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Comparison of food intake groups, dietary oxygen radical absorbance capacity (ORAC), and their relationship with atherogenic indices of plasma in patients with metabolic syndrome and healthy individuals

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ABSTRACT

The increasing prevalence of metabolic syndrome on the one hand and its relationship with other chronic non-communicable diseases on the other hand has led to many studies to investigate the causes of metabolic syndrome or its components. This study was a case-control study that was performed on 160 men and women (80 individuals with metabolic syndrome and 80 healthy individuals) with a mean age of 47.8 years. In this study, demographic questionnaires, 147-item feed frequency, anthropometric and body composition information, blood pressure, and a fasting blood sample were taken from all subjects. All data were analyzed using SPSS software. People with metabolic syndrome had higher intakes of cereals, offal, fruits, oils, and snacks, and the differences were significant. Also, the mean atherogenic plasma index (AIP), cardiac risk ratio, and atherogenic coefficient (AC) in the group of patients with metabolic syndrome were higher significant than in the patients. However, there was no significant difference between the ORAC diet in the healthy and affected groups. There was also no association between dietary ORAC and AIP. Among the food groups, only nuts and viscera were not associated with the ORAC diet, but more food groups such as legumes, meats, fast foods, vegetables, spices, nuts, tea, coffee, and sugars were not associated with AIP. The results also showed that according to AIP values, 71.3% of healthy people are at risk of developing metabolic syndrome. According to the results, it seems that indicators related to the quality of dietary fat have an effective role in the development of metabolic syndrome and its components. However, the ORAC index did not have a significant effect on the development of the metabolic syndrome and its components and was associated only with the intake of many food groups.

1. Introduction

The increasing prevalence of metabolic syndrome on the one hand and its relationship with the incidence of diabetes and cardiovascular disease on the other hand has led to various studies in this field and extensive research to investigate the various causes and factors of this complication (1). Nearly three decades ago, Dr. Raven identified a cluster of physiological and metabolic features that are seen together. Metabolic syndrome or X syndrome means the simultaneous occurrence of cardiac risk factors such as abdominal obesity, hypertension, glucose intolerance, or impaired insulin metabolism and lipid disorders (increased triglycerides and decreased to some extent (HDL) (2). The basis of different definitions has been reported from 7 to 58%, the increase in obesity in recent decades has increased the prevalence of metabolic syndrome and its prevalence is increasing in Iran. There are differences in race and multiple definitions of this syndrome (3, 4). The prevalence of this syndrome is also high in Western and Asian countries. The high prevalence of this syndrome has been reported in other countries of the world. The syndrome affects one in four people in the Middle East. It

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is also relatively common in most developed and developing countries and it can be said that approximately 10 to 20% of non-diabetic people have this syndrome (5). Metabolic syndrome has been reported in the European population with a 2.8 to 8-fold increase in the risk of type 2 diabetes and a 1.5 to 6-fold increase in the risk of cardiovascular disease. The prevalence of metabolic syndrome increases with age, which is faster in women. This syndrome is very common among adults in Tehran and according to the NCEP criteria is more than 30%, which is significantly more in women than men (6). A world standard method for measuring the antioxidant capacity of various foods and antioxidants such as catechins, vitamins E, etc. is the Index of Oxygen Radical Absorbance Capacity (ORAC) of the diet. The higher the ORAC index for each food, the higher the antioxidant content of that food, which varies in different food groups (7). Studies have shown that the type of consumed food, especially the consumption of antioxidants is effective in reducing the process of weight gain, which not only improves the lipid profile of individuals but also can play a very effective role in preventing hypertension and consequently metabolic syndrome (8). Interventional studies using antioxidant supplements (vitamins E and C, beta-carotene, zinc, and selenium) have shown that supplementation with antioxidants has no effect on the risk of metabolic syndrome, but prospective studies have shown that serum basal levels of some antioxidants, especially beta-antioxidants. Vitamins E and C and to some extent zinc are inversely related to the incidence of metabolic syndrome in later years. Studies in older women have shown that the amount of antioxidants received through food, followed by total antioxidant capacity (TAC), has a significant relationship with blood triglyceride levels, waist circumference, fasting blood glucose, and HDL (9). The most important risk factors for heart disease (such as atherosclerosis, heart attack, etc.) at the cellular level include elevated LDL, total cholesterol, triglycerides, and decreased HDL. Small LDL particles are highly atherogenic and are easily converted to oxidized LDL (10). Dubiasva et al. (11) showed that the TG/HDL logarithm as an atherogenic index (AIP) represents the balance between the actual plasma TG concentration and HDL, which determines the pathway of cholesterol transport within the arteries. In fact, plasma atherogenic index (AIP) can be considered as an important predictor of coronary heart disease. As the TG/HDL ratio increases, HDL particles tend to become smaller, so a higher ratio indicates the possibility of stopping HDL and weakening the reverse cholesterol transfer. The ratio of total cholesterol to HDL indicates your potential for blockage in the arteries of the heart. A ratio greater than 4.5 is considered a high risk of coronary heart disease. This ratio may decrease with an increase in good cholesterol (HDL) and/or a decrease in bad cholesterol (LDL) and indicates a cardiac risk ratio. The atherogenic coefficient (AC) is another indicator that is determined by the ratio of non-HDL cholesterol to HDL cholesterol (12). Numerous studies have demonstrated the effect of receiving different lipid profiles on plasma atherogenic and thrombogenic profiles with respect to different nutrient intakes. Because the intake of different fats is closely related to metabolic syndrome, it is important to study their effects on each other. Consumption of saturated fatty acids and trans fatty acids increases the risk of developing metabolic syndrome by increasing the risk of cardiovascular disease, hyperlipidemia, hypertension, insulin resistance, diabetes, and obesity. Trans fatty acids lower HDL, increase lipoprotein a, LDL, and triglycerides, and inhibit the metabolism of essential fatty acids. The amount of trans fatty acids in food directly affects the incidence of cardiovascular disease in humans. Trans fatty acids also increase the risk of CVD through the role of hypercholesterolemia (13). Studies have also shown for a long time that the consumption of saturated fatty acids (12 to 16 carbons, palmitic, lyric, Myristic) increases LDL levels. Saturated fatty acids work by exerting atherogenic and thrombogenic effects by increasing the production of very-low-density lipoproteins (VLDL), reducing the level of LDL receptors, and increasing platelet aggregation (14). Due to the treatment costs incurred due to metabolic syndrome on the one hand and the possibility of finding ways to prevent or reduce the incidence of this disease by using appropriate food sources in this study, the present study tried to compare food intake groups and Oxygen Radical Absorbance Capacity (ORAC) of diet and its relationship with atherogenic indices in patients with metabolic syndrome and healthy individuals.

2. Materials and methods

The present study was a case-control study. Participants in the study included 80 people with metabolic syndrome and 80 healthy people who were referred to the Health Monitoring Center of Chamran Hospital. Among the people referring to the Health Monitoring Center of Chamran Hospital in Tehran, first, the research objectives, the objectives of the study, and the method of its implementation were explained to the qualified individuals, so that they can cooperate in the study if they wish and fill out the consent form. Individuals who met the inclusion criteria (defined by NCEP ATP III 2005) (15), 3 out of 5 characteristics of insulin resistance, obesity, high triglyceride (above 150 mg/dL), low HDL (less than 40 mg/dL in men and less than 50 mg in women) as well as over 25 years of age. Relevant questionnaires include a general questionnaire containing general information such as age, occupation, economic status, culture, social status, characteristics of metabolic syndrome (smoking, drinking, etc.), and 147-item food frequency questionnaire (16) were used. Also, anthropometric indices (such as weight, height, waist, etc.), body mass composition (percentage of muscle and body fat) were measured by Inbody-270 (InBody Co., Ltd. South Korea). Blood samples were also taken and the required factors were measured in the laboratory located in the same center. We used the information obtained from the food frequency questionnaire to calculate fat quality factors (thrombotic and atherogenic indices) and an antioxidant index of food intake (ORAC). By combining body mass, anthropometric indices and blood biomarkers in patients with metabolic syndrome and healthy individuals. All participants had to complete this form before entering the study. Relevant personal information such as age, education, economic, social and cultural level, physical activity, marriage and income were obtained using a general questionnaire.

2.1. Anthropometric indices

The BAI bioelectric impedance analyzer is used as an alternative to monitoring muscle mass and body fat percentage. The bioelectric impedance analyzer measures the resistance of electric current in body tissues through electrical impulses and as a result, the ratio of body tissues is determined according to the resistance created. The weight of the subjects was measured and recorded using a bioelectric impedance analyzer (InBody-270) with an accuracy of 100 g (0.1 kg). For this purpose, the participants were standing with their hands slightly away from the body (45-degree angle). The electrodes of the device were in contact with the thumb of both hands and the soles of both feet. During the measurement, all participants without socks and shoes, with minimal clothing, in a standing position (without making the slightest movement), so that the soles of the feet were in contact with the electrodes of the device, which were specific to the feet. And participants held the handles of the device while measuring body composition by holding down the button on the handles with the thumb in their hands. Tablets or metal objects such as keys, belts, watches, jewelry, etc. The height of people was measured using a gauge in a standing position and without shoes while the shoulders were in normal condition, with an accuracy of 0.1 cm. Body mass was calculated by dividing weight in kilograms by height squared in meters.

2.2. Blood pressure measurement

The arterial blood pressure of each participant was measured with a hospital sphygmomanometer of A&D mercury design model UM-102 (Toshima City, Tokyo, Japan) after 15 minutes of rest, for each measurement with at least one-minute distance and one hand. In order to ensure the blood pressure, 3 samples were taken for each sample and the average of 2 close to each other was recorded as the patient's blood pressure.

2.3. Biochemical tests

A sample of 5 ml of venous blood was taken from all subjects after 10-12 hours of fasting during the night between 8-9 in the morning. To separate the serum, the samples were centrifuged at room temperature at 3000 rpm for 15 minutes using a centrifuge machine (Worner Lab WN-4A, Zhejiang, China). Serum level of 25-hydroxy D was measured as well using the HPLC method.

2.4. Food measurement

Diet and food groups were assessed using a food frequency questionnaire and patients were taught how to complete a food frequency questionnaire. The data were then analyzed using the FFQ (for extraction of non-USDA nutrients and unreported nutrients such as alpha-linolenic and gamma-linolenic, we used similar values in USDA and formulas in FFQ) (16).

2.5. Radical oxygen uptake capacity

Oxygen Radical Absorbance Capacity (ORAC), is a test tube analysis that measures the total antioxidant power of foods and other chemical substances (17). It is a world standard method for measuring the antioxidant capacity of various foods and various antioxidants such as catechins, vitamin E, etc. A higher ORAC index of food means the highest antioxidant content of that food. In the present study, the ORAC index was calculated based on the USDA food data source (18).

2.6. Atherogenic index of plasma

All lipid profile was analyzed using Cobas e-411 analyzer (Roche Diagnostics, Basel, Switzerland). The TG/HDL logarithm as an atherogenic index (AIP) indicates the balance between the actual plasma TG concentration and HDL, which determines the pathway of cholesterol transport within the arteries (19).

2.7. Atherogenic coefficient

The atherogenic coefficient (AC) is another indicator that is determined by the ratio of non-HDL cholesterol to HDL cholesterol (20).

2.8. Cardiac risk ratio

The ratio of total cholesterol to HDL indicates your potential for blockage in the arteries of the heart. A ratio greater than 4.5 is considered a high risk of coronary heart disease. This ratio may decrease with an increase in good cholesterol (HDL) and/or a decrease in bad cholesterol (LDL) and indicates a Cardiac Risk Ratio (CRR) (12).

2.9. Sample size measurement

The sample size was calculated using Gpower software version 3.1.9.7 (21). Since in the present study, in addition to comparing the two groups of patients and healthy, the relationship between variables with metabolic syndrome is investigated, therefore the software settings are based on two comparison modes between the two groups (Linear bivariate regression: Two groups, difference between intercepts) and correlation calculation. In both cases, 80% Z and 95% significance levels were calculated and the highest figure was considered as the sample size, which is equal to 72 people in each group and a total of 144 people. In order to prevent a possible drop of samples, 10% was added to the total sample volume, and finally, the study sample size was equal to 160 samples who were randomly selected among the candidates for cooperation in the present project based on inclusion criteria.

2.10. Statistical analysis

Mean and standard deviation were used to describe quantitative variables according to the conditions and frequency report (percentage) was used for qualitative variables. Pearson correlation analysis was used to determine the correlation between disease severity and food intake in normal assessments and Spearman correlation analysis was used in abnormal assessments. The Chi-square test was used for qualitative variables. Also, the logistic regression test was used to examine the triangles and also independent t-test was used to compare the case and control groups. Logistic regression test and ANCOVA were used to modify confounders. SPSS software 27 (IBM SPSS Inc, Chicago, Illinois, USA) was used for data analysis and the significance level was less than 0.05.

3. Results

In this case-control study, we evaluated 80 people with metabolic syndrome and 80 healthy people (160 people in total) in the laboratory and anthropometric evaluations and examined their dietary intake. As Table 1 shows, the two groups with metabolic syndrome and the healthy group were significantly different only in terms of physical activity and income, but were not significantly different in terms of gender, marriage, education, occupation, smoking, and alcohol consumption. As Table 2 shows, people with metabolic syndrome consumed significantly more grains, viscera, fruits, oils, and snacks among food groups than healthy people. Based on Table 3, the mean plasma atherogenic index (AIP) in patients compared to healthy individuals was 0.72 and 0.28 and significant, respectively. The atherogenic coefficient is higher in patients than in healthy individuals and is 4.26 and 1.82, respectively. The CRR was also higher in people with metabolic syndrome than in healthy people. However, the oxygen uptake capacity (ORAC) capacity of the diet was not significant in the healthy and affected groups. As Table 4 shows, in the general population studied, AIP had a positive correlation with cereals, offal, fruits, oils, salts, and spices. The CRR was also positively correlated with cereals, legumes, meats, offal, dairy products, vegetables, condiments, fruits, oils, sugars, and snacks. Atherogenic coefficient had a positive correlation with other food groups except for fast foods, nuts,

Table 1. Comparison of demographic factors between two groups of metabolic syndrome and healthy individuals.

		Control N=80	Case N=80	P value
Gender				0.87
	Male	42 (52.5)	41 (51.2)	
	Female	38 (47.5)	39 (48.8)	
Marital status				0.12
	Single	12 (15)	20 (25)	
	Married	68 (85)	60 (75)	
Education				0.47
	Illiterate	2 (2.5)	5 (6.3)	
	Diploma and sub-diploma	22 (27.5)	24 (30)	
	Post-diploma and bachelor's degree	46 (57.5)	38 (47.5)	
	Master degree and higher	10 (12.5)	13 (16.3)	
Job				0.38
	Managerial employee	8 (10)	7 (8.8)	
	Non-managerial employee	39 (48.8)	35 (43.8)	
	Worker	0 (0)	2 (2.5)	
	Housewife	16 (20)	16 (20)	
	Retired	11 (13.8)	15 (18.8)	
	Unemployed	3 (3.8)	0(0)	
	Self-employment	3 (3.8)	5 (6.3)	
Income				0.004
	Under 3 million	19 (23.8)	9 (11.3)	
	3 to 6 million	0 (0)	9 (11.3)	
	6 to 9 million	36 (45)	31 (38.8)	
	Above 9 million	25 (31.3)	31 (38.8)	
Physical activity				0.006
	No activity	35 (43.8)	49 (61.3)	
	Low activity	29 (36.3)	28 (35)	
	Moderate activity	9 (1.3)	3 (3.8)	
	Extensive activity	7 (8.8)	0 (0)	
Corona condition				0.87
	Negative	46 (57.5)	47 (58.8)	
	Positive	34 (42.5)	33 (41.3)	
Smoking				0.15
	No	76 (95)	71 (88.7)	
	Yes	4 (5)	9 (11.3)	
Alcohol consumption				
	No	80 (100)	80 (100)	

* Analyzed by Chi-square.

tea and coffee, salt, and spices with which there was no correlation. Also, there was no correlation between nuts and dietary groups between the ORAC diet and viscera. The cardiac risk ratio and atherogenic coefficient had a positive correlation with the ORAC diet. However, there was no correlation between the atherogenic index of plasma and dietary ORAC. As it has illustrated in Fig. 1, the value of the plasma atherogenic index in the group of healthy individuals based on low, moderate, and high risk of cardiovascular disease were 11.3, 17.5, and 71.3%, respectively.

Table 2. Comparison of food group consumption between metabolic syndrome patients and healthy persons.

Food groups (g/day)	Case	Control	P
Grains	574.56±354.30	466.63±127.73	0.011*
Beans	46.56±38.09	41.47±43.00	0.430
Meats	126.68±35.80	121.26±29.94	0.300
Fast food	16.41±14.10	17.93±26.13	0.648
Innards	2.88±2.56	1.96±1.91	0.011*
Dairy	426.03±160.62	382.04±117.63	0.050
Vegetable	292.79±115.10	278.68±113.14	0.435
Condiments	15.12±15.05	11.79±11.95	0.123
Fruits	324.47±95.83	263.34±99.20	0.0001*
Dried fruits	33.24±51.14	32.27±24.75	0.878
Oils	32.28±17.51	26.72±12.76	0.023*
Candies	22.41±21.05	19.27±22.20	0.360
Tea and coffee	882.62±418.68	870.63±332.38	0.841
Salt	6.79±4.26	5.97±2.63	0.145
Junks	8.50±7.83	5.05±5.40	0.001*
Spices	7.13±3.16	8.01±2.94	0.067

* Analyzed by t-student test.

Table 3. Comparison of plasma atherogenic index, cardiac risk ratio, and atherogenic coefficient between metabolic syndrome patients and healthy persons.

Index	Case	Control	P
Atherogenic index of plasma (AIP)	0.72±0.14	0.28±0.16	0.0001*
Cardiac risk ratio (CRR)	5.26±1.23	2.82±0.76	0.0001*
Atherogenic coefficient (AC)	4.26±1.23	1.82±0.76	0.0001*
ORAC	28682.02±5884.09	27918.86±5568.39	0.401

Table 4. Correlation between plasma atherogenic index, cardiac risk ratio, and atherogenic coefficient with food groups.

Food groups	Atherogenic index of plasma		Cardiac Risk Ratio		Atherogenic Coefficient		ORAC	
	R	P	R	P	R	P	R	P
Grains	0.165*	0.037	0.175*	0.027	0.175*	0.027	0.229**	0.004
Beans	0.051	0.524	0.229**	0.004	0.229**	0.004	0.384**	0.0001
Meats	0.094	0.235	0.216**	0.006	0.216**	0.006	0.308**	0.0001
Fast food	-0.052	0.516	0.072	0.364	0.072	0.364	0.226**	0.004
Innards	0.176*	0.026	0.176*	0.026	0.176*	0.026	0.063	0.428
Dairy	0.160*	0.044	0.297**	0.0001	0.297**	0.000	0.574**	0.0001
Vegetable	0.084	0.292	0.237**	0.003	0.237**	0.003	0.568**	0.0001
Condiments	0.082	0.300	0.261**	0.001	0.261**	0.001	0.547**	0.0001
Fruits	0.207**	0.009	0.388**	0.0001	0.388**	0.000	0.457**	0.0001
Dried fruits	-0.030	0.703	-0.069	0.384	-0.069	0.384	0.066	0.404
Oils	0.258**	0.001	0.249**	0.002	0.249**	0.002	0.367**	0.0001
Candies	0.078	0.328	0.237**	0.003	0.237**	0.003	0.382**	0.0001
Tea & coffee	0.004	0.965	-0.028	0.728	-0.028	0.728	0.225**	0.004
Salt	0.184*	0.020	0.117	0.140	0.117	0.140	0.314**	0.0001
Junks	0.192*	0.015	0.333**	0.000	0.333**	0.000	0.282**	0.0001
Spices	-0.024	0.765	-0.117	0.140	-0.117	0.140	0.485**	0.0001

Table 5. Correlation between plasma atherogenic index, cardiac risk ratio, and atherogenic coefficient with oxygen radical scavenging capacity (ORAC).

Index	R	P
Atherogenic index of plasma (AIP)	0.115	0.147
Cardiac risk ratio (CRR)	0.222	0.005
Atherogenic coefficient (AC)	0.222	0.005

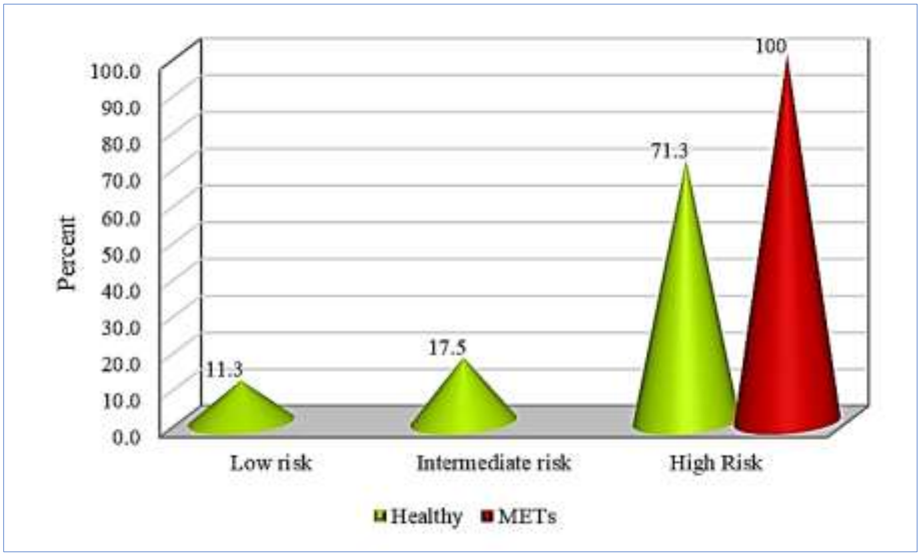

Fig. 1. Comparison of the atherogenic index of plasma between metabolic syndrome patients and healthy persons.

4. Discussion

In the present study, the intake of vegetables in two groups of healthy people with metabolic syndrome was not significant, which could be due to the type of vegetables consumed by people. Some studies in line with the present study have not linked the intake of vegetables with people with metabolic syndrome. Of course, many studies have also shown that eating vegetables is inversely related to the metabolic syndrome line. These studies suggest that consumption of fruits and vegetables increases insulin production in the body by increasing the intake of antioxidant compounds and thus plays a role in preventing metabolic syndrome by preventing insulin resistance. A variety of fruits and vegetables, storage methods, and cooking methods can be considered as the reason for the difference in the results of studies (22). In the present study, fruit consumption was significantly higher in people with metabolic syndrome. This result was consistent with a study by Ismailzadeh et al. (23). The results showed that there is no relationship between increased fruit intake and decreased risk of metabolic syndrome. The study showed that despite receiving more consumption of meat products in people with metabolic syndrome, there is no significant relationship between meat consumption in the two groups of people with metabolic syndrome and healthy people. But many studies show that eating processed and unprocessed red meat, as well as innards as a result of high cholesterol, increases a person's risk of cardiovascular disease (24). The present study showed that the consumption of oils in the group with metabolic syndrome was significantly higher than in healthy individuals. A study by Moradi Nazar et al. (25) in 2021 showed that the consumption of hydrogenated oils was associated with a decrease in plasma atherogenic indices. Also in the study of Awake Night et al. (26), a direct relationship was observed between the consumption of oils with high saturated fatty acids (SFA) and the development of metabolic syndrome. Also, in a study conducted by Lee et al. (27) in 2015 to investigate the effect of very-long-chain fatty acids on the risk factors for metabolic syndrome, in this study 4323 Korean adults were studied. The results of the study showed that high oil intake of High-chain fatty acids is significantly associated with optimal metabolic status, including circulating triglyceride and LDL levels. Also, people who had higher levels of omega-3 and omega-6 fatty acids showed an inverse relationship with metabolic syndrome. The results of the study showed that grain consumption in people with metabolic syndrome was significantly higher than in healthy people. According to the results of the NHANESIII study, low and moderate carbohydrate intake is associated with a low prevalence of metabolic syndrome in men (28). However, other studies show that eating whole grains reduces total cholesterol and LDL, as well as improves fat distribution, which improves insulin resistance and fasting insulin levels, thereby reducing the risk of metabolic syndrome. In a study performed on mice, the results showed that mice that consumed more carbohydrates had significantly higher atherogenic indices. Sugars also strongly influenced the increase of the atherogenic index (29). The results of a special study showed that dairy consumption in both groups of people with metabolic syndrome and healthy people is not significantly different from each other. In line with this study, in a review of 16 studies reviewed, the findings of 11 studies showed that people who ate more high-fat and high-fat dairy foods were thinner and gained less weight over time. None of the 16 studies showed a positive association between high-fat or dairy-consuming dairy products with the amount of adipose tissue at baseline or over time. Contrary to the most common dietary guidelines recommending low-fat milk and dairy products, the studies reviewed in this article showed that dairy fat consumption was not significantly associated with an increased risk of overweight, cardiovascular disease, and type 2 diabetes and consequent metabolic syndrome (30). The present study showed that the mean atherogenic index of plasma (AIP), Cardiac Risk Ratio, and Atherogenic Coefficient (AC) in patients were higher and more significant than in healthy individuals. Among the existing studies, there are very few studies that have calculated all these indicators in people with metabolic syndrome. Only one study by Javardi and colleagues on obese and overweight individuals found that the estrogenic index in obese individuals was significantly higher than in normal-weight individuals. However, there was no significant difference between obese and normal groups in terms of the thrombogenic index (24). In their study, Julibert and colleagues (31) also examined the fat quality index between the two groups. In men and women with metabolic syndrome, the fat quality index was higher and lower, respectively, than those in the healthy group. The two groups were not significantly different in terms of the ORAC index. The results of our study are in line with some studies. In comparison, Zujko and colleagues compared healthy people with metabolic syndrome and found that healthy people with DTAC and dietary polyphenols did not differ significantly (32). Dziegielewska and colleagues (33) also found that people with metabolic syndrome and healthy people did not differ significantly in terms of oxidant and antioxidant indices, including superoxide dismutase, total serum antioxidant capacity, and reactants with Thiobarbituric acid. The results of the present study also showed that dietary oxygen uptake (ORAC) capacity was correlated with CRR and AC but not with AIP. In a study in which Hermsdorff et al. (34) examined the total antioxidant capacity of food with indicators of obesity, metabolic stress, and oxidative stress, the results of this study showed that the total antioxidant capacity of food was inversely related to glycemia, total cholesterol to HDL ratio, triglyceride, and LDL concentration was positively correlated with HDL. Also, the results of the present study showed that due to the amount of plasma atherogenic index, a high percentage of people in the healthy group are also at risk of developing metabolic syndrome. Genetic, metabolic, and environmental factors, including diet, appear to play an important role in the development of this syndrome.

5. Conclusion

According to the results of this study, it seems that the atherogenic index of plasma and the quality of fats received as a result of receiving different food groups can play a very important role in preventing people with metabolic syndrome. In this study, dietary ORAC, which reflects the antioxidant capacity of the diet, was associated with the intake of many food groups but was not related to the plasma atherogenic index.

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