Metabolic Syndrome and Related Lifestyle Factors Among Group of People in Erbil City

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Doi: 10.23918/eajse.v9i1p33

Abstract: The prevalence of the metabolic syndrome is rising worldwide. This study aimed to demonstrate the association between major dietary patterns with metabolic syndrome components and the related lifestyle factors among adults in Erbil city. In this cross-sectional study, the participants were selected by applying convenience sampling method among healthy adults by means of lack of chronic diseases and not being pregnant. The study was conducted on a group of n=378 healthy adults filled the form consisted of the 3 sections (sociodemographic, physical activity questionnaire and food frequency questionnaire) in Tishk international university and Brayati neighborhood. among 378 participants, only n=203 participants responded to the practical part, n=113 females and n=90 males, aged between 19 to 60 years. Biochemical tests, anthropometrics, and blood pressure measurements were performed. factor analysis with a principal component PCA method was used to identify dietary patterns. Three major dietary patterns were identified and designed as healthy, western, and traditional with the factor loads (29.66, 20.56 and 17.56) respectively. A high score in western dietary pattern ranges was most correlated with a higher risk of abnormal blood glucose, HbA1c, cholesterol, and low-density lipoprotein concentration p-values (0.002, 0.022,0.015, and 0.008) respectively. The participants were determined to be %69.5 physically inactive. A significant association exists between dietary patterns and related lifestyle factors and metabolic syndrome risks among Erbil adults.

Keywords: Dietary Patterns, Metabolic Syndrome, Lifestyle, Factor Analysis, Adults

1. Introduction

Metabolic syndrome is a common metabolic disorder that has arisen due to the rising prevalence of obesity worldwide. The theory of metabolic syndrome has occurred for at least 80 years. Kylin, a Swedish physician, first described this confluence of metabolic disorders' risk factors for cardiovascular disease in the 1920s. As a result of hypertension clustering, gout, and hyperglycemia (Kylin, 1923).

Vague identified upper body adiposity risk factor (apple or male-type obesity) as the obesity phenotype most commonly associated with metabolic disorders linked with type 2 diabetes and cardiovascular disease 1947 (Vague 1947).

The metabolic disorder is defined differently, but a new definition will be universally applicable in the near future. However, the pathophysiology appears mainly due to obesity, insulin resistance, atherogenic dyslipidemia and hypertension (Cornier et al., 2008).

Received: June 20, 2022
Accepted: August 18, 2022
Hadi, P., & Karim, Z. (2023). Metabolic Syndrome and Related Lifestyle Factors Among Group of People in Erbil City. *Eurasian Journal of Science and Engineering, 9*(1),33-45.

This syndrome's pro-inflammatory state is common, increasing type 2 diabetes and cardiovascular diseases. Lifestyle factors such as alcohol consumption, cigarette smoking, and physical activity have affected an individual's metabolic profile. A healthy diet and physical activity decrease the syndrome's risks. Drug treatment is sometimes appropriate for obesity and diabetes (Eckel et al., 2005).

The studies of the Medline database were performed for dietary patterns that may be linked to the syndrome. Modification in dietary patterns was shown to have a positive effect. Epidemiological studies have found that people who eat a diet high in fruits and vegetables are less likely to develop metabolic syndrome (Baxter et al., 2006).

Physical activity (PA), including all types, impacts improving individuals' health and well-being psychologically and physically. The studies show the linkage between PA and metabolic syndrome that decreases the risk of the syndrome (He et al., 2014).

Many non-communicable diseases were observed to have a strong linkage with obese individuals of all ages. Lifestyle factors have also been shown to greatly impact the development of such diseases due to the rise of sedentary lifestyles, especially in modern countries. Moreover, the world health organization (WHO) ranks inactivity as the fourth most significant cause of death globally (Dumith et al., 2011).

Nutritional assessment is a systemwide process that determines the nutritional status of individuals by collecting and interpreting anthropometric, biochemical, clinical, and dietary data assessments to determine and avoid the risk factors of the prevalence of diseases among individuals (Gibson, 2005).

The current study aimed to determine the risk factors of metabolic syndrome components and associated lifestyle factors using a cross-sectional study to show the major dietary patterns consumed and to demonstrate the correlations between metabolic syndrome biochemicals with food frequency intake, anthropometric assessments and Physical activity among a group of healthy adults in the Erbil city population.

2. Materials and Methods

2.1 Description of Study Design and Sample Collection

The cross-sectional study used a Google form questionnaire. The data was collected from November 2021 to April 2022 based on the self-reported socio-demographic data and questionnaires on dietary patterns of food frequency and physical activity. A biochemical assessment, Blood pressure measurement, and anthropometric assessment were vouchered to the participants.

The sample size was calculated concerning population size and the statistical number of adults in Erbil city based on the studies of sample size calculation with standards of determination of statistical population size, interval, and internal confidence (Ibrahim & Abdelmonem, 2015; Kadam & Bhalerao, 2010).

The participants who volunteered to participate in the research project were (N= 378 adults) in the Tishk International University and Brayati neighborhood in Erbil city that filled out the questionnaire, and (N= 203 participants) among the volunteers involved in the practical part which the gender of participants were females N= 113 and males N=90.

The study was carried out on participants by different methods; for educated people, the questionnaire was explained and filled out by them, and for uneducated people, filled out by asking the questions face to face, and the voucher gift for anthropometric and biochemical assessments and blood pressure measurements was given to the participants.

2.2 Socio-demographic and Lifestyle Data

The socio-demographic part of the data variables included: the participant's full names, phone number, gender, age, marital status (single, married, or divorced), and educational level (uneducated, primary school, high school, university, or institution, higher education). The lifestyle data part was based on the International physical activity questionnaire(IPAQ). The short form of the physical activity consisted of (N=7) questions to identify the activity of the participants. The metabolic equivalent of task MET was identified and expressed in minutes/week (Craig et al., 2017).

2.3 Dietary Patterns and Food Groups

The third part of the questionnaire was a food frequency questionnaire FFQ based on the European prospective investigation into cancer and nutrition Norfolk (EPIC- Norfolk FFQ) designed to measure the participant's frequency of usual food intake in the previous year. FFQ is one of the validated methods concerning referential methods. (Mulligan et al., 2014; Trichia et al., 2020).

The EPIC- Norfolk FFQ consisted of common and non-commonly consumed foods; based on the Kurdish culture, 105 foods that Kurdish people commonly consumed among 130 food and food products from the questionnaire were asked to know how frequently the participants consumed various food items during the previous year based on certain portions which the standard portion sizes of each food were shown to the participants. The food frequencies intake was classified into: Never or less a month, 1-3 times per month, once per week, 2-4 per week, 5-6 per week, once per day, 2-3 per day, 4-5 per day and +6 per day (Mulligan et al., 2014).

In order to determine the dietary patterns and analyze them, the 105 food items were grouped into 38 food groups due to the large number of food items. The reason for placing a food item in certain food groups (Table 1) was based on the similarity in the nutrient profile. Some food items were individually considered as a food group (e.g., eggs and margarine) due to the different and unique nutrient profiles and based on the food groups used in other similar studies (Mulligan et al., 2014; Newby & Tucker, 2004).

Table 1: Food grouping that used in factor analysis to determine dietary patterns

Food Groups	Food Items
Processed meats	Sausages
Red meats	Beef, hamburger, lamb
Organ meats	Beef liver
Fish	Canned Fish, Frozen Fish, batter fish
Poultry	Chicken or other poultry, e.g., Turkey
Eggs	Eggs

Butter	Butter
Margarine	Hard Margarine
Low-fat dairy products	low-fat yogurt, Low-fat soft cheese
High-fat dairy products	Full fat or Greek fat yogurt, double or clotted cream, Dairy desert, Cheddar cheese, Milk Pudding, ice cream, Milk chocolate
Tea	Tea
Coffee	Coffee
Fruits	Apples, Pears, Oranges, Grape Fruits, Bananas, Grapes, Melon, Peaches, Strawberries
Fruit juices	Apple juice, orange juice, grapefruit juice, or other Fruit juices
Processed Fruits	Dried Fruits, Tinned Fruits
Cruciferous vegetables	Broccoli, spring greens, kale, Brussels sprouts, Cabbage, cauliflower
Yellow vegetables	Carrots
Tomatoes	Tomatoes, Tomato ketchup
Green leafy vegetables	Spnach
Other Vegetables	Green salad (Lettuce, Cucumber, Celery), Watercress, Sweet corn, Beetroot, Green Beans, zucchini, Parsnips, Turnips, Swedes, Leeks, Onions, Mushroom, Sweet Peppers
Legumes	Baked Beans, Dried (Lentils, Beans, Peas)
Garlic	Garlic
Potatoes	Boiled, mashed, instant, or jacket Potatoes, Roast Potatoes
Whole Grains	Brown bread and rolls, Whole meal bread and rolls, Breakfast cereal, Brown rice, Whole meal pasta
Refined Grains	White bread and rolls, Cream crackers, cheese biscuits, Porridge, White rice, White or green pasta, e.g., Spaghetti, Macaroni (Noodles), Lasagna, Sweet biscuits chocolate, e.g., Digestive Sweet Biscuits plain
Pizza	Pizza
Snacks	Chips, Crisps, or other packet snacks
Nuts	Peanuts or other nuts

Salad Dressings	Salad cream, mayonnaise, French Dressing, and Other Salad Dressing
Sweet and Deserts	Sponge cakes, Fruit pies, Buns, Pastries, Doughnuts, Fruit pies, Chocolates, Snack Bars
Animal Fat	Tallow
Sugars	Sugar (added to Tea, Coffee), Cereal Sweets, Toffees, Mints
Condiments	Jam, jelly, honey
Soft Drinks	Low calorie or (Diet Fizzy) Soft Drinks, Fizzy Soft Drinks, e.g., Coca-Cola. Lemonade
Yogurt Drink	Ayran (Dough)
Broth	Vegetable soup, Meat Soup
Pickles	Pickles, chutney
Rashi	Rashi (Tahin)

2.4 Biochemical Assessment and Blood Pressure Measurements

The volunteer participants were vouchered to have a biochemical assessment, which consisted of lipid profile blood tests (Cholesterol, Hdl, Triglyceride, LDL, and VLDL) and blood sugar levels (blood glucose level and HbA1c), And blood pressure measurements (systolic and diastolic).

The blood samples were obtained from the antecubital vein of participants by a private clinical laboratory team to be analyzed. Participants were called the day before the test to inform them to be on fasting for at least 10 hours to get an accurate result. The result was returned to the participants as a report with nutritional guidelines. The blood pressure was measured by using a German brand (Beurer BM 40) upper arm blood pressure monitor and recorded based on the standard ranges of systolic pressure of 90 mm Hg - 120 mm Hg and a diastolic pressure of 60 mm Hg - 80 mm Hg (Lüders et al., 2012).

Lab professionals analyzed blood sample concentrations with a smart instrument (chemistry analyzer – GENO TEK) in a private laboratory based on the laboratory reference standard ranges: fasting blood glucose 70 mg/dL - 100 mg/dL, HbA1c 4.0-5.6% (20-38 mmol/mol), Cholesterol 60 mg/dL - 200 mg/dL, Triglycerides 30 mg/dL - 150 mg/dL, High Density Lipoprotein 35 mg/dL - 150 mg/dL, Low-density lipoprotein 0 mg/dL - 130 mg/dL, Very low density lipoprotein 2 mg/dL - 30 mg/dL (Roberts, 1967).

2.5 Anthropometric Assessment

The weight and body composition of the participants were measured by (Xiaomi Mi-Scale 2) smart body composition analyzer, which is connected with the smartphones (MI FITNESS APP) by Bluetooth. The profile for each participant was created in the app, and the height was also asked to directly find the body mass index BMI and show the ideal weight based on the age and metabolism of the individuals.

The Xiaomi Mi Body Composition Scale2 can measure various body metrics; the measurements with the normal ranges used in the analysis study consisted of BMI 18.5 - 24.9, body fat 28-35%, water percentage >55%, protein percentage >16%, and muscle mass >35 kg.

The studies validated the accuracy of the Xiaomi Mi Body Composition Scale2 compared to the clinical bioelectrical impedance body composition analyzer that the smart scale designed with the same basic the participants stand on the scale with bare feet. A small electrical charge is transferred into the body that can map body composition by measuring resistance and rate of transfer. Researchers in the studies chose Xiaomi Mi Body Composition Scale2 because of its ease of use, scale size, and portability (Alidadi et al., 2019).

The body composition measurements were saved and returned to the participants with blood test results and nutritional guidelines. The questions concerning the reasons for the deficiency of proteins or water percentage, how to lower body fat, and ideal weight were answered.

2.6 Statistical Analysis

The SPSS statistical package for social sciences v.22 (IBM) was used to analyze data. The factor analysis is defined as a class of multivariate statistical which is a part of the technique of principal component analysis (PCA) that is used to summarize and reduce data and ability to analyze and interrelationship of a large number of qualitative variables, to validate the hypothesis, factor analysis applied and performed the principal component analysis (PCA) with the method of varimax rotation, used to identify the dietary patterns based on the 38 groups the absolute value of factor loading <0.5 weren't shown in the table (Tang et al., 2013).

Descriptive statistics were used to demonstrate the data of socio-demographics and body composition. Also, the independent Sample t-test was used that compares the means between two variables used to identify and analyze the relationship between dependent variables such as healthy, western, and traditional factors with independent variables such as case-control study (normal and high ranges) of biomarkers (Johnson & Wichern, 2002).

Correlation analysis was used to identify the relationship between independent and dependent variables to determine the relationship and correlations between food groups with other variables. One-way ANOVA is an extension of the independent sample t-test used to test and claim three or more equal populations, known as one-way variance analysis (Aroian et al., 2017).

2.7 Ethical Approval of the Study

The Scientific committee of postgraduates in Salahadin University, Faculty of agricultural engineering sciences – food technology department in Erbil city approved the study in October 2022.

3. Results

Table 2 shows the descriptive Statistics for demographic questions. Most responders are female (55.7%), while most age groups are between 19 and 32 (78.3%). The percentage of single (61.6%) is higher than the percentage of married (38.4%). The majority of people in this survey graduated from a university or institute (55.7%), followed by higher education (33%), high school (4.4%), secondary (1.5%) and not educated (1.5%), respectively.

Table 2: Descriptive Statistics for Social Demographic questions

		F	%
Age Group/ year	19-32	159	78.3%
	33-46	33	16.3%
	47-60	11	5.4%
Gender	Female	113	55.7%
	Male	90	44.3%
Martial Status	Single	125	61.6%
	Married	78	38.4%
Education stage	Uneducated	3	1.5%
	Primary School	8	3.9%
	High School	9	4.4%
	University or Institution	113	55.7%
	Higher Education	67	33.0%
	Secondary School	3	1.5%

Table 3 represents the result of the Rotated Component Matrix for a Principal Component Analysis of the Dietary Food Patterns. All thirty-eight elements of the healthy food are loaded at factor (1) and explain 29.667 of the total variances. Then, all eight elements of western food are loaded at factor (2) and explain 20.566 of the total variances. Finally, all seven elements of the traditional food are loaded at factor (3) and explain 17.570 of the total variances.

Table 3: Shows the Rotated Component Matrix for a Principal Component Analysis of the Food Groups

	Factor		
	Healthy	Western	Traditional
Cruciferous vegetables	0.918		
Other vegetables	0.917		
Green Leafy vegetables	0.842		
Legumes	0.841		
Yellow vegetables	0.798		
Broth	0.757		
Garlic	0.738		
Condiments	0.714		
Fruits	0.664		
Tomatoes	0.605		
Pickles	0.599		
Fruit juice	0.59		
Sweet and deserts	0.569		
Rashi	0.554		
Animal fat		0.936	

Butter		0.932	
Margarine		0.921	
Salad dressings		0.905	
Low-fat dairy product		0.85	
Egg		0.706	
High-fat dairy products		0.623	
Pizza		0.550	
Processed fruits			0.760
Potatoes			0.737
red meat			0.729
refined grains			0.713
whole grains			0.615
Soft drinks			0.610
Coffee			0.547
Percentage of variance explained	29.6668	20.5664	17.5696

The absolute values of factor loadings <0.5 were not shown;

Table 4 shows the descriptive Statistics for questions related to Body Composition questions. The results show that most of the people in this study have a normal weight (48.3%), followed by overweight (36%), obese (12.8%), and underweight (3%), respectively. Most of the people in this study have low body fat (41.4%), followed by normal (34%) and high body fat (24.6%), respectively. Most of the people in this study have normal body muscle (57.1%), followed by great muscle (34%) and low body muscle (8.9%), respectively. The percentage for low body water (86.2%) is higher than normal body water (13.8%), while just (25.1%) of them have great protein in their bodies, as shown in Figure1.

Table 4: Descriptive Statistics for Body Composition questions

		n	%
Body Mass Index	Under Weight	6	3.0%
	Normal Weight	98	48.3%
	Overweight	73	36%
	Obese	26	12.8%
Body Fat – Male	Normal Body fat	17	7.8%
	High Body fat	73	33.5%
Body Fat – Female	Low Body Fat	12	5.5%
	Normal Body Fat	50	22.9%
	High Body Fat	51	23.4%
Muscle Mass	Low Muscle Mass	18	8.9%
	Normal Muscle Mass	116	57.1%
	Great Muscle Mass	69	34%

Body water	Low body water	175	86.2%
	Normal Body Water	28	13.8%
Body Protein	Low Body Protein	76	37.4%
	Normal Body Protein	76	37.4%
	Great Body Protein	51	25.1%

Table 5 shows a weak positive statistically significant correlation between HDL and overall traditional (0.160) at the significance of α=0.05. Then, the result shows a weak positive correlation between blood glucose and LDL and overall health. Still, there is a weak negative correlation between Cholesterol, triglyceride, HDL, VLDL, and HBA1C with overall healthy food. Next, a weak positive correlation exists between blood-glucose cholesterol, HDL, VLDL, and HBA1C with overall health. Still, there is a weak negative correlation between each triglyceride and VLDL with overall western food. Finally, there is a weak negative correlation between the blood glucose cholesterol, HDL, VLDL, HBA1C, triglyceride, and VLDL with traditional food.

Table 5: Correlation between Blood glucose, Cholesterol, Triglyceride, HDL, LDL, VLDL, and HBA1C with each of the measures (overall healthy, overall western and overall traditional) separately

	Overall Healthy	Overall Western	Overall Traditional
Blood Glucose	0.015	0.002	-0.047
Cholesterol	-0.021	0.015	-0.033
Triglyceride	-0.040	-0.061	-0.078
HDL	-0.053	0.050	0.160*
LDL	0.028	0.008	-0.090
VLDL	-0.046	-0.061	-0.078
HBA1C	-0.065	0.022	-0.025

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6 shows a weak positive statistically significant correlation between Vigorous Physical Activity VPA and diastolic (0.149) at the significant level of α=0.05. Then, the result shows a weak positive correlation between VPA and each of the (cholesterol, triglyceride, LDL, VLDL, HBA1C, and systolic, but there is a weak negative correlation between VPA and glucose and HDL. The result shows there is a weak positive statistically significant correlation between moderate physical activity MPA and each of the blood glucose (0.201), triglyceride (0.238), and VLDL (0.212), consequently at the significant level of α=0.01. Also, the result shows a weak positive correlation between MPA and each of the (cholesterol, HBA1C, and systolic, while there is a weak negative correlation between MPA and each of the (HDL, LDL, and Diastolic) separately. The result shows a weak negative statistically significant correlation between walking physical activity WPA and diastolic (-0.169) consequently at the significant level of α=0.05. Also, the result shows a weak positive correlation between WPA and each of the (blood glucose, LDL, and HBA1C) while there is a weak negative correlation between WPA and each of the (cholesterol, Triglyceride, HDL, VLDL, and systolic) separately.

Table 6: Correlation between VPA, MPA, and WPA with each of the tests in Metabolic Syndrome

	Blood Glucose	Cholesterol	Triglyceride	HDL	LDL	VLDL	HBA1C	Systolic	Diastolic
VPA	-0.016	0.041	0.058	-0.058	0.048	0.061	0.026	0.135	0.149*
MPA	0.201**	0.073	0.238**	-0.024	-0.013	0.212**	0.137	0.053	-0.002
WPA	0.053	-0.097	-0.092	-0.118	0.023	-0.092	0.088	-0.069	-0.169*

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 7 shows no statistically significant correlation between BMI and each of the tests from metabolic syndrome at the significant level of α=0.05. Then, the result shows there is a weak positive correlation between BMI and each of the (triglyceride, HDL, and VLDL) but there is a weak negative correlation between BMI and each of the glucose, cholesterol, LDL, HBA1C, systolic, and diastolic) separately.

Table 7: Correlation between BMI and each of the tests in Metabolic Syndrome

	Blood Glucose	Cholesterol	Triglyceride	HDL	LDL	VLDL	HBA1C	Systolic	Diastolic
BMI	-0.062	-0.055	0.023	0.053	-0.089	0.025	-0.002	-0.106	-0.006

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4. Discussion

We identified major 3 three dietary patterns among the participants Healthy, Western and Tradition, by factor analysis – factor loading matrix. The healthy pattern included food items (Cruciferous vegetables, other vegetables, Green Leafy vegetables, Legumes, Yellow vegetables, Broth, Garlic, Condiments, Fruits, Tomatoes, Pickles, Fruit juice, Sweet and deserts, and Rashi). Western patterns included (Animal fat, Butter, Margarine, Salad dressings, Low-fat dairy products, eggs, High-fat dairy products, and Pizza), and Tradition patterns included (Processed fruits, Potatoes, red meat, refined grains, whole grains, soft drinks and Coffee).

We observed that Sweets and deserts are identified in the first factor, which is the healthy food group that consisted in the questionnaire (Sponge cakes, Fruit pies, Buns, Pastries, Doughnuts, Fruit pies, Chocolates, and Snack Bars). In general, they identified unhealthy foods. Healthy adults from universities nowadays take care of their health, control their calorie intake and physical activities, and participate in gyms. The second group of the neighborhood we visited consumed and focused more on homebaked desserts (Garcia et al.,2021).

The Healthy dietary patterns were statistically significant with cholesterol and LDL. Which percentage of the variance of the healthy group was 29.7%. Most of the blood tests were near the normal range because we worked with healthy adults. Some factors such as genetics, environment, and methods of preparing healthy foods and storage all affect the individual's health and risk of metabolic syndrome components (Lemmer et al., 2021).

The western dietary patterns explained percentage variance was 20.6%, which wasn't statistically significant within the metabolic syndrome biomarkers of adults who participated in the research. The age of the participants was 78.3% of ages between 19-32 old years. The metabolism and metabolic syndrome change with age compared to the other age groups and are identified to be healthier (Peiris et al.,2022).

The traditional dietary groups explained the percentage of variance was 17.6% and was statistically significant with blood glucose (P- Value= 0.031), Triglyceride (P-value=0.041). and the blood glucose and triglycerides are the biomarkers that are associated with diabetes and cardiovascular diseases. Traditional dietary food items are generally known as unhealthy foods. In most studies, unhealthy foods have been identified to affect an increasing prevalence of metabolic syndrome components and cause chronic diseases.

5. Conclusion

In conclusion, in this study three major dietary patterns (healthy, western, and traditional) were identified among participants in Erbil city. The most frequently consumed food groups per day among participants in Erbil city were tomatoes, sugar added in tea and coffee, poultry, egg, and fruits. And most frequently drunk drinks per day were tea, yogurt drink, coffee, and fruit juice.

The healthy dietary pattern was associated with the lower risk factors of metabolic abnormalities among participants as this food groups include of all vegetables fruit loaded. only a few risk factors of metabolic abnormalities were found to be associated with the food groups loaded with the traditional dietary patterns of participants.

Most food groups loaded with the westernized dietary pattern were linked to the higher risk factor of metabolic abnormalities due to the unhealthy food groups that increased prevalence and improved metabolic syndromes among Kurdish adults in Erbil city.

It was concluded in current study that most of the participants in Erbil city were physically inactive and not performing physical activity. Most participants' BMI was above the normal range +24.9 and other abnormal body compositions of high body fat of males and females with insufficient body water composition.

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