Metabolic Syndrome and the Mediterranean Diet with the Particular Interest of Some Food Stuffs

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Rec Date: Sep 16, 2015, Acc Date: Jan 02, 2016, Pub Date: Jan 08, 2016

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Abstract

Aim: Universities responsive to social changes can change rapidly and correctly and reflect these changes in the Programs and institutions that are intertwined with society. Program development, in accordance with the requirements of the profession, is integrated with program evaluation studies. The objective of the present study is to evaluate expectation sand needs of stakeholders of Nutrition and Dietetic programs in Turkey.

Methods: Thirty-four Nutrition and Dietetics programs in Turkey were analysed qualitatively in terms of their historical background, present status, program structure, and knowledge and skills offered through courses. After identification of the stakeholders (participants) of the programs, they were given questionnaires and interviews to provide their opinions about the program. The total number of participants in the present study was 408; 34.3% are students, 22.1% are dietitians, 17.2% are patients and clients, 13% are instructors, 12.2% are cooks and waiters, and 1.2% are managers.

Results: There was a statistically significant difference (P<0.05) among students, dietitians and instructors in Evaluating the programs’ competency providing basic qualifications aimed through theory, practice and extra field courses. The same difference occurred for the degree they find important skills and knowledge for the profession. Majority of the stakeholders agreed the programs should include more practice courses on work-related knowledge and skills.

Conclusions: Programs should be reviewed in accordance with the needs and expectations of stakeholders. Segments of society affected by the program should actively participate in future program studies.

Keywords: Curriculum; Dietetics; Education; Needs assessment; Nutritional science; Program

Introduction

Metabolic syndrome (MetS) is one of the most rapidly increasing problem around the globe; diagnosing around a quarter of the world's adult population as a consequence of the ongoing obesity epidemic [1]. The significant rise of obesity decrease in normal physical activity, due to factors such as industrialization, radical changes in our environment therefore supplying foods and alteration of our nutritional habits. The caloric intake has increased dramatically when food preparation moved from the family kitchen to commercial suppliers. An increase in caloric consumption is accompanied by an unprecedented reduction in physical activity together with increasingly sedentary lifestyle. More importantly, decreasing of normal physical activity during childhood by addiction to television and computers may reduce mitochondrial abundance and oxidative capacity of skeletal muscles, creating susceptibility factor for MetS during adulthood. In these cases the Mets begins at an earlier age and may be more severe [2]. There is evidence that MetS is increasing between children, adolescents generation ages [3].

With the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) definition, prevalence of the MetS in Europe, Asia, Australia, and North and South America ranges between 9.6% and 55.7%; with the World Health Organization (WHO) definition, prevalence ranges between 13.4% and 70.0%; and with the International Diabetes Federation definition, prevalence ranges between 7.4% and 50% [4]. It is estimated that around a quarter of the world's adult population have metabolic syndrome [5]. The other factors for Mets is manifested by elevated serum triglycerides (TG), low density lipoprotein (LDL), and low high-density lipoprotein cholesterol (HDL-C). Therefore; MetS represents a combination of cardio-metabolic risk determinants, including central obesity, insulin resistance, glucose intolerance, hypertension, hyperinsulinemia, micro albuminuria and the others such as nonalcoholic fatty liver disease (NAFLD), polycystic ovarian syndrome, atherosclerosis, the proinflammatory state, and oxidative stress [6]. They are having twice times risk of heart attack or stroke compared the people without of the syndrome, thus a shortened life span [7]. They are having twice times risk of heart attack or stroke compared the people without of the syndrome [8].

Metabolic syndrome is identified and characterized as co-occurrence of at least 3 of the 5 metabolic abnormalities: waist circumference (WC) of at least 88 cm for women and at least 102 cm for men, HDL-C less than 40 mg/dl (<1.04 mmol/l) for men and less than 50 mg/dl (1.29 mmol/l) for women or drug treatment, TG of at least 150 mg/dl (1.69 mmol/l) or drug treatment, fasting plasma glucose...
of at least 100 mg/dl (5.6 mmol/l) or drug treatment of hyperglycemia, and hypertension (systolic blood pressure ≥130 mm Hg or diastolic blood pressure ≥85 mm Hg) or drug treatment for a previous diagnosis of hypertension [9]. According to the International Diabetes Federation, almost the similar criteria for definition of MetS if a person has central obesity (waist circumference ≥94 cm for Europid men and ≥80 cm for Europid women) plus any two of the following four factors: raised TG level (≥150 mg/dl, or receiving specific treatment for this lipid abnormality); reduced HDL-C (<80 mg/dl in males and <50 mg/dl in females, or receiving specific treatment for this lipid abnormality); raised blood pressure (systolic ≥130 mmHg or diastolic ≥85 mmHg, or receiving treatment for previously diagnosed hypertension); and raised fasting plasma glucose (≥100 mg/dl, or previously diagnosed type 2 diabetes) [10].

There are several nutritional reasons for developing of obesity but the mainly important and the simple one is an imbalance between energy intake and expenditure [11]. In diets designed to prevent and treat obesity by manipulating energy content, macronutrient distribution is usually set at 15% protein, <30% lipids, and 50-55% carbohydrates, with reductions in dietary fat and increases in fiber favored [12].

Among several contributing factors that influence the prevalence of MetS, dietary habits play an essential role and accordingly, several studies have assessed the impact of dietary habits especially on the risk of MetS. Moreover, lifestyle interventions, including dietary changes and physical activity, play a crucial role in the prevention of MetS condition as well. Diets rich in whole grain cereals, fruits, and vegetables, with low animal-fat such as the Mediterranean diet (MD) consumption, seem to confer the prevention of CVD risk factors, like hypertension, hypercholesterolemia, and obesity and MetS [13].

**The Mediterranean diet and foods**

The traditional Mediterranean diet (MD) is characterized by a high intake of olive oil, vegetables and fruit, nuts and moderate intake of fish, cereals; a poultry; a low intake of dairy products, red meat, and wine in moderation, consumed with meals. The foods composed of MD are rich monounsaturated fatty acids-MUFA, antioxidant vitamins, fat, soluble vitamins and some minerals, rich vitamin E and n-3 fatty acids, fiber, and phytochemicals such as resveratrol [14]. In the Mediterranean diet is represented by MUFA, ranging from 16 to 29% of energy, with olive oil as the principal fat [15] and with intake of saturated fatty acids (SFA) 8% of energy.

The beneficial role of the MD with regard to mortality from all causes, CVD and cancer [16], as well as obesity and type 2 diabetes has already been reported from the results of many epidemiological studies and clinical trials. Main mechanisms include antioxidant and anti-inflammatory effects of the foods included in MD pattern [17]. Scientific evidence has been documented about the beneficial role of diets with a relatively high MUFA content on cardiovascular risk factors, obesity. These beneficial MUFA are provided by the traditional Mediterranean food pattern and, specifically, by olive oil and most nuts [18].

A prospective study follow up the MD has been shown that an updated Mediterranean score was inversely associated with WC, systolic blood pressure and TGs, and positively associated with HDL-C. The Mediterranean dietary pattern, especially by limiting refined grains and sweetened beverages, could be useful for prevention of CVD and type 2 diabetes. The findings of the study with both the traditional and the updated MD score reduced MetS risk and this is a good example for in other populations that of the non-Mediterranean countries [19]. Almost similar finding has been shown in the other an epidemiological study that the MD was associated with reduced risk of MetS, like (WC) high-density lipoprotein cholesterol, triglycerides, systolic and diastolic blood pressure, and glucose.

Although the MD is complex in nature, it is not so difficult to evaluate its contents. Therefore it is advised that this dietary pattern can be easily adopted by all population groups and various cultures and cost-effectively serve for primary and secondary prevention of the MetS and its individual components [1].

**Olive oil and the other fatty acids**

Olive oil is considered a functional food, apart from having a high level of MUFA, the oleic acid, contains many minor components with potential biological properties [20]. Some of these minor components are including (i) polyphenolic compounds such as phenolic acids (e.g., 4-hydroxybenzoinic acid, protocatechuc acid, gallic acid, etc.), tyrosol, hydroxytyrosol and derivatives; lignans and flavonoids (e.g., apigenin, luteolin, quercetin); (ii) chlorophyll derivatives; (iii) hydrocarbon (squalene); (iv) carotenoids (e.g., β-carotene, lutein, neoxanthin) and; (v) tocopherols (α, β, γ and Δ). These components of an olive oil varies, depending on the cultivar, climate, ripeness of the olives at harvesting, and the processing system employed to produce the types of olive oil [21].

When saturated fatty acid is replaced by MUFA in the diet, two important effects are the decrease in LDL-C and maintaining the HDL-C at a higher level rather than SFA when is substituted by PUFA or carbohydrates. Oleatriched LDL-C have been shown to be less susceptible to oxidation than rich in linolate, and also olive oil-rich diets increase the LDL-C particle size more than carbohydrate-rich diets [20]. Thus, a high-MUFA diet, such as a classical Mediterranean food pattern, may be a better substitute than the low-fat, high-carbohydrate diet for a Westernized diet that is rich in SFA, considering the improving in the HDL-C levels and inhibition in the LDL-C oxidation. In is demonstrated that the consumption of medium- and high-phenolic content olive oil (25 ml/day) decreased lipid oxidative damage biomarkers such as plasma oxidized LDL-C, and hydroxy fatty acids, besides to increase HDL-C. This improvement in the lipid oxidative damage was linear with the phenolic content of the olive oil consumed, therefore MUFA fat. MUFA intake could be associated with an increased sensitivity to insulin, a reduction in blood pressure. However, the other components of olive oil, such as the phenolics compounds could be associated with lower blood pressure and a reduced risk of hypertension than the other factors [22]. There is also some evidence that a proportion of total dietary fat in excess of 40% worsens insulin sensitivity, particularly when the diet includes high saturated fat [23].

**Polyunsaturated fatty acids (PUFAs)**

Required daily energy is obtained basically from carbohydrates and fatty acids which intake of them excessively derivatives interfere with hepatic insulin signal transduction. Reactive oxygen species accumulate, which cannot be quenched by adjacent peroxisomes; these reactive oxygen species reach the endoplasmic reticulum, leading to a compensatory process termed the “unfolded protein response,” driving further insulin resistance and eventually insulin deficiency [3].
Unsaturated fatty acids are classified by the number of double bonds as mono- or polyunsaturated. They are mainly found in the cis setting of double bond, where the two hydrogen atoms are positioned on the same side. Therefore, in double bond, the chain carbon axis forms a slightly bent angle in the opposite part to the two hydrogen atoms, and the higher the amount of double bonds is, the greater the bending is. Thus, in the phospholipids lipoprotein packing, PUFAs restrict the space for cholesterol molecules accommodation in the lipoprotein [24].

Polyunsaturated fatty acids belong to different series according to location of the first double bond in the carbon chain from the methyl terminal side and thus belong to the n-3 (omega-3), n-6 (omega-6) and n-9 (omega-9) series. Oleic acid (C18:1), a member of the n-9 series, is one of the mostly found in olive and canola oils as the main dietary sources. The most PUFA belonging to the n-6 series is linoleic acid (C18:2:LA), followed by arachidonic acid (C20:4:AA), which is mainly found in corn and sunflower oils. The main sources of α-linoleic acid (ALA), a member of the n-3 series, are linseed, soy and canola oils. Linoleic and linolenic acids are essential to humans, as mammalian cells. Eicosapentaenoic (C20:5; EPA) and docosahexaenoic (C22:6; DHA) acids, members of the n-3 series, are found in the fat of cold and deep sea water fish. They are synthesized from linolenic acid (Figure 1) [25].

Several actions of PUFAs that could influence blood cholesterol. PUFA reduce the hepatic production rate of very low density lipoprotein (VLDL) concomitant to lesser expression of microsomal triacylglycerol transfer protein (MTP) which is involved in the assembly and secretion of this lipoprotein [27].

The n-3 fatty acids reduce the risk for CVD partly by improving the blood lipid profile and decreasing blood pressure. Alfa linolenic acid effects on the modulation of lipoproteins, while EPA and DHA may decrease TG synthesis and adiposity. Daily supplementation with 20-50 g ALA-rich flaxseed reduced total cholesterol and LDL-C concentrations in normolipidemic and hypercholesterolemia patients. In healthy males, fish oil and DHA-oil supplementation (4 g/day) for 15 weeks lowered fasting plasma TG concentrations and postprandial total chyloinmicron concentration [28,29].

In obese individuals, body mass index (BMI), WC, and hip circumference were inversely correlated with EPA and DHA intakes. In patients with dyslipidemia, consumption of EPA+DHA (3 g/day) increased HDL-C and decreased TG in blood after 3 and 6 months. In a study in patients with MetS, fish oil n-3 fatty acids supplementation for 6 months reduced body weight and serum concentrations of LDL-C, total cholesterol and TG at a relatively low dose (180 mg EPA+120 mg DHA capsule/day). It has been suggested that the TG-lowering effects of DHA and EPA may be caused by decreased hepatic TG secretion and enhanced clearance of TG from the plasma [30,31].

Impaired insulin action in skeletal muscle is related to TG accumulation, and that long-chain n-3 fatty acids in phospholipids of skeletal muscle may be important for efficient insulin action. Skeletal muscle is the principle site of insulin mediated glucose disposal and the fatty acid composition of membranes influences the action of insulin within the skeletal muscle, whereas the fasting serum insulin concentration was positively correlated with the percentages of LA indicating that high or increased LA is associated with decreased insulin sensitivity. Therefore, abnormalities in the fatty-acid composition of membranes may be involved in the linking to insulin resistance and hyperinsulinemia, obesity, hypertension, type 2 diabetes mellitus, and coronary artery disease, suggesting that diet may influence their development [32].

Overall, it has shown that weight loss in combination with a daily serving of fish had additive effects on blood pressure reduction, improved heart rate, serum lipids, and glucose and insulin metabolism. It is also found that dietary fish enhanced the effects of weight loss on serum leptin levels. In a clinical trial that evaluated the effects of fish consumption during a period of energy restriction found a specific leptin and insulin decrease that was independent of body fat mass reduction [12].

The Nutrition Committee of the American Heart Association specifies that patients without coronary heart disease should eat oily fish twice weekly. Patients with coronary heart disease should consume about 1 g EPA and DHA daily, preferably from oily fish, and individuals with hypertriglyceridemia may be advised to receive 2-4 g fat. Patients were prescribed to consume 2 g PUFA supplementation for 12 months in order to improve their plasma lipid pattern. After the treatment, results showed that PUFA long-term supplementation was associated with a significant reduction in systolic and diastolic blood fatty acid content of the fish is important, but also other nutrients in fish may influence on CVD. In this sense, it is suggested that the intake of lean fish at least four times per week could reduce blood pressure levels in coronary heart disease patients. Therefore, fish and itsfatty acids should be considered an effective strategy in the treatment of CVD and MetS [23].

Trans fatty acids (TFAs)

It is claiming those four specific foodstuffs that have been associated with the development of MetS: trans-fats, branched-chain amino acids, ethanol, and fructose [3]. Between them, trans fatty acids are the geometric isomers of cis fatty acids, presenting the same molecular formulation with a different structure that can be synthesized from bacteria fermentation in ruminants and found in small amounts in meat and milk. However, their most important source is hydrogenated fat (elaidic acid) such as vegetable's oils that are widely employed in

Figure 1: N-6 and n-3 serious fatty acids [26].

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Citation: Aksoy M (2016) Metabolic Syndrome and the Mediterranean Diet with the Particular Interest of Some Food Stuffs. Endocrinol Metab Syndr 5: 1000221. doi:10.4172/2161-1017.1000221
industrialized foods [27]. Trans fatty acids have several implications in MetS, they are strongly associated with a rise in inflammatory processes, plasma TGs and cholesterol, as well as a reduction in HDL. Therefore, trans fatty acids increase CVD risk by influencing risk factors and also by direct actions on the endothelium, such as on its injury and death by inducing apoptosis in human cells via activation of the caspase pathway [27]. Apart from in this inflammatory human mitochondria cannot be β-oxidation of TFAs in the liver, contributing to ectopic intrahepatic lipid accumulation [33].

On the other hand, trans-unsaturated fats in processed foods have been in the Western diet since the early 20th century. This is because the trans-isomerization of the double bond prevents fatty acid breakdown by bacteria, prolonging the shelf life of foods. After the recognized association between trans-fat consumption and diseases risk, consumed of them in the "Western diet" has been gradually declining [33].

**Recommended Intakes of dietary fatty acids**

Although every country recommend dietary fatty acid combination according to their own condition but the American Dietetic Association (ADA) have modified their previous dietary recommendations for individuals restricted total fat to 30% of energy, with SFA, MUFA, and PUFA at 10% of energy [34]. Moreover, the statement on dietary fatty acids from the ADA and Dietitians of Canada allows for total fat between 20 and 35% of energy, enhancing MUFA intakes up to 25% of energy [35]. Furthermore, the NCEP ATP III, endorsed by the American Heart Association (AHA), has recommended dietary guidelines for primary and secondary prevention of CVD with emphasis on monitoring total dietary fat and targeting a reduction in SFA. Similar to the ADA, earlier recommendations by the AHA, NCEP Step I and II diets, limited total fat intake to 30% and MUFA intake to 15% of energy. Recently, the Joint FAO/WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition recommended that MUFA intakes be 15-20% of energy, according to total fat intakes [36]. MUFA intakes should be determined by calculating the difference, i.e. MUFA (% energy)=Total Fat (% of energy) - SFA (% of energy) - PUFA (% of energy) - TFA (% of energy). Thus, MUFA intakes will range with respect to the total fat and fatty acid composition of the diet [37].

**Antioxidants**

Nutritional studies have obtained positive results on MetS using botanical or pharmaceutical antioxidant supplements, however, the most healthy and advised compounds are those coming from the most popular antioxidant-rich foods such as fruits, vegetables, legumes, olive oil, red wine, green tea and nuts. In this sense, the MD, found that consumption of legumes, olive oil and red wine was associated with lower prevalence of MetS [38]. On the other hand, in a study antioxidant supplementations to subjects have showed no benefits on the incidence of MetS. However, baseline serum antioxidant concentrations of β-carotene and vitamin C were negatively associated with the risk of MetS [23]. Positive results have been also described, concretely an individual flavonoid supplementation (quercetin) in 93 obese and overweight subjects with MetS traits decreased systolic blood pressure, HDL-C concentrations and plasma oxidized LDL concentrations, while cholesterol, TGs and some inflammatory markers remained unaltered [39]. Nowdays, interest in natural herbal supplements is growing rapidly. Human studies have shown that caffeine and green tea catechins may improve weight loss as well as weight maintenance through their effects on thermogenesis and fat oxidation. One study investigated the role of a green tea–caffeine mixture on weight maintenance after a period of body weight loss and found weight stability to be improved in comparison with patients that did not eat the mixture [12].

Green tea is naturally rich in a group of antioxidants known as catechins. A number of studies including green tea and other foods with high antioxidant content indicate that their bioactive components confer a protective effect against coronary heart disease. Tea catechins reduce the serum cholesterol concentrations and suppress postprandial hypertriacylglycerolemia in animal and human experimental studies. Thus, it has been suggested that green tea may contribute in the prevention of MetS [40].

Overall, antioxidant supplementation is still a controversial issue, however, there is a full agreement that a high antioxidant (no supplemented) diet based on a combination of high antioxidant foods is able to improve the benefits of weight loss alone, and especially in those patients with cardiovascular alterations and people with MetS features [23].

**Milk, dairy products and minerals**

In a Mediterranean diet work, low fat dairy consumption (but not whole-fat) was found to be associated with a lower risk of incident hypertension, even after control for several potential confounders such as age, sex, physical activity, BMI. Another study showed that dietary supplementation with whole-fat dairy products, compared to low-fat dairy, was associated with weight gain while no differential effects were observed for levels of blood pressure [41].

Many metabolic and dietary factors appear to influence the degree to which dairy affects metabolic syndrome parameters such as calcium (Ca) and vitamin D, BMI and age. Dairy products are the main source of dietary calcium (Ca) and different mechanisms have been proposed for explain the role of Ca in the risk for suffering MetS [23]. However, there are evidences that Ca provided as a food supplement or by fortification appears to decrease LDL-C and TG concentrations, as well as to increase HDL-C concentrations. The potential hypolipidemic mechanisms of calcium may occur via: (i) the inhibition of fat absorption accompanying an increased fecal fat excretion; (ii) inhibition of the absorption of bile acids; (iii) a calcium-induced increase in the conversion of cholesterol to bile acids [42].

Earlier intervention studies showed that skim milk or yogurt consumption might decrease plasma cholesterol levels, while whole milk had neither a hypo- nor hypercholesterolemia effect [42,43]. A possibility is that the intestinal bacteria can bind bile acids to cholesterol, resulting in an excretion of bile acid cholesterol complexes in the faces. Then this conformed, a published meta-analysis that dietary Ca has the potential to increase fecal fat excretion, which could be relevant for preventing weight (re)gain. However, some investigators did not find dietary Ca enrichment to have beneficial effects during a weight-loss process [12].

In addition to the effects on lipid profile, an inverse relationship between the MetS and dairy product intake might be mediated by Ca intake to some extent, mediated by its effect in reducing body weight and fat mass [44]. Dietary Ca could affect the body fat mass not only by increasing fecal fat excretion but also by stimulating lipolysis and inhibiting lipogenesis, which is stimulated in high dietary calcium. In...
addition, Ca could partly account for the observed inverse association between dairy consumption and the risk of hypertension. Also, it has been suggested that some peptides (containing up to 10 amino acids) produced as a result of dairy fermentation or during the digestive process could have angiotensin converting enzyme (ACE)-inhibitory and endothelia release-inhibitory activity [45]. However, the antihypertensive potential of the peptides requires that they reach target sites without being degraded and inactivated by intestinal or plasma peptidases [23].

There is another theory about the dietary Ca on the regulation of energy metabolism and obesity risk. A nutritional intervention trial demonstrated that higher low-fat dairy intake among overweight type-2 diabetic patients on is caloric-restricted regimens enhances the weight-loss process. The proposed mechanisms are primarily mediated by circulating calcitriol. The increased calcitriol produced in response to low-calcium diets stimulates adiposity Ca2+ influx and, promotes adiposity, while higher calcium diets inhibit lipogenesis, stimulate lipolysis, lipid oxidation and thermo genesis, and inhibit diet-induced obesity in mice [12]. The Atherosclerosis Risk in Communities (ARIC) study also revealed that dairy consumption was inversely associated with incident MetS [46].

Legumes

Legumes are the good sources of vegetables protein, besides a high nutritive value, contain significant quantity of polyphenolic compounds such as flavonoids, isoflavones, phenolic acids and lignans. Epidemiological studies have found inverse associations between legume consumption and CVD [47]. It is known that soy consumption reduced plasma malondialdehyde (MDA) levels and increased total plasma antioxidant capacity (TAC) in postmenopausal women with MetS. It is also concluded that soy isoflavones significantly reduce total and LDL-C. It is not only soy consumption has some benefits on metabolic alterations, but also, the other legumes, such as beans, lentils, chickpeas, etc, have improved cardiovascular risk factors and oxidative stress markers [48]. The other benefits of them to help lost weight improved their plasma antioxidant capacity and decreased the oxidized LDL concentration and cholesterol levels (total and LDL-C) as well as gives the higher satiety effect. Thus, currently, these kinds of foods are considered relevant components of a healthy diet because of their important benefits on CVD manifestations [23].

Red wine

Wine is one of the MD drinks that have resveratrol which is a polyphenolic compound found in grapes and red wine. Resveratrol has some potential therapeutic implications such as anti-inflammatory, antioxidant, cardio-protective, anti-ageing actions and beneficial properties against metabolic diseases [49]. In animal studies have shown that resveratrol is able to protect against the metabolic changes associated with hyper caloric diets. It has been claimed that resveratrol able to prevent also MetS. Moreover, it has been also suggested that resveratrol exerts its multiple protective effects against the MetSthrough stimulating AMP-activated protein kinase and promoting mitochondrial biogenesis [50]. A short intervention study was carried out to determine the in vivo effects of the red wine consumption (400 ml/day for 2 weeks) where increases in total plasma antioxidant capacity and decreases in oxidative stress markers (plasma MDA and glutathione) were found. At the endpoint, the supplemented group showed beneficial effects on lipid and lipoprotein metabolism, oxidative stress and inflammatory markers in both pre- and postmenopausal women [51].

Another randomized crossover trial compared the effect of gin with red wine intake, showing greater antioxidant effect for the red wine consumption. However, in spite of most findings about resveratrol are positive, a recent animal study showed that this micronutrient supplementation significantly increased homocysteine levels and negatively affected HDL metabolism [23].

Potassium and magnesium

The mainly dietary sources of magnesium (Mg) intake include whole grains, legumes, nuts, and green leafy vegetables that are all of them including in MD. Low Mg intake and low Mg status have been associated with a higher prevalence of MetS so inadequate Mg consumption is related with glucose and insulin metabolism impairment [52]. Experimental and clinical studies suggest that Mg intake may be inversely related to the risk of hypertension and type 2 diabetes mellitus, and may decrease blood TG and increase HDL-C levels [12].

Other dietary micronutrient that has been used in the treatment of obesity and some metabolic disorders together with Mg is potassium (K). Both minerals are main components of the DASH diet, which has been designed as an anti-hypertensive treatment [53]. This diet basically consists of high fruit, vegetable, and low-fat dairy content and is designed to be lower in total fat, saturated fat, and cholesterol and abundant in nutrients such as magnesium, calcium, and protein. Some data suggest that higher K and Mg intake could favor decreases in blood pressure. Thus, high levels of K, Mg, and Ca seem to have a beneficial effect on the weight loss process as well as on metabolic diseases. Indeed, some nutritional intervention studies have found the DASH diet to be more effective for weight loss and metabolic variables than other conventional diets [54].

Prevention of metabolic syndrome

Among several contributing factors that influence the prevalence of MetS, between them dietary habits play an essential role and accordingly, several studies have assessed the impact of dietary habits on the risk of MetS [13].

Lifestyle interventions, including dietary changes and physical activity, play a crucial role in the prevention of MetS condition. Diets rich in whole grain cereals, fruits, and vegetables, with low animal-fat consumption, seem to confer the prevention of CVD risk factors, like hypertension, hypercholesterolemia, and obesity and MetS as well [8].

1. Weight control by caloric restriction, particularly of lipogenic substrates, improves insulin sensitivity and reduces liver fat accumulation. Excessive fatty acid derivatives interfere with hepatic insulin signal transduction, by altering dietary modification chance hepatic substrate availability, thus reducing risk for MetS [55,56].

2. Reduction in hepatic substrate flux: by reducing the rate of substrate absorption and resultant liver metabolic capacity, the serum glucose rise and subsequent insulin response can be attenuated. This can be done by reducing glyceric load, which is by increasing the fiber content of food. Increased dietary fiber intake can be also reduced lipogenesis and hepatic lipid export [57].

3. Increase in substrate clearance: by increasing hepatic mitochondrial substrate metabolism. This can be directly
accomplished by exercise. By stimulating the sympathetic nervous system and exercise causes to increase mitochondrial efficiency thus mitochondrial biogenesis in liver and muscles. The age of the mitochondria is relevant because new mitochondria are more efficient, generating fewer ROS. Exercise also burns acetyl-CoA and prevents the buildup of fatty acids, which improves insulin sensitivity in the liver and muscles [3].

In conclusion, supplementation of an individual healthy and balance diet such as MD with daily serving of nuts, olive-olive oil, vegetables and fruit meal (especially fish, poultry) and the other essential dietary compounds, plus daily or three times in a week exercise, will be improved healthy life and prevent MS risk of people [5].

References


