of recommended allowance (DRI). In addition, protein intake was more than recommended food allowance (DRI) which reached to (119.32%, 146.04% & 116.50% respectively of DRI). As for total fat and carbohydrate that students groups at (0, 6 & 12 weeks) consumed fat and carbohydrate more than the recommended daily allowance which recorded (110.8, 108.5, 109.10% for total fat and 104.01, 108.89, 112.28% for carbohydrate respectively).

Table 1: Mean and standard deviation of nutrients at (0, 6 & 12 weeks) compared with dietary reference intake (DRI):

Nutrients	Groups (0 w)	Groups (6 w)	Groups (12 w)	DRI
Water (g)	406.59±217.44	472.04±225.78	318.99 ±146.10	1500
Energy (kcal)	1573.87±422.54	1618.39±385.17	1682.20±492.45	2500
Protein (g)	54.89 ±19.66	67.18±24.16	53.59±25.31	46
Total fat (g)	60.94±24.54	59.68±23.35	60.01±25.26	35
Carbohydrate (g)	201.44±83.71	203.12±85.29	231.93±98.34	130
Fiber, total (g)	8.78±6.11	9.46±3.56	10.22±5.88	21

Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat and Protein (2002/2005) and Dietary Reference Intakes for Water (2005). Each value represent the mean± SD
Significant with control group $^*p < 0.05$

3.1.2. Mean and standard deviation of minerals at (0, 6 & 12 weeks) compared with dietary reference intake (DRI)

It is noticed that the daily intake of calcium by students groups at (0, 6 & 12 weeks) were less than recommended food (DRI) allowances (39.59%, 47.21% & 40.33% respectively of DRI) (Table 2). The percentage of magnesium intake for students groups was lower than the recommended allowance (DRI) which recorded (52.19%, 61.32% & 46.95% of DRI). With respect to levels of minerals in subjects groups which represent in Table (2), it can seen that the daily consumption of iron, phosphorus, sodium, zinc, manganese and selenium were higher than the recommended level of DRI. Whilst, daily intake of potassium and copper were very lower than recommended food allowance (DRI) which recorded (37.23, 39.14, 39.20% and 90, 86.66 & 70 % respectively of DRI).

Table 2: Mean and standard deviation of minerals at (0, 6 & 12 weeks) compared with dietary reference intake (DRI).

Nutrients	Groups (0 w)	Groups (6 w)	Groups (12 w)	DRI
Ca (mg)	475.13±278.50	566.52±207.23	484.03±255.51	1200
Fe (mg)	9.41±3.84	9.88±3.48	10.76±4.42	8
Mg (mg)	167.01±76.04	196.23±62.19	150.26±107.63	320
P (mg)	773.59±303.54	911.98±269.07	855.47±304.23	700
K (mg)	1749.92±923.68	1839.88±800.14	1842.46±1053.86	4700
Na (mg)	1578.88±953.53	1436.88±780.90	1505.25±828.21	1300
Zn (mg)	9.19±6.15	10.78±5.96	11.24±7.22	8
Cu (mg)	0.81±0.39	0.98±0.60	0.93±0.58	0.9
Mn (mg)	3.36±4.54	5.36±3.54	5.00±2.22	1.8
Se (µg)	77.74±33.00	88.68±26.59	79.69±30.44	55

Dietary Reference Intakes for minerals (1997, 2000, 2001, 2005&2011), Each value represent the mean± SD
Significant with control group *$p< 0.05$

3.1.3. Mean and standard deviation of vitamins at (0, 6 & 12 weeks) compared with dietary reference intake (DRI)

It is clear that the daily intake of vitamin C and thiamin were lower for students subjects groups (Table 3). Daily intake of vitamin B-6, folate, vitamin E and vitamin D were lower than the recommended allowance (DRI) for students groups (0 w) which recorded 57.33, 59.57, 24.80 and 3.77% respectively, for (6 w group) which recorded (66, 57.86, 23.73 and 5.89% and finally for (12 w group) which recorded (55.33, 59, 27.6 and 6.80% respectively). Whilst the daily intake of riboflavin, niacin, vitamin B-12 and vitamin A were higher than standard RDA for tested subjects.

3.1.4. Mean and standard deviation of essential amino acids for subjects at (0, 6 & 12 weeks) compared with dietary reference intake (DRI)

With respect to daily rates of essential amino acids consumption of students subjects groups which represent in table (4), it can be seen that the daily intake of all essential amino acids for (0 w group) was lower than the levels of dietary reference intake (DRI) which recorded (7, 5.98, 5.43, 6.14, 7.92, 3.96, 2.72, 4.02 and 6.9%) for (tryptophan, leucine, lysine, threonine, isoleucine, methionine, cystine, phenyalanine and valine respectively). As, that the daily intake of all essential amino acids for (6 w group) was lower than the levels of dietary reference intake (DRI) which recorded (9.28, 7.56, 7.19, 7.85, 10.32, 5.48, 3.24, 5.25 and 8.72%) for (tryptophan, leucine, lysine, threonine, isoleucine, methionine, cystine, phenyalanine and valine respectively). In addition, the daily intake of all essential amino acids for (12 w group) was lower than the levels of dietary reference intake (DRI) which recorded

(5.57, 5.94, 5.17, 5.92, 7.96, 3.88, 2.68, 4.13 and 6.78%) for (tryptophan, leucine, lysine, threonine, isoleucine, methionine, cystine, phenyalanine and valine respectively).

Table 3: Mean and standard deviation of vitamins at (0, 6 & 12 weeks) compared with dietary reference intake (DRI)

Nutrients	Groups (0 w)	Groups (6 w)	Groups (12 w)	DRI
V. C (mg)	52.25±47.36	52.97±25.85	36.15±16.59	75
Thiamin (mg)	0.94±0.36	0.934±0.503	0.95±0.45	1.1
Riboflavin (mg)	1.34±0.59	1.39±0.57	1.26±0.61	1.3
Niacin (mg)	14.48±7.21	16.70±7.65	14.69±8.98	14
B 6 (mg)	0.86±0.45	0.99±0.47	0.83±0.46	1.5
Folate, total (mcg)	238.30±153.27	231.46±125.41	236.00±155.15	400
B 12 (mcg)	2.93±4.18	3.09±1.38	4.45±2.87	2.4
Vitamin A, IU	2321.26±3424.76	2237.24±1477.92	1797.05±310.39	1166.66
Vitamin E (mg)	3.72±3.91	3.56±2.04	4.14±2.66	15
Vitamin D (IU)	22.65±54.21	35.34±16.00	40.84±14.94	600

Dietary Reference Intakes for vitamins (1998,2000,2001&2011), Each value represent the mean ± SD
Significant with control group *p< 0.05

Table 4: Mean and standard deviation of essential amino acids at (0, 6 & 12 weeks) compared with dietary reference intake (DRI).

Nutrients	Groups (0 w)	Groups (6 w)	Groups (12 w)	DRI
Tryptophan (mg)	0.49±0.21	0.65±0.32	0.39±0.24	7
Leucine (mg)	3.29±1.60	4.16±2.16	3.27±1.90	55
Lysine (mg)	2.77±1.69	3.67±1.43	2.64±1.84	51
Threonine (mg)	1.66±0.83	2.12±1.17	1.60±0.98	27
Isoleucine (mg)	1.98±1.01	2.58±1.41	1.99±1.18	25
Methionine (mg)	0.99±0.52	1.37±0.73	0.97±0.59	25
Cystine (mg)	0.68±0.32	0.81±0.35	0.67±0.36	25
Phenylalanine (mg)	1.89±0.87	2.47±1.16	1.94±1.12	47
Valine (mg)	2.21±1.06	2.79±1.45	2.17±1.23	32

Dietary Reference Intakes for Amino Acids (2002/2005), Each value represent the mean ± SD
Significant with control group *p< 0.05

3.2. Some anthropometric measurement of the subjects

Data presented in Table (5) showed some anthropometric measurement of subjects. It could be noticed that the mean of students subjects height was 1166.72 ± 6.56 cm, the weight mean of the subjects was 83.50 ± 7.55 kg. Otherwise, the mean percentage of BMI were 14.67 and 16% for overweight and obese subjects and the mean of subjects age was 20.22± 3,87.

Table 5: Anthropometric characteristics of the study subjects

	Variables	Mean ±SD
	Height (cm)	166.72 ± 6.56
	Weight (kg)	69.50 ± 16.55
BMI (Kg/m^2)	**Underweight < 18.5 n (%)**	23 (15.3%)
	Normal 18.5–24.9 n (%)	81 (54%)
	Overweight 25–29.9 n (%)	22 (14.67%)
	Obese ≥ 30.0 n (%)	24 (16%)
	Age	20.22 ±3.87
	F	1.672

BMI: Body Mass Index; n=150, Each value represent the mean± SD
Significant with control group *p< 0.05

4. Discussion

Immunological cells require enough energy, with macro- and micronutrients acting as cofactors in the progress, articulation, and maintenance of the immune response. Protein-rich foods aid immunoglobulin synthesis and possess antiviral properties (Ng *et al*., 2015; Norman *et al*., 2008; Schuetz *et al*., 2019). Therefore, individuals should take vegetables, nuts, legumes whole grains, and animal-based meals as part of a normal diet. Similarly, taking a low-fat plant-based diet may aid in strengthening the immune system (Mishra & Patel, 2020). Fiber can also help maintain a healthy body mass index (BMI), which is linked to better immunity (Rinninella *et al*., 2019). Vitamins A, C, E, carotenoids, and flavonoids, for example, are widely accesssible in the diet and act as antioxidants, scavenging oxidative free radicals (Waheed Janabi *et al*., 2020). Vitamin D supplementation was found to be safe in prevention of upper respiratory infections and influenza (Grant *et al*., 2020; Martineau *et al*., 2017).

An unhealthy meal pattern may have an association with dietary quality and diversity and it has been shown that lower dietary diversity scores increase the probability of metabolic syndrome (Michels, and Schulze, 2007). A low dietary diversity score might be predisposed to nutrients deficiency such as iron deficiency anemia among adolescent girls (Gholizadeh *et al*., 2018). Nutrients deficiency is considered a significant factor for infection susceptibility due to immune response impairment if left untreated in some settings. Furthermore, age category might affect the dietary pattern preference for example adults, their common dietary pattern is a western diet-like style and it may increase the risk of metabolic syndrome, obesity, and other complication (Sun *et al*., 2014). According to the report of World Health Organization in 2011, a BMI of greater than or equal to 30 is classified as obese. A person's body fat composition changes and increases on body overweight (Mahadevan and Ali 2016).

It is a well known fact that central or abdominal fat is far more likely to be linked with chronic metabolic disorders rather than the overall excess weight reflected by BMI. Moreover, Nuttall (2015) reported that BMI as one of best effective anthropometric indices for women to identify the obesity case. Furthermore, Bastien *et al.* (2013) indicated that, body mass index (BMI) as the most commonly marker which are firmly associated with the probability and riskiness of the obesity. In addition, Wang *et al.,* (2020) stated that obesity as a basic independent and modifiable risk factor and previous epidemiological studies suggested a progressive rise in the prevalence of obesity. In this study conducted among 150 students from the college of Basic Education in Kuwait and the Faculty of Specific Education, at Mansoura University, Egypt, It is fact that Abdominal obesity appeared in females than males (Cnop *et al.,* 2003 and Aleidi *et al.,* 2015), and related the difference to the different body fat distribution between females and males as the numbers and size of fat cells consider a possible determinants of rats of adiponectin production (Cnop *et al.,* 2003 and Gierach *et al.,* 2014). The study results Similar to a study done at Pharos University which showed that 11.8 % of the students were obese (Yahia *et al*., 2008). And slightly similar to Saudi students where 15.7% of the students were obese (Al-Rethaiaa *et al*., 2010).

This can result from the global nutrition transition, as many nation's diet intake shifted from consuming traditional cultural food to the fast food (Popkin *et al*., 2012). The fast food is a popular pattern intake rich in salt, trans, and saturated lipid, simple carbohydrates, however poor in complex carbohydrates and fibers. It is also described as a diet high in calories while low in nutrients, including vitamins and minerals. The consumption of the fast food is associated with the high prevalence of obesity and chronic diseases such as Type 2 diabetes. Thus, this dietary pattern leads indirectly to increased inflammatory markers. Evidence shows that the fast food with physical inactivity, have been identified as a risk factor of 'metaflammation', which is a metabolism-induced inflammation. The suggested reason, however, is the enhanced absorption of lipopolysaccharide (LPS), which is a component of the cellular membranes of gram-negative bacteria, from the intestinal microbiota leading to excessive gut leakage, recognized by innate immune system cells via toll-like receptor 4 (TL4) and by its activation of inflammatory response. This allows the infection to occur through the gut to the bloodstream. The fast food can lead to less variety of the gut microbes because of the low intake of fiber, while high in salt, sugars that alert inflammation and lead to some type of cancers, and other immune-related diseases (Makki *et al*., 2018).

The observed difference in the percentage and distribution of obesity/overweight in the current study could be related to complex multifactorial influence related to different behavioral and genetic factors of the students. Physical inactivity and faulty eating habits may partially explain the increased prevalence of overweight and obesity in the current study.

5. Conclusion

Consuming an optimal diet is associated with improving the quality of human life and reserves a healthy immune system that can protect from any infection or illness. An ideal diet supplies the body with the extreme amount of necessary nutrients and enhance the immune system. The results show that more that 20% of students are overweight or obese, and practicing unhealthy dietary and lifestyle habits. Moreover, the subjects not taking their recommended dietary intake from some vitamins and minerals that boost the immune system. Thus an organized nutrition educational program should be applied for new students enrolled in the university. In addition, universities should minimize fast-food stores inside the university and encourage healthy food stores.

6. Acknowledgment

Thank you to Dr. Madiha Mohamed Abdel-Hay for providing the necessary for the successful completion of this project.

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