

Article

Healthy Dietary Patterns Associated With Health Risk

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Abstract: This study aimed to investigate the impact of dietary patterns on

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metabolic syndrome among students and staff at Tikrit University. Metabolic syndrome is associated with health risk factors such as obesity, hypertension, dyslipidemia, and hyperglycemia, which in turn increase the likelihood of developing heart disease and type 2 diabetes. The study employed an observational cross-sectional design and was conducted from September 24, 2024, to February 1, 2025. Data were collected using an online questionnaire that included sociodemographic information, an Intended Physical Activity

Questionnaire (IPAQ), and an assessment of dietary intake using the Food Frequency Questionnaire (FFQ). A total of 667 participants had their body mass index (BMI) measured, and 223 completed the questionnaire.

The results showed that the majority of participants were in the 18–32 age group, with a higher proportion of males than females. Furthermore, 66% of participants engaged in physical activity, and there was a higher proportion of structural and visceral fat in males compared to females. The study revealed that most dietary patterns showed no significant differences between the various groups, with the exception of differences observed in the consumption of potatoes, rice, and pasta, as well as sweets and snacks.

The study concluded that the participants' overall metabolic status was relatively good, but highlighted the need to promote nutritional awareness and physical activity within the university environment to reduce weight gain and the risk of future metabolic disorders.

Keywords: Metabolic disorders, dietary patterns, Intended Physical Activity Questionnaire

Introduction

Healthy dietary patterns can generally be described as those rich in health-promoting foods, including plant-based foods, fresh fruits and vegetables, antioxidants, soy, nuts, and sources of omega-3 fatty acids, and low in saturated and trans fats, animal-derived proteins, and added/refined sugars [1].

Dietary patterns are complex exposures that include the quantities and combinations of foods typically consumed, the nutrients those foods contain, and the interactions between food components [2]. There are several dietary systems, including the Mediterranean diet. The Mediterranean diet is based on the components of traditional eating patterns in European and Mediterranean countries. It encompasses not only the types of food consumed and their relative contributions to daily food intake, but also an approach to eating that considers how food is sourced (e.g., sustainability and environmental friendliness), cooked, and eaten, as well as lifestyle considerations such as engaging in regular physical activity, getting enough rest, and participating collectively in meal preparation and sharing [3]. The Dietary Approaches to Stop Hypertension (DASH) diet is a dietary pattern aimed at preventing and treating hypertension and improving cardiovascular health [4]. The DASH diet derives its name from the Dietary Approaches to Stop Hypertension study, which evaluated the impact of dietary patterns on blood pressure [5]. There are several dietary approaches that differ from one another. Some exclude meat and fish but allow milk, dairy products, and eggs, while others exclude all animal-based foods [6]. Evidence suggests that diets based on animal protein are associated with a significantly reduced risk of cardiovascular disease and cancer [7]. Individuals following an animal protein diet typically have a lower body mass index (BMI), as well as lower total cholesterol, triglycerides, LDL cholesterol, and blood glucose levels [8].

One of the challenges with these dietary approaches is the risk of nutritional deficiencies, including deficiencies in protein, fatty acids (particularly omega-3), vitamin B12, iron, zinc, vitamin D, and calcium. However, foods rich in animal protein, as well as fruits and vegetables, are characterized by high fiber, antioxidants, phytochemicals, fatty acids, and omega-6 [9]. If well-planned and balanced, foods rich in animal protein can be suitable for all age groups, even pregnant or breastfeeding women [10].

Study Objectives:

- 1 To investigate the relationship between different dietary patterns and metabolic syndrome.
- 2 To compare metabolic status between individuals with healthy and unhealthy dietary patterns.

Materials and Methods

Study Sample

The sample size was randomly selected from each college within Tikrit University. The random representative sample size and the range of the persuasion method were between 650 and 670 individuals.

The exclusion criteria for participants were the absence of chronic diseases, age not less than 18 years, and non-pregnancy (for women). The inclusion criteria were that participants be healthy adults. The number of participants who volunteered for the research project was 223 adults from Tikrit University who completed the questionnaire, and 120 participants who volunteered for the practical component. Body mass index (BMI) was measured for all 667 participants.

Data Collection

The questionnaire was developed using Google Forms and was designed to include three main sections:

The first section included socio-demographic data. The second section consisted of questions related to physical activity based on international standards. The third section assessed dietary patterns using a Food Frequency Questionnaire. Social and Demographic Indicators, Physical Activity, and Dietary Intake

The social and demographic component of the data variables included: sex, age, marital status (single, married, or divorced), and educational level (illiterate, primary, secondary, university or institution, postgraduate).

The lifestyle data component was based on the International Physical Activity Questionnaire (IPAQ). A condensed form of physical activity consisting of (n=7) questions was used to assess participants' activity levels.

The metabolic equivalent of the activity levels (METs) for each task was determined and expressed in minutes/week [11].

Participants' dietary intake was assessed using the FFQ questionnaire based on the European Prospective Investigation into Cancer and Nutrition Norfolk (EPIC-Norfolk FFQ), designed to measure the frequency with which participants consumed their usual food intake over a previous period. The EPIC questionnaire was adapted to be appropriate for the dietary culture and community of Tikrit University faculty and students. The EPIC-Norfolk study's dietary frequency questionnaire consisted of 130 food items, products, and beverages. Based on the dietary culture of the study area, 105 food items were selected from these 130 items to determine the frequency of participants' consumption of different nutrients over a given period, based on specific portion sizes. Standard portion sizes for each food were presented to the participants. Consumption frequency was categorized as: never or less than a month, 1–3 times a month, once a week, 2–4 times a week, 5–6 times a week, once a day, 2–3 times a day, 4–5 times a day, and 6+ times a day [12].

To identify and analyze dietary patterns, the 105 food items were grouped into 38 food groups due to the large number of food items included. The food items were categorized into specific food groups based on their similarity in nutritional composition and nutrient content. Some food items were considered as a separate group (such as eggs and margarine) due to their distinct and unique nutritional composition, based on the food groups used in similar previous studies [12].

Statistical Analysis

The Kruskal-Wallis H-test was used to check for statistically significant differences between more than three independent groups, as the data did not meet the normality assumption and were classified as non-normal ordinal/continuous measures. This test relies on rank analysis rather than means and serves as an alternative to one-way ANOVA when the assumptions are not met. The testing methodology was followed as described in Dinu et al. [7].

Social and Demographic Characteristics of Participants

The social and demographic characteristics of the participants are shown in Table (1). Participants were randomly selected, and the table indicates that the number of male participants was higher than the number of female participants. The most represented age group in this study was 18-32 years, comprising 91.6% of participants. The number of unmarried participants was higher than the number of married participants, at 83.7% and 15.3%, respectively. University or institute students were the most represented group, accounting for 88.8% of participants, followed by postgraduate students at 8.8%. The lowest representation was for those in preparatory and primary education, at 1.9% and 0.5%, respectively. As for clinical studies related to nutritional and health relationships, it has been shown that females are more interested in participating in this study through randomized participation between females and males [13]

Table (1): Demographic Variables

Percentage	Number	Total	Variable
91.6	197	year 32 – 18	age
6	13	year 46 – 33	
2.3	5	year 60 – 47	
100.0	215	Total	Sex
87.4	188	Male	
12.6	27	Female	
100.0	215	Total	Marital status
83.7	180	Single	
15.3	33	Married	
0.9	2	Divorced	

100.0	215	Total	
0.5	1	Elementary	Educational level
1.9	4	Secondary	
88.8	191	University or Institute	
8.8	19	Higher Education	
		Degree	
100.0	215	Total	

Physical Activity

Table (2) shows the number of participants in physical activity. The number of participants who engaged in physical activities was 142, which was greater than the number of those who did not engage in physical activity, which was 73. Regarding physical activity, it included light physical activity, represented by individuals who rely on walking; moderate physical activity, represented by individuals who exercise daily at home; and vigorous physical activity, represented by individuals who exercise regularly in gyms. The table also shows that the percentage of people who engage in physical activity in Tikrit is higher than the percentage of those who do not, at 66% and 34%, respectively.

Table (2): Physical Activity

Percentage	Number	Total	Variable
66.0	142	physical activities	Physical activity
34.0	73	not engage in physical activities	
100.0	215	Total	

The Impact of Demographic Characteristics on Dietary Pattern Consumption

The Croxall-Wallis test was conducted to analyze differences in dietary pattern consumption among three age groups: 18-32 years, 33-46 years, and 47-60 years. The results are shown in the following table:

Table (3): Comparison of Dietary Patterns by Age

P-value	H	mean	Number	age	Dietary Pattern
0.347	2.118	109.34	197	year32 – 18	Meat and fish
		102.46	13	year 46 – 33	
		69.50	5	year 60 – 47	
			215	Total	
0.097	4.659	109.99	197	year 32 – 18	Bread and biscuits
		99.77	13	year 46 – 33	
		50.90	5	year60 – 47	
			215	Total	
0.859	0.305	108.59	197	year 32 – 18	Grains
		100.77	13	year 46 – 33	
		103.50	5	year 60 – 47	

			215	Total	
0.000	16.298	113.16	197	year 32 – 18	Potatoes, rice, and pasta
		53.38	13	year 46 – 33	
		46.50	5	year60 – 47	
			215	Total	
0.628	0.930	108.66	197	year 32 – 18	Dairy products and fats
		93.38	13	year46 – 33	
		120.10	5	year 60 – 47	
			215	Total	
0.014	8.487	111.72	197	year 32 – 18	Sweets and snacks
		69.58	13	year46 – 33	
		61.30	5	year 60 – 47	
			215	Total	
0.229	2.952	110.14	197	year 32 – 18	Soups, sauces, and appetizers
		88.27	13	سنة 46 – 33	
		75.00	5	year 60 – 47	
			215	Total	
0.439	1.647	109.64	197	year 32 – 18	Drinks
		89.12	13	year46 – 33	
		92.50	5	year60 – 47	
			215	Total	
0.838	0.354	108.63	197	year 32 – 18	Fruits
		104.12	13	year 46 – 33	
		93.20	5	year60 – 47	
			215	Total	
0.990	0.021	108.12	197	year 32 – 18	Vegetables
		107.65	13	year 46 – 33	
		104.10	5	year 60 – 47	
			215	Total	
0.391	1.878	106.25	197	year 32 – 18	Main Products
		126.65	13	year 46 – 33	
		128.60	5	year 60 – 47	
			215	Total	

Table (4): Comparison of dietary patterns in terms of gender

P-value	U			Sex	Dietary Pattern
		mean	Number		
0.068	1987.000	110.93	188	Male	Meat and fish
		87.59	27	Female	
			215	Total	
0.405	2286.500	109.34	188	Male	Bread and biscuits
		98.69	27	Female	
			215	Total	
0.749	2456.000	108.44	188	Male	Grains
		104.96	27	Female	
			215	Total	
0.116	2064.000	105.48	188	Male	
		125.56	27	Female	
			215	Total	
0.341	2250.500	109.53	188	Male	Potatoes, rice, and pasta
		97.35	27	Female	
			215	Total	
0.446	2307.500	106.77	188	Male	Dairy products and fats
		116.54	27	Female	
			215	Total	
0.773	2451.000	108.46	188	Male	Sweets and snacks
		104.78	27	Female	
			215	Total	
0.152	2105.500	105.70	188	Male	
		124.02	27	Female	
			215	Total	
0.523	2345.000	109.03	188	Male	Soups, sauces, and appetizers
		100.85	27	Female	
			215	Total	
0.701	2422.000	108.62	188	Male	Drinks
		103.70	27	Female	
			215	Total	
0.689	2417.000	107.36	188	Male	
		112.48	27	Female	
			215	Total	

U: Mann-Whitney U test, P-value: Statistical significance (statistically significant at P ≤ 0.05).

Table 4 shows a comparison of dietary patterns according to gender (males and females) using the Mann-Whitney U test. This test is used to measure significant differences between two independent groups when the data do not follow a normal distribution.

From the data in the table and its analysis, it became clear that most dietary patterns did not show any significant differences between males and females, as the P-value was greater than 0.05. This indicates the absence of significant differences between the sexes in the consumption of these dietary patterns. These patterns included: meat, fish, grains, legumes, dairy products, fats, sweets, baked goods, soups, appetizers, fruits, vegetables, and oil products.

U: Mann-Whitney U test, P-value: Statistical significance (statistically significant at $P \leq 0.05$) The only dietary pattern that showed significant differences was that related to bread and biscuits, which showed a significant increase ($p < 0.05$) among males according to the arithmetic mean. This indicates that females consume these types of foods more frequently than males.

These results suggest that dietary habits and traditions were largely similar between the sexes, with very slight differences in some dietary patterns. The reason for these differences may be due to some individuals' preference for these patterns compared to others, or to social or cultural factors that play a major role in food choices and influence dietary patterns.

Obesity is primarily caused by poor diet quality and energy imbalance, and it poses a significant public health challenge. Addressing gender-related dietary behaviors is crucial for improving adherence to dietary recommendations and their effectiveness in combating obesity. This study highlights different gender-related dietary patterns in terms of meal frequency and timing among obese individuals. Gender-related eating patterns are consistent with studies showing emotional and impulsive eating behaviors in obese individuals and candidates for gastric bypass surgery. For example, recent evidence underscores the role of emotional regulation in shaping these behaviors, with women exhibiting a greater tendency to eat emotionally and impulsively than men, as observed in studies of gastric bypass surgery candidates [14]. Men also tend to eat fewer meals per day than women, a behavior that may reflect gender-related differences in appetite control and food preferences [15]. These findings are consistent with previous research suggesting that males tend to prefer larger, less frequent meals, while females tend to eat smaller, more frequent meals, which may improve their ability to manage hunger throughout the day. Interestingly, there is a different relationship between meal frequency and micro- and macronutrient intake between the sexes, suggesting that differences in food preferences between males and females may influence eating patterns [16] [17].

Dietary Patterns That Showed No Significant Differences

No significant differences were recorded in the consumption of most dietary patterns across different age groups, as the p-value was greater than 0.05. This indicates that the consumption of meat and fish, vegetables and fruits, grains, dairy products and fats, broths, sauces and condiments, beverages, fruits, vegetables, and staple foods did not differ statistically significantly between the three age groups. This suggests a relatively uniform dietary pattern for these foods among individuals regardless of age.

Age-related differences in dietary intake are consistent with previous findings. The Western diet, based on fast food, has been shown to be more prevalent among younger age groups, while scores for more traditional diets either increase with age or show no significant correlation [18]. Unless younger individuals gradually shift their diets toward consuming more traditional foods as they age, these results suggest a transition from a traditional dietary pattern to one rich in meat and sweets. However, in this study, we have data for populations over 40 years of age. Developments in dietary habits were observed in the Nordic population between 2011 and 2014, with a decrease in the consumption of fish and whole grains [19]. On the other hand, changes towards healthier dietary patterns were observed with the adoption of a diet rich in vegetables, fruits, and whole grains, while moving away from fats and sugars, as well as with increasing age in groups with higher levels of education [20]. The hypothesis of a dietary shift towards a Western diet was tested and refuted in a study by Azzam et al. during the period 1993-2013, as some countries changed from having a low Western dietary index (traditional diet) to a high Western dietary index, and countries previously classified as having a high Western dietary index regressed towards a traditional diet during the same period [21]. National health policies may explain the need to accelerate the transition to healthier dietary patterns in countries with a high Western diet index.

Dietary Patterns Showing Significant Differences

On the other hand, the results showed significant differences in the consumption of certain food patterns, namely potatoes, rice, and pasta, where the results showed very strong statistical significance ($P=0.000$). This indicates that the consumption of this food group varies considerably among age groups, which may be attributed to changes in dietary habits and nutritional needs with age.

The results also showed significant differences in the consumption of sweets and snacks ($P=0.014$), indicating that the consumption of these foods varies according to age group. This could be explained by the fact that younger people tend to consume sweets and fast food more than older adults, who may be more selective about healthy food choices or have health-related dietary restrictions. The findings are consistent with those of Gajda et al., who noted that asthenic syndrome and muscle weakness share common physiological pathological markers related to cellular aging and metabolic and endocrine regulatory pathways, including AMPK (aminobutyric acid kinase), a vital cellular enzyme that acts as an energy sensor [22] [23]. When energy levels in a cell (such as glucose) decrease, AMPK is activated to stimulate energy-producing processes (such as glucose uptake and fat burning) and suppress energy-consuming processes (such as protein and fat production) to maintain energy balance. The endocrine resistance pathway is also implicated. Common potential health problems associated with these two conditions have been identified (movement disorders, falls, and death). Deficiencies in certain nutrients that contribute to these conditions, such as energy, protein, and vitamin D3 deficiency, are often identified in the diet. It is important to include other contributing factors in the pathophysiology of these diseases, which are still not well understood. These factors include dietary patterns. This study found an association between the incidence of asthenic syndrome and nonspecific dietary patterns, namely the consumption of refined grain products, butter, potatoes, and processed protein products (cheese, bacon, smoked sausages, and hot dogs). In contrast, a more appropriate dietary pattern, associated with frequent consumption of fruit and water, reduced the risk of these conditions. To this end, further research should consider the mechanisms involved in the development of muscular dystrophy and asthenic syndrome and their co-occurrence, including dietary patterns. The challenge lies in the need for survey-based study samples, including clinical trials.

Conclusions

- 1- The majority of participants were male (87.4%), indicating that males have a greater interest in healthy eating behaviors compared to female participants. 2. The largest group of participants (91.6%) were aged 18-32, indicating a high level of nutritional awareness among this age group and an understanding of the importance of healthy eating habits.
2. There were no significant differences in most dietary patterns among the age groups, with the exception of potatoes, rice, pasta, sweets, and snacks.
3. Educational level had a significant impact on dietary choices, such as fruits, legumes, and oily products, as those with higher levels of education demonstrated greater nutritional awareness.

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