

THE IMPORTANCE OF THE MEDITERRANEAN DIET IN THE PREVENTION OF CARDIOVASCULAR DISEASES

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Summary: Cardiovascular diseases (CVD) are a heterogeneous group of diseases, with a leading share in morbidity and mortality worldwide. The rapid upward trend of these diseases requires preventive measures aimed at reducing cardiovascular risk factors, among which unhealthy dietary trends are of particular importance.

In recent decades, cultural globalization and urbanization have led to lifestyle changes, which have been particularly reflected in unhealthy dietary trends that include a low intake of whole grains, fruit, fiber, legumes, nuts and seeds, omega-3 fatty acids, polyunsaturated fatty acids, vegetables, milk and calcium, and a high intake of sodium, trans fats, red or processed meat and sugar-sweetened beverages. This phenomenon has created the so-called “nutrition transition”, in which obesity, CVD and diet-related chronic diseases represent new challenges for public health systems.

An unhealthy diet is a modifiable risk factor for the development of CVD. In the prevention of this group of diseases, emphasis is placed on the importance of the Mediterranean dietary model, as the healthiest and most complete nutritional model, which contributes to a significant reduction in the incidence, prevalence and mortality of CVD.

Keywords: Mediterranean diet, cardiovascular diseases, prevention.

In the context of healthy eating habits, a dietary pattern inspired by the principles of the Mediterranean diet is associated with multiple health benefits, due to its protective effects against a wide range of chronic and metabolic diseases, including obesity, diabetes mellitus (DM), CVD, neurodegenerative diseases and cancer [1].

The term “Mediterranean diet” was introduced in the mid-1970s in the United States of America (USA) by Ancel Keys (1904–2004), one of the most prominent scientists of our time, and his wife Margaret Haney. In their publications, they were the first in the English-speaking world to demonstrate the value of the Mediterranean diet on the basis of their scientific research combined with culinary art. Thanks to their studies, the World Health Organization (WHO) was later encouraged to promote the Mediterranean diet in order to improve global health and to use the Mediterranean diet pyramid as a pedagogical tool illustrating its basic rules [2].

The Mediterranean diet was recognized as an “intangible cultural heritage of France and Italy, Greece, Spain and Morocco by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2010 [3]. The basis of

the Mediterranean diet is a balanced intake of nutrients (carbohydrates, proteins, fats, vitamins and minerals) that are rich in plant-based proteins, complex carbohydrates and fiber, monounsaturated fatty acids and polyunsaturated fatty acids [4]. The Mediterranean diet, which is based on the traditional diet of the Mediterranean countries, has a significant positive impact on health. It reduces the risk of a wide range of diseases, especially CVD, type 2 diabetes mellitus (T2DM), obesity and certain types of cancer [5]. The results of the conducted studies indicate that a two-point increase in the score of adherence to the Mediterranean diet determines a 9% reduction in total mortality, a 9% reduction in CVD mortality, a 6% reduction in the incidence of or mortality from neoplasms, and a 13% reduction in the incidence of Parkinson’s disease and Alzheimer’s disease [6]. This dietary regimen has favorable effects on the endocrine and metabolic balance, contributes to the regulation of insulin sensitivity, blood pressure, lipid profile, lipoprotein particles, oxidative stress, inflammation and the prevention of carotid atherosclerosis. Unsaturated fats and polyphenols, which characterize the Mediterranean diet, form the basis of CVD prevention, especially in dietary regimens rich in

vegetables, showing lower levels of total cholesterol and lower levels of systolic blood pressure. Also, this dietary regimen has favorable effects in reducing glycoxidative damage and the inflammatory response, compared with a diet based on the consumption of saturated fatty acids [7].

Assessing the impact of Mediterranean food choices on the serum metabolic profile in healthy adolescents performing physical activity of different intensity levels, it was shown that active subjects who consume typical Mediterranean food have a better serum metabolic profile, which suggests that adherence to the Mediterranean pattern and the performance of physical activity lead to a significant reduction in the glucose and lipid profile, thus making the Mediterranean diet and physical activity a winning combination for health status [8].

Conducted studies have shown that practicing the Mediterranean diet is a significant factor in the prevention of malignant diseases. In persons who practiced this dietary regimen, an increase in the plasma concentration of several binding proteins was recorded, such as insulin-like growth factor binding protein (IGFBP)-1, IGFBP-2 and sex hormone-binding globulin,

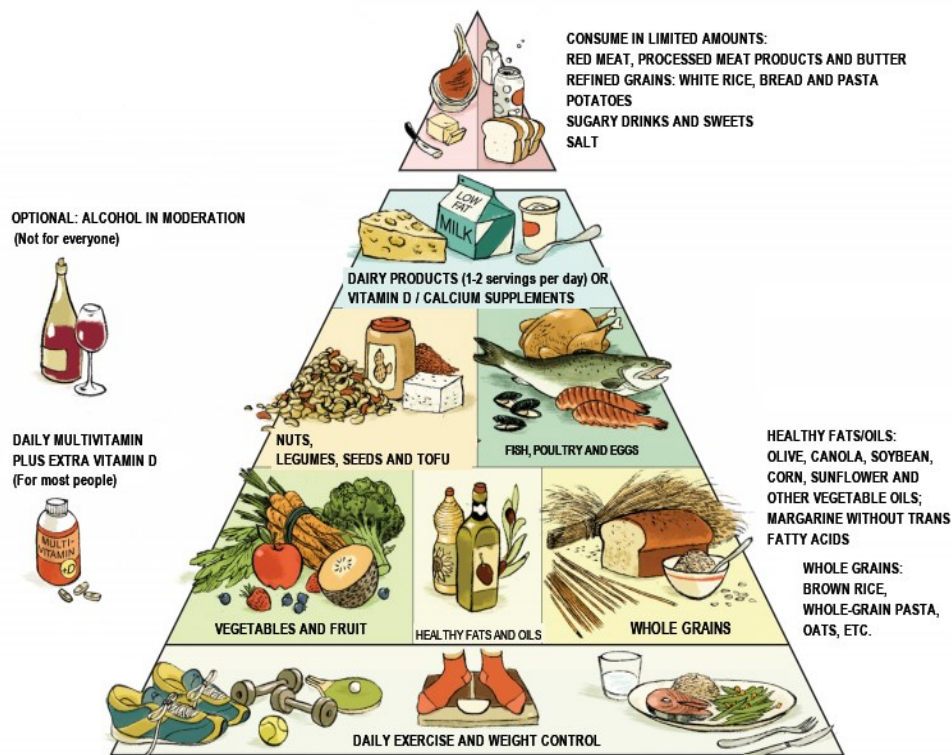
which resulted in a reduction in the biological activity of IGF-1, testosterone and estradiol. Insulin, estrogens, androgens and IGF-1 are powerful cellular mitogens, associated with the development and growth of several tumors, including cancer of the breast, colon, prostate, pancreas and endometrium [9].

The Mediterranean diet pyramid

The Mediterranean diet pyramid is representative of the Mediterranean diet and was developed on the basis of the dietary habits of long-lived adults in the Mediterranean region. The pyramid follows general guidelines on the choice of foods, but does not prescribe their exact quantity. Nutritionists, sociologists, anthropologists and farmers have collectively contributed to the development of what we currently call the Mediterranean diet, adapting the pyramid to the new lifestyle of the Mediterranean region [10]. The Mediterranean diet pyramid (Figure 1.) includes ingredients from all food groups in appropriate proportions and frequencies and is intended for the generally healthy adult population. However, it is flexible enough to also meet the needs of pregnant women, children and people with various pathophysiological conditions [11].

Figure 1. The Mediterranean diet pyramid

Source: <https://dijetapro.org/wp-content/uploads/2015/12/piramida-1-1.png>



Cereals form the basis of the Mediterranean diet, providing calories, macronutrients, micronutrients, dietary fiber, minerals and a multitude of phytochemicals. These nutritional factors are necessary for the homeostasis of human metabolism and the function of multiple organs. The intake of cereals, especially whole grains, contributes to the preservation of health and the prevention of CVD, cerebrovascular disorders, DM, malignant diseases and a reduction in the rate of total mortality [12]. In the context of preserving the cardiovascular and cerebral systems, regular intake of cereals reduces the risk of coronary heart disease, myocardial infarction, heart failure, small- and large-vessel stroke and ischemic stroke [13]. They achieve their cardioprotective potential by lowering blood pressure, total cholesterol and low-density lipoprotein cholesterol and by regulating glucose levels [14]. Regular use of cereals in the diet also exhibits antioncogenic potential, especially in tumors of the gastrointestinal tract. This antioncogenic potential is particularly manifested by a reduced risk of pancreatic cancer in middle-aged men [15]. Conducted studies point to the importance of cereals, especially rice, for maintaining ideal weight and preventing obesity. Rice achieves its anti-obesity effect through its influence on vascular function and on the condition of the liver and pancreas, by reducing adipocyte hypertrophy and lipid accumulation, whereby the inflammatory and antioxidant systems are improved and fecal elimination of cholesterol is increased. It exerts particularly protective effects at the level of the host microbiota and contributes to the restoration of eubiosis [16]. An optimal daily intake of cereals in the range of 3 to 7 servings per day, which is equivalent to 90 to 210 g of whole-grain products, is associated with the lowest risk of mortality from all causes, coronary heart disease, T2DM and colorectal cancer [17]. Pasta is made from refined grains, which may contribute to its perception as "fattening", but unlike many other refined grains, the unique structure of pasta makes it a carbohydrate with a low glycemic index. Low glycemic index/load diets have been shown to be beneficial for weight loss or weight maintenance in adults and children, even when the low glycemic index diet includes pasta [18]. Bread is an integral part of the diet worldwide, with a significant contribution to key nutrients. Although evidence

on the impact of bread consumption on health is still lacking and depends on the overall diet, whole-grain breads have shown consistent beneficial effects on human health [19]. Bread provides several nutrients such as sugar, proteins, iron, calcium and various vitamins. An average daily intake of 300 g of bread can provide the nutrients needed by the body and create the desired nutritional status. Bread can provide 1,2% of protein, 60% of thiamine and niacin, 40% of calcium and 80% of the daily iron requirement of an adult [20].

According to WHO recommendations, consuming adequate amounts of fruit and vegetables is one of the basic elements of a healthy diet, which reduces the risk of chronic non-communicable diseases and ensures an optimal daily intake of dietary fiber [21]. The importance of fruit and vegetables in the diet is reflected in the high percentage of fiber, minerals, vitamins and phytochemicals they contain [22]. These nutritional components have a favorable effect on the body through the regulation of oxidative stress, inflammatory processes and insulin resistance. The high fiber content of fruit and vegetables has a favorable effect on the regulation of cholesterol levels and arterial blood pressure [23]. The consumption of vegetables, as well as the combination of fruit and vegetables, has a favorable effect on reducing the risk of metabolically unhealthy obesity, especially in young people who are obese. In a study conducted by Guedes et al. [24], in a population of university students, it was found that inadequate intake of fruit and vegetables was present in 87% of respondents, with a prevalence of overweight of over 39%, whereby the risk of overweight was two to three times higher in respondents who did not have an adequate intake of fruit and vegetables. In recent years, it has been established that the consumption of fruit and vegetables has a preventive effect against certain types of cancer, especially gastrointestinal cancers, due to their high content of fiber and antioxidants. In a large meta-analysis of cohort studies, increased consumption of fruit alone and in combination with vegetables corresponds to a reduction in the probability of gastric cancer by 13% and 25% [25]. The recommended daily intake is at least 200 g of fruit and 150-200 g of vegetables, i.e. at least 1-2 servings of fruit and 3-4 servings of vegetables per day. Consumption of phytosaccharides (>450 g/day) and fruit intake

reduce the risk of CVD by 14,2% and 6,7% [26-28].

Olive oil is located at the center of the Mediterranean diet pyramid. It is an ideal source of monounsaturated fats, vitamin E, polyphenols, chlorophyll and phytosterols, micronutrients that exert numerous benefits on the body, including anti-inflammatory, antioxidant, neuroprotective, anticancer, antidiabetic, antimicrobial and antisteatotic effects [29-30]. They exhibit a particular protective potential at the level of the cardiovascular system, because it contributes to the regulation of lipid status, blood pressure, insulin sensitivity and glycemic control. Olive oil shows great potential in the positive modulation of the composition of the gut microbiota and of microbially produced products, which is associated with the prevention of cardiometabolic diseases [31]. Daily use of olive oil in the diet can significantly reduce the risk of CVD, stroke and T2DM, but also of overall mortality. The maximum benefit can be achieved by consuming between 20 and 30 g per day. In a study conducted by Donat-Vargas et al., it was found that an additional intake of olive oil of 25g/day reduces the risk of CVD by 16% and the risk of T2DM by 22% [32].

According to the Mediterranean diet pyramid, milk and dairy products are foods whose consumption is recommended daily. Dairy products are rich in high-quality proteins, vitamins (riboflavin, vitamin D, vitamin B-12), calcium, potassium and magnesium, which are important for maintaining muscle mass, improving vascular function, bone mineralization and neuromuscular function, and contribute to overall cardiovascular health [33]. Fermented or cultured dairy products, such as yogurt, contain probiotic bacterial cultures that are assumed to reduce the production of trimethylamine-N-oxide, a metabolite that is an early predictor of metabolic syndrome, implicated as a cause of atherosclerosis and CVD [34]. The results of conducted studies suggest that the intake of fermented dairy products for every 20 g reduces the risk of the incidence of and mortality from CVD[35]. In studies conducted by Guo[36] et al. in 2021, and Lu Y. et al. in 2025 [37], it was found that the consumption of dairy products has a significant impact on reducing the incidence of hypertension and cerebrovascular diseases, and favorable effects on serum cholesterol, triacylglycerides and blood pressure. Daily

consumption of dairy products has a positive effect on anthropometric parameters, specifically on waist circumference, especially in women. Women who consume more than 1,9 servings of dairy products per day are 53% less likely to have a waist circumference greater than 80 cm [38].

Thanks to their rich bioactive composition, nuts exert numerous positive effects on the body. A high percentage of monounsaturated and polyunsaturated fatty acids, tocopherols and tocotrienols, phytosterols, sphingolipids, carotenoids, chlorophyll and alkyl phenols, and phenolic compounds (including flavonoids, phenolic acids, stilbenes, lignans) exert positive effects on the cardiovascular, central nervous, respiratory and endocrine systems, with a significant role in reducing the risk of developing malignant diseases [39]. A nut intake of the recommended 28 g/day is associated with a 21% reduction in the risk of CVD (including the incidence of and mortality from coronary heart disease, atrial fibrillation and stroke mortality), an 11% reduction in the risk of death from cancer and a 22% reduction in all-cause mortality [40]. Each increase in total nut consumption of 5 g/day is associated with a 3%, 6% and 25% lower risk of pancreatic and colon cancer [41]. Nut intake contributes to the regulation of all biochemical parameters associated with DM, including fasting glycemia, plasma insulin, glycated hemoglobin (HbA1c) and the oral glucose tolerance test (OGTT) [42].

The Mediterranean region has a rich fishing tradition, which results in significant fish consumption. Fish meat is rich in many polyunsaturated fatty acids that exert favorable effects on the cardiovascular system. Polyunsaturated fatty acids include long-chain Ω -3, especially eicosapentaenoic acid and docosahexaenoic acid, obtained primarily from fish and seafood, as well as alpha-linolenic acid, obtained from various plant sources. Polyunsaturated fatty acids exert a protective role on the cardiovascular system by increasing the level of high-density lipoproteins, reducing inflammatory factors, improving heart rhythm and blood pressure, regulating left ventricular diastolic filling and increasing vagal tone. [43]. Consumption of fish 3-4 times a week reduces the risk of developing coronary diseases by about 12%, while a lower weekly fish intake of about 100-150 g also reduces the risk of coronary diseases, but by a significantly smaller

percentage, of 4-7% [44]. In a study conducted by Mihan et al., the risk of CVD was lowest with a moderate amount of fish (i.e. at least 175 g/week, or approximately 2 servings/week), with no further apparent reduction in risk with a higher fish intake (i.e. >350 g/week, or >3-4 servings/week) [45].

From a nutritional point of view, meat contains all the essential amino acids (which makes it a complete protein), is rich in some key micronutrients, such as vitamin B12, iron, zinc, selenium, iodine and vitamin D, and also has non-negligible amounts of essential fatty acids, especially in the lean parts (e.g. monounsaturated fatty acids, long-chain omega-3 polyunsaturated fatty acids, as well as conjugated linoleic acid) [46]. White meat, which differs in its nutritional composition from red meat in terms of a lower percentage of fat and iron, has a favorable effect on health. White meat achieves its favorable effect on the body by reducing the risk of developing CVD, DM, stroke, cancer, as well as all-cause mortality [47]. Potentially beneficial effects are achieved if fresh, unprocessed and lean white meat is used in the diet [48]. A particularly important effect of white meat is reflected in the prevention of cancer. Higher consumption of red meat is associated with an 84% increased risk of hepatocellular carcinoma, while white meat is associated with a 39% reduced risk; red meat consumption is associated with a higher risk of breast cancer, while the use of white meat in the diet can reduce this risk [49]. White meat also has a positive effect on body weight regulation, in terms of a favorable effect on the reduction of excess body weight, especially in women who are overweight or obese [50].

Eggs are a well-known source of dietary cholesterol, which is why their excessive use in the diet was disputed at the end of the last century. The American Heart Association (AHA), in its 2000 revision, recommended a cholesterol intake of less than 300 mg/day in order to reduce the increase in blood cholesterol, despite the lack of concrete evidence that egg consumption can cause elevated cholesterol levels. The latest Dietary Guidelines for Americans no longer set limits on egg consumption, but instead advocate egg consumption as part of a healthy diet [51]. An egg contains 177 mg of cholesterol, but only 1.3 g of saturated fat [52]. The lipids in egg yolks comprise a mixture of healthy unsaturated fatty

acids, including triglycerides, phospholipids, cholesterol, high-density lipoproteins (HDL), low-density lipoproteins (LDL) and very-low-density lipoproteins (VLDL). LDL makes up two thirds of the total yolk and is responsible for its emulsifying properties, while proteins provide essential amino acids. Egg yolks serve as a significant source of essential vitamins such as A, B2, B6, B12, biotin, folic acid, D, E and K, together with minerals such as calcium, zinc, iron, potassium, magnesium, iodine, fluoride, selenium and phosphorus. These vitamins and minerals play a key role in maintaining vision, contributing to bone and muscle growth, promoting well-being and strengthening immunity. In addition, they contain antioxidants such as lutein and zeaxanthin. The proteins found in eggs exert numerous beneficial effects on the body, which are reflected in the prevention of malnutrition, improvement of skeletal muscle function, and anti-infective, hypotensive, anticancer and anti-obesity properties [53]. When it comes to the potential protective effect on the cardiovascular system, the emphasis is placed on the amount of eggs consumed. The results of a study conducted by Godos et al. [54] revealed that a moderate egg intake (4/week) did not increase the risk of CVD, while a high egg intake (1/day) was associated with heart failure. Another study showed that a moderate egg intake (5-6 per week) was associated with a reduced risk of CVD, including a 26% lower risk of hemorrhagic stroke and a 12% lower risk of coronary heart disease [55].

The harmful effect of red meat on cardiovascular health has been widely demonstrated, primarily due to its higher content of saturated fatty acids and cholesterol. Red meat consumption is associated with the risk of CVD, primarily coronary heart disease, as well as with an increased risk of all-cause mortality. Reducing red meat intake by 3 servings per week reduces the risk of the incidence of acute myocardial infarction, stroke and T2DM [56]. Additional harmful factors accompanying the use of red meat in the diet are increased amounts of salt, nitrates and peroxynitrites, which can influence the development of atherosclerosis and vascular dysfunction, which are predictors of CVD, with a particular influence on the development of ischemic heart disease [57]. Red meat consumption is a risk factor for the development of hypertension. Replacing one serving per day

of red meat with white meat, fish, eggs or dairy products reduces the risk of developing hypertension by 8-15% [58].

A category of foods that, according to the guidelines of the Mediterranean diet, should be limited are sweets. Sweets and other sweetened foods have a high content of energy and added sugar, while their content of essential micronutrients is generally low [59]. The consumption of sweets has numerous negative health effects, including the risk of obesity, DM, CVD and hypertension. According to WHO recommendations, sugar consumption should be limited to less than 5% of total energy intake [60].

CONCLUSION

CVD continue to be the leading cause of morbidity and mortality in the world, with an unhealthy diet playing a significant role among changeable or modifiable risk factors. The modern lifestyle and changes in dietary habits have contributed to an increased frequency of obesity, diabetes mellitus and other metabolic disorders that form the basis for the development of CVD.

The Mediterranean diet is one of the best-studied and scientifically confirmed models

of healthy eating. Its basic characteristics include a high intake of whole grains, fruit, vegetables, legumes, nuts, olive oil and fish, with a moderate intake of dairy products, eggs and white meat, and limited consumption of red meat, industrially processed food and sweets. Numerous epidemiological, cohort and intervention studies have shown that adherence to the Mediterranean dietary pattern contributes to an improved lipid profile, regulation of arterial blood pressure, reduction of inflammation and oxidative stress, better glycemic control and a reduced risk of atherosclerotic changes.

The available scientific evidence indicates that the Mediterranean diet significantly reduces the incidence of and mortality from CVD, but also the risk of other chronic non-communicable diseases, including T2DM, obesity and certain malignant diseases. Therefore, its application can be considered one of the most effective non-pharmacological strategies in the primary and secondary prevention of cardiovascular diseases. Promoting the principles of the Mediterranean diet through public health programs, health education and everyday clinical practice can contribute to improving the health status of the population and reducing the burden of CVD

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