



Major approaches to the mediterranean diet and metabolic syndrome: a concise systematic review

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Abstract

Introduction: Metabolic syndrome is the association of chronic diseases related to diet and physical activity. Also recognized as a complex entity that associates well-established cardiovascular risk factors, such as hypertension, hypercholesterolemia, and diabetes, among others, with central fat deposition and insulin resistance. Currently, Metabolic Syndrome has gained disturbing dimensions within clinical practice, becoming one of the greatest challenges at the beginning of this century. In contrast, the Mediterranean diet recognized by the combination of a tasty palate and nutritional benefits, in addition to the culture of its link between health and longevity is a strategy in the treatment of metabolic syndrome. Although there is no consensus on the most adequate nutritional strategy to treat Metabolic Syndrome (MS) in a way that reduces cardiovascular risk, recent studies show the efficacy of adopting healthy lifestyles capable of reversing this trend. **Objective:** To address the role of diet in MS therapy, with a primary focus on the interaction of the benefits of different nutritional interventions in the remission of MS, contributing to the integration of the current evidence in the preexisting context. **Methods:** The model followed for the systematic review was PRISMA. The search strategy was carried out in the databases PubMed, Embase, Ovid and Cochrane Library, Web Of Science, Science Direct Journals (Elsevier), Scopus (Elsevier), and OneFile (Gale), from September to November 2022, with articles in the last years. **Results and Conclusion:** In light of the studies carried out in the research it was found that the Mediterranean diet has shown benefits in the secondary prevention of this syndrome, although the underlying

mechanisms are not completely clear. It is important to revitalize and apply this diet in the future in terms of preventive and therapeutic guidelines.

Keywords: Mediterranean diet. Metabolic syndrome. Nutritional therapy. Prevention. Control.

Introduction

Diets are always in fashion and are reinvented according to the nutritional deficiencies or needs of each individual in terms of health and aesthetics in general. In this sense, the search for weight loss is one of the constants that affect the population to solve the problem that is obesity. Excessive weight gain generates comorbidities that many of which are characterized as metabolic syndrome, in which the individual, to be diagnosed, must have three or more metabolic or anthropometric alterations such as increased waist circumference, systemic arterial hypertension, hyperglycemia, hypertriglyceridemia and reduction in serum levels of HDL [1].

It is important to highlight the association of MS (metabolic syndrome) with cardiovascular disease, increasing overall mortality by approximately 1.5 times and cardiovascular mortality by approximately 2.5 times [2]. As a primary measure for coping with the alterations that trigger MS, the practice of physical activities, the reduction of caloric intake, and the reduction of body weight are found. These factors directly influence the stability of blood pressure as well as the reduction of cholesterol and blood glucose levels and the reduction of waist circumference.

According to Mathai [3], correctly planning food to prepare balanced meals is an important factor in

regulating these rates. The combination of protein, fat, and carbohydrates during different meals or snacks allows better control of blood glucose levels and less insulin release than that seen when eating only meals or snacks consisting mainly of carbohydrates. However, there is no consensus on the most appropriate nutritional strategy to treat MS. Although current proposals are related to behavioral changes such as changing eating habits and physical activity, nutritional recommendations can be established by healthy patients or patients with isolated alterations and have different results, since genetic and cultural history must be considered. of each individual. The diet to be beneficial for most patients with MS must include fruits, vegetables, dry legumes, cereals, unsaturated fat (mono and polyunsaturated), and low-fat dairy products in adequate amounts [1].

In this sense, the Mediterranean diet presents itself as the main therapeutic proposal in the treatment of MS, since it corresponds to caloric limitations without altering the adequate nutritional status of the patient. According to Salas et al. [4], the traditional Mediterranean diet is characterized by a high intake of cereals, vegetables, fruits, and olive oil; a moderate intake of fish and alcohol, especially wine; and a low intake of dairy products, meats, and sweets. The Mediterranean diet has a high content of unsaturated fat since olive oil is used abundantly in cooking. Dried fruits, too, with a high content of unsaturated fat are foods commonly consumed in the Mediterranean diet. Evidence from epidemiological and clinical studies indicates that regular intake of nuts can have a positive effect on adiposity, insulin resistance, and other metabolic disorders related to MetS [4,5].

Thus, the present study addressed the Mediterranean diet as a therapeutic proposal in the treatment and prevention of metabolic syndrome and evaluated its effectiveness as a nutritional benefit in quality of life.

Methods

Study Design

The present study followed a concise systematic review model, following the systematic review rules - PRISMA (Transparent reporting of systematic review and meta-analysis: [//www.prisma-statement.org/](http://www.prisma-statement.org/)).

Search Strategy, Study Quality and Risk of Bias

The literary search process was carried out from September to November 2022 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, addressing scientific articles from various eras to the present day. The descriptors (MeSH Terms) were

used: *Mediterranean diet. Metabolic syndrome. Nutritional therapy. Prevention. Control*, and using the Boolean "and" between MeSH terms and "or" between historical findings.

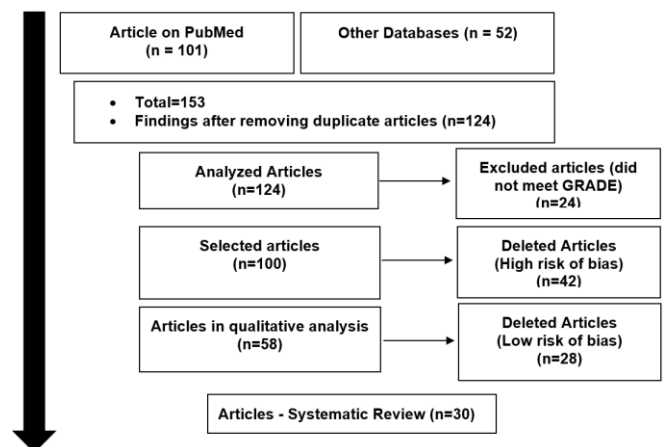
Quality was rated as high, moderate, low, or very low for risk of bias, clarity of comparisons, accuracy, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analysis of randomized clinical trials, followed by randomized clinical trials. The low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument through the analysis of the Funnel Plot graph (Sample size versus Effect size), using Cohen's test (d).

Results and Discussion

Summary of Findings

As a corollary of the literary search system, a total of 153 articles were found that were submitted to the eligibility analysis and, then, 30 of the 58 final studies were selected to compose the results of this systematic review. The listed studies showed medium to high quality (Figure 1), considering in the first instance the level of scientific evidence of studies in types of study such as meta-analysis, consensus, randomized clinical trial, prospective and observational. The biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies showed homogeneity in their results, with $X^2=95.4\%>50\%$. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 42 studies with a high risk of bias and 24 studies that did not meet GRADE.

Figure 1. Flowchart showing the article selection process.



Major Findings And Considerations Metabolic Syndrome (MS)

MS is made up of a set of metabolic abnormalities,

of which insulin resistance (IR) stands out [6]. The most relevant individual components of the metabolic syndrome and possible interventions for them are described below, highlighting the preventive measures related to food.

❖ Obesity

Obesity, now known as an "epidemic" disease, is considered by the National Cholesterol Education Program's Adult Treatment Panel III (NCEP ATP III) as the main reason for the increase in the prevalence of MetS; it contributes to high blood pressure, low HDL, high cholesterol and hyperglycemia; factors that are associated with a higher cardiovascular risk [6,7]. As a primary intervention measure, dietary approaches are adopted that may vary in the prescription of total energy value and macronutrients. However, the decrease in daily energy intake is the most important determinant of effective weight loss. It should be remembered that the association of diet with physical activity increases weight loss and decreases abdominal fat [7].

❖ Blood Pressure

Blood pressure as a component of metabolic syndrome is a factor that increases the likelihood of cardiovascular disease as well as cardiovascular and renal morbidity and mortality. Among the environmental factors that are related to blood pressure levels, diet seems to play an important role in both the prevention and treatment of systemic arterial hypertension [5].

❖ Hypertriglyceridemia

Hypertriglyceridemia results from the elevation of lipoproteins responsible for transporting triglycerides and is slightly associated with obesity. The reduction of triglyceride levels can be achieved by reducing the consumption of fast-absorbing carbohydrates, as well as the consumption of omega-3 fatty acids derived from saltwater fish [8].

❖ Hyperglycemia

Hyperglycemia is defined as altered fasting glucose, impaired glucose tolerance, or type 2 diabetes mellitus (DM). Diets that take into account the glycemic index (GI) of foods are among the current proposals for managing hyperglycemia, especially for patients with DM. Among these proposals, the high consumption of fibers stands out, particularly soluble fibers, which have beneficial effects on the metabolism of glucose and lipids [5].

The prevalence of MS in the world reaches worrying percentages. In the United States it is

estimated at 24%, and above 60 years of age this figure rises to 43.5%. In general, the prevalence of MS has been increasing and these findings are associated with the epidemic of obesity and diabetes mellitus [9].

Despite the data sending an alert to society, there are still few studies that report the statistics of the syndrome in some countries and, therefore, further studies on the prevalence of MS that prioritize awareness and its risks are necessary. However, studies in different populations, such as Mexican, North American and Asian, reveal high prevalence of MS, depending on the criteria used and the characteristics of the population studied, rates ranging from 12.4% to 28.5% in men and from 10.7% to 40.5% in women [9,10].

Studies carried out by DiBello et al. [11] found that a more modern dietary pattern associated with a high intake of processed and refined foods, including rice, potato chips and pancakes, was positively associated with the presence of MetS. Accordingly, Noel et al. [12] identified that a traditional dietary pattern rich in rice, beans and fat, and sweets high in sugar, sugary drinks and dairy desserts was associated with a greater probability of having MetS and low concentrations of HDL-cholesterol. In this context, the Mediterranean diet has been presented as the main element in the treatment of MS.

Mediterranean Diet

The Mediterranean region is made up of parts of three continents. The countries of Europe - Italy, Spain, Greece, Yugoslavia, France and Albania; from Africa - Egypt, Libya, Tunisia, Algeria and Morocco; and Asia - Turkey, Israel, Syria and Lebanon represent the region bathed by the Mediterranean Sea. Despite the great cultural, social and economic differences between these countries, certain geographical elements in common, such as relief, climate, soil and hydrography, influenced agriculture and, consequently, eating habits, making them co-founders of Mediterranean cuisine [13].

From the middle of the 20th century, researchers identified the epidemic of cardiovascular diseases in industrialized countries. However, in research, their incidence was much lower on the island of Crete, located in the Mediterranean [14]. This incidence is probably due to the use of monounsaturated fatty acids, such as olive oil, by the population. Several studies seek to confirm singularities and establish the benefits of Mediterranean food [15].

Recognized gastronomically and nutritionally for the great combination of tasty taste and healthy effects on the body, the Mediterranean diet is propagated as an ideal diet model. Formed by the climate and agricultural

tradition of the region, it is composed of a high consumption of vegetables, fruits, cereals, legumes, oilseeds, fish, olive oil, wine and a low intake of animal products, simple sugars and saturated fats [16].

In this context, the traditional Mediterranean diet is known for the health and longevity benefits it provides. It is characterized by a high intake of unsaturated fat, since olive oil is used abundantly in cooking. Dried fruits, too, with a high content of unsaturated fat are foods commonly consumed in the Mediterranean diet. Evidence from epidemiological and clinical studies indicates that regular intake of nuts may have a positive effect on adiposity, insulin resistance, and other metabolic disorders related to MetS [6,14].

Results of a review carried out by Babio et al. [17] indicated that a healthy eating pattern characterized mainly by high consumption of vegetables, fruits, nuts, olive oil, legumes and fish; moderate in alcohol, and reduced in red meat, processed meat, refined carbohydrates and high-fat dairy products is beneficial for individuals at increased risk of MS or individuals with MS.

Also, Gouveri et al. [18], in a multivariate analysis, revealed that the Mediterranean diet is associated with a 20% reduction in MS (odds ratio: 0.80; 95%CI: 0.65-0.98), after adjustment for age, sex, smoking, light physical activity, LDL-cholesterol and γ -glutamyl transferase concentrations, diabetes, cardiovascular disease, family history of hypertension, and/or hyperlipidemia.

In 1993, the World Health Organization (WHO) and the Oldways Preservation & Exchange Trust, together with researchers from the Center for Nutritional Epidemiology at Harvard, promoted the development of food guides in the form of pyramids. In this conference, the food pyramid of the Mediterranean Diet was organized, which is based on dietary patterns existing in the 1960s, typical of the Island of Crete [19].

The basis of the Mediterranean food pyramid is formed by whole grains and olive oil, which can be consumed daily. Next, the food groups are represented by vegetables and fruits. Above, pulses, nuts, and cooked vegetables. Near the apex of the pyramid are eggs, fish and seafood, poultry, milk, and derivatives, which should be consumed a few times a week. At the top of the pyramid, are red meat, simple sugars, and saturated fats, which should not be consumed more than once a month. This population has a habit of regular physical activity, consumption of water in abundance, and wine moderately [14]. Thus, the Mediterranean diet spreads as a health perspective, when adopted correctly followed by habits of physical activity and disassociated from tobacco and tobacco.

alcohol in excess, and has satisfactory results in a quality of life as well as in the prevention of diseases that constitute metabolic syndrome.

Diet versus Benefits

The word diet is of Greek origin and means lifestyle. Despite socially representing deprivation and renunciation, the term expresses the connection between man and the region in which he lives. The diet present in Mediterranean countries seems to give the population a connection with health and longevity [16].

By following the dietary principles that the diet suggests, it is possible to benefit as well as prevent many factors that trigger the metabolic syndrome. The Mediterranean diet has shown several benefits, both in the development of MS [20] and in terms of its components. In a meta-analysis of 50 randomized and controlled studies, involving a total of 534,906 participants, Kastorini [21] found a significant decrease in the risk of MS in individuals adhering to the diet, with a reduction in waist circumference, blood glucose, triglycerides, systolic blood pressure, and diastolic pressure, and increased levels of HDL-c when compared with other diets.

As for the factors of the dietary pattern that are rich in fruits and vegetables; moderate in low-fat dairy products; and low animal protein content, but with a substantial amount of vegetable protein, from legumes and dried fruits, are active in reducing both systolic and diastolic pressure between hypertensive and normotensive individuals. In addition, diet is associated with a lower risk of cardiovascular disease and MS [17].

The association of a good food plan and the regulation of physical activity practices are entirely related to the benefits against MS [22]. It has been proven that this association causes a significant reduction in abdominal circumference and visceral fat, significantly improves insulin sensitivity, decreases plasma glucose levels [23], and may prevent and delay the onset of type 2 diabetes a significant reduction in blood pressure and triglyceride levels, with an increase in HDL-cholesterol [18].

Treatment and Prevention of the Metabolic Syndrome

The treatment of MS aims to improve resistance to insulin action. In this sense, weight loss represents the basis for treatment, as it improves insulin sensitivity, reducing the risk of cardiovascular complications [24-26].

According to Salas [6], the main focus for patients with MS is the control of individual cardiovascular risk factors, which can be achieved through changes in

lifestyle, including dietary intervention. A balanced caloric intake is recommended, which, associated with physical activity, allows for reaching and/or maintaining the ideal weight. In this sense, it can be stated that carrying out an eating plan for weight reduction, associated with physical exercise is considered the first-choice therapy for the treatment of patients with metabolic syndrome [24].

As for prevention, the ideal is to adhere to healthy eating practices, since obesity and IR play a central role in the pathogenesis of MS, all strategies that are used to improve them seem to be effective in their prevention and therapy.

Maintaining a moderate to a high level of physical activity and/or limiting sedentary activities, especially in children, is one of the points of interest in the prevention or treatment of MS3. However, it is important to correctly promote physical activity, as there is a positive association between its practice and the reduction of body fat and RI [12].

Given the exposure to MS, the urgency to act immediately and effectively to prevent the growing trend that this problem tends to maintain becomes notorious since the proportion of children and young people who present it is worrying. Thus, lifestyle changes are undoubtedly necessary to minimize this problem and they necessarily involve increasing the practice of physical exercises and the consequent decrease in sedentary activities (watching television, playing computer games, using cell phones, etc.) [25].

Changes in the diet, especially in this age group, are essential, since high-energy-density foods are often used, which end up providing a lot of calories; other measures must be taken, such as the use of drugs or other types of more specific treatments, when the objectives are not at all achieved only with the lifestyle changes mentioned above [25-27]. It has been proven that even slight reductions in body weight greatly improve the components of MS and, as almost all individuals who suffer from it are overweight or even obese, perhaps starting a diet that suits your health and lifestyle problems, is a good starting point [28-30].

Conclusion

The present review addressed the beneficial effects of the Mediterranean diet in reducing the prevalence of metabolic syndrome, therefore, the dietary pattern described in the Mediterranean diet added to physical activities can be used as useful clinical tools in the treatment of metabolic syndrome. In addition, the suggested menu, with foods rich in fiber, is associated with a reduction in cardiovascular risk and, therefore,

the Mediterranean diet is recognized as an agent for promoting health and preventing obesity. In this sense, it is verified that dietary factors can play a fundamental role both in the individual components and in the prevention and control of metabolic syndrome. Recent data associate the presence of metabolic syndrome with lower consumption of whole grains, fruits, and vegetables. Therefore, there is a close relationship between these foods and dietary fiber, and, likely, soluble fiber is more directly related to these effects.

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Ethical Approval

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Informed consent

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

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