Journal of Health Study and Medicine
2021, No. 4
pp. 83–96
DOI 10.36145/JHSM2021.23

The Effect of a Plant-based Diets on the Cardiovascular System in Geriatric Patients – Review

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Abstract

Cardiovascular disease is one of the most common causes of death in developed countries and its incidence increases with age. The group of cardiovascular diseases includes different disease entities. Most of them are associated with the atherosclerotic process in the blood vessels. One of the most important methods of preventing atherosclerosis and its complications is proper nutrition, rich in polyunsaturated vegetable oils and low in saturated fatty acids. Many research results confirm the positive effect of a plant-based diet on the circulatory system. A well-balanced diet based on plant-based products reduces the risk of hypertension, heart disease, prevents type 2 diabetes, lowers cholesterol and helps to reduce blood pressure. Vegetarian eating patterns can reduce cardiovascular disease mortality by 30%. In addition, the plant-based diet is the only dietary pattern that has shown cessation and reversal of atherosclerotic plaque. Today, plant-based diets are becoming more popular and are increasingly used as a means of preventing and treating cardio-metabolic diseases.

Key words: *plant-based diet, cardiovascular disease, geriatric patient*

Introduction

Cardiovascular diseases (CVD) have been ones of the main causes of disability and mortality in the world population for years. CVDs are group of disorders whose development is most often based on atherosclerosis. It leads to reduction in the patency of blood vessels and even their complete closure. As a result of these pathological changes, blood flow to the brain or heart becomes obstructed. The development of atherosclerosis is especially dangerous because it can lead to ischemic heart cells. CVDs are chronic diseases that develop asymptomatically over a long period of time. Symptoms usually appear only in the advanced stage of the disease [1].

The frequency of their occurrence is influenced by many different factors. Modifiable risk factors are those that can be influenced by changing bad habits. These include smoking, obesity high blood cholesterol physical inactivity and hypertension. Non-modifiable risk factors are those that cannot be changed. These include gender, age and genetic burden. The dominant risk factors for CVD are advanced age and an improperly balanced diet, in which products are rich in saturated fat predominate [2, 3]. Currently, plant-based diets are gaining popularity and are increasingly used to prevent and treat cardio-metabolic diseases [4].

Definition and epidemiology

CVDs are a group of disorders relating to pathology of heart and blood vessels. According to the World Health Organization, this group includes coronary heart disease, cerebrovascular disease, congenital heart disease, peripheral arterial disease, rheumatic heart disease, deep vein thrombosis and pulmonary embolism. The most common cause of acute cases , including heart attack and stroke, is a blockage in the form of fatty deposits in the blood vessels. These deposits prevent the free flow of blood to the heart or brain [5].

CVDs are the most common causes of death among elderly people. It is estimated that by 2030, 20% of the population will be over the age of

65 years old [6]. The aging of the organism is the main, non-modifiable risk factor for these diseases. The latest research shows that in Europe 45% of deaths are caused by cardiovascular diseases. The epidemiological structure of these diseases is changing, but coronary heart disease is still the dominant one. Cerebrovascular disease is another serious and life-threatening disorder.

These two diseases are the most common causes of death from CVDs. They account for 20 and 11% of deaths, respectively [7]. Death rates from stroke and coronary heart disease are higher in Eastern and Central Europe than in Western, Northern and Southern Europe [8]. The percentage of deaths due to cardiovascular diseases is higher in women (49% of all deaths) than in men (40% of all deaths) [7].

Etiology of cardiovascular diseases

The most common cause of development for cardiovascular diseases is atherosclerosis. Even in the early years of the 20th century, atherosclerosis was perceived as an integral part of human aging [9]. Today, there is awareness, that the initiation and development of atherosclerosis depends on the lifestyle. Epidemiological studies have shown that the incidence of cardiovascular diseases and the number of deaths due to them are directly related to the risk factors of atherosclerosis [10]. The previously mentioned modifiable risk factors are responsible for 90% of the cardiac risk of the population and are independent of the region of the world, race, sex or age [11, 12]. These include smoking, dyslipidemia, hypertension, diabetes, visceral obesity, psychosocial factors, diet, alcohol consumption and physical activity.

Atherosclerosis is a chronic inflammatory disease of the arteries which consists of 1) endothelial dysfunction, 2) lipid storage in the endothelium, 3) accumulation of leukocytes and smooth muscle cells in the vessel wall, 4 formation of foam cells and 5) deposition of cell matrix fibers [11]. The undisputed cardiovascular risk factor is hypercholesterolaemia [13]. The risk of coronary artery disease is twice as high in a person with elevated levels of total cholesterol (240 mg/dl) than in a person with a concentration of 200 mg/dl. There is evidence that high plasma concentration of LDL cholesterol is the

cause of the onset and progression of atherosclerosis, and lowering the concentration reduces the risk of cardiovascular events [11]. Other abnormalities leading to the development of atherosclerosis are increased levels of very low density lipoproteins (VLDL), residual lipoproteins, lipoprotein [a] or decreased HDL levels [13]. The significance of elevated triglycerides as a risk factor for atherosclerosis is still unknown [10].

Pharmacotherapy of atherosclerosis

As part of the primary prevention of cardiovascular diseases, changes in lifestyle and, if necessary, pharmacological treatment should be pursued in the first place [14]. People with an existing disease, should eliminate or modified conventional risk and should implement pharmacotherapy. European Cardiac Society identifies 3 groups of drugs that improve the prognosis of coronary artery disease: anti-aggregation drugs, statins and angiotensin converting enzyme inhibitors.

Antiplatelet drugs significantly reduce the risk of vascular thrombosis. The most common standard is acetylsalicylic acid (ASA, acetylsalicylic acid) at a dose of 75–150 mg per day [15]. In some cases, the inhibitory purinergic P2Y receptor (P2Y12, an adenosine diphosphate receptor expressed by platelets) is also used in combination with aspirin [16].

The use of statins in patients has been shown to reduce the number of CVD events. The main benefits of using this group of drugs are the reduction of LDL cholesterol by up to half, depending on the type and dose of statin used [16]. This slows down and inhibits the development of atherosclerosis, and sometimes even leads to the regression of existing changes. Their additional advantage is improving the functioning of the endothelium, because of anti-inflammatory and anticoagulant activity [15].

Angiotensin converting enzyme (ACEI) inhibitors are being improved in patients with atherosclerosis and concomitant hypertension, diabetes or after a heart attack. This class of drugs blocks the conversion of angiotensin I to II. They have a beneficial effect on cell remodeling, as well as anti-arrhythmic and stabilizing effect on atherosclerotic plaque [15].

The impact of a plant-based diet on the cardiovascular system

Plant-based diets are characterized by the reduction or complete elimination of animal products. They are usually based on the consumption of vegetables, fruits, grains, nuts and legumes. Numerous studies have shown that following a diet rich in high-quality plant foods is associated with a reduced risk of cardiovascular complications in the elderly. Moreover, a vegetarian diet is the only dietary pattern that has shown resolution and reversal of atherosclerotic plaque in clinical trials [17, 18].

A well-balanced plant-based diet allows to lower abnormal lipid levels, helps to normalize blood pressure, fibrinogen levels and reduce overweight [19].

There are several biological mechanisms that may explain the beneficial cardiometabolic effects of this kind of diets. These are: lower calorie intake, decreased consumption of saturated fat and cholesterol, increased consumption of fiber, increased consumption of antioxidants and micronutrients, higher consumption of poly – and monounsaturated fatty acids, higher consumption of plant sterols [17, 20].

Plant-based diet and lipids

The lipidogram determines the concentration of triglycerides, total cholesterol, and low and high-density lipoproteins (LDL and HDL, respectively). The analysis of these indicators provides information on the state of lipid metabolism and metabolic disorders. As a result, it is possible to determine the risk of developing atherosclerosis and cardiovascular complications.

Clinical studies have shown that for every 1% decrease in LDL cholesterol, the risk of a serious cardiac event is reduced by approximately 1%. Diet modification and increased physical activity may lower LDL cholesterol up to 40%.

Consumption of saturated fat increases plasma LDL cholesterol, which is one of the major risk factors for coronary heart disease. Research shows that modification of eating habits and introducing a diet rich in polyunsaturated vegetable oils can reduce the risk of cardiovascular disease by improving the

lipid profile by up to 30%. The incidence of cardiovascular disease would decrease with a change of diet.

Moreover, recent studies have shown that dietary cholesterol increases the concentration of total and LDL cholesterol in the serum. Dietary cholesterol comes from animal products (meat, eggs, dairy). The use of a vegan diet can significantly reduce total and LDL cholesterol levels, which is directly related to a reduced risk of heart disease [17, 21, 22].

Plant-based diet and blood pressure

Systolic hypertension is an independent, well-documented risk factor for cardiovascular complications. It has also been proven that the amount of systolic blood pressure is a stronger prognostic indicator than the amount of diastolic pressure. Systolic hypertension increases cardiac mortality 3 times, stroke frequency 4 times and heart disease incidence 2,5 times [23].

A high intake of animal protein, especially meat, increases blood pressure. On the other hand, high potassium intake effectively lowers them, among people with hypertension. Plant-based diets are usually characterized by low fat intakes and high fiber and potassium intakes. Observational studies showed that people on plant-based diets had on average lower systolic blood pressure by 6.9 mm Hg, and diastolic blood pressure was lower by 4.7 mm Hg. It should be mentioned that the reduction took place independently of the use of non-pharmacological preventive methods, such as reducing salt intake, reducing the weight of patients, and increasing their physical activity [17]. A cross-sectional study of 11,004 British men and women by EPIC (European Prospective Investigation into Cancer) and Nutrition-Oxford found that among of 4 types of diets (carnivorous, pescatarian, vegetarian and vegan), veganism promotes the rarest occurrence of hypertension among patients. The mechanism by which plant-based diets lower blood pressure is not fully understood, but there are several hypotheses. These include 1) better vasodilation, 2) greater supply of antioxidants from the diet, 3) greater anti-inflammatory effect, 4) increased insulin sensitivity, 5) decreased blood viscosity, 6) changes in the RAA system and 7) sympathetic nervous system. It is also

possible that 8) modifications in the intestinal microbiota caused by plant diets are important [24]. Observational studies have shown correlations between the lower occurrence of hypertension in people with eating habits avoiding the consumption of animal products [25].

Overall, meta-analyzes, clinical and cross-sectional studies have shown strong evidence and benefits of a plant-based diet for hypertension.

Plant-based diet and glycemic control:

Type 2 diabetes has already gained the name of a civilization disease, rising all over the world, and has even gained the name of an epidemic of the 21st century. It affects people of all ages, and in Poland alone in 2018 the number of patients according to the NHF was 2.6 million [26]. Currently, there are approximately 415 million people with diabetes worldwide, and this number is expected to rise to 642 million by 2040 [27].

Plant diets are helpful in supporting the therapy of type 2 diabetes. Studies have shown reductions in drug use as well as significant improvement in performance in people who have adopted a plant-based diet and exercise. In type 2 diabetes, this allows to better control your blood glucose, even without exercise. This is due to factors such as weight loss as well as low blood lipids. Long-term studies also show that patients stay on a low-fat vegan diet longer than on a conventional caloric deficit diet [17, 28].

Observations have shown an association between inadequate blood glucose control and cardiovascular risk. Plant-based diets lower HbA1c (glycosylated hemoglobin) by 0.4 percentage points compared to conventional diets. This change alone reduces cardiovascular risk by approximately 6% [16, 17].

An additional mechanism that may affect better glycemic control are gastrointestinal hormones, especially incretins, whose action in type 2 diabetes is weakened. Plant-based diets can improve the release of these hormones [17]. Switching to a plant-based diet promotes greater consumption of products that reduce the risk of diabetes (e.g. grain fiber). It also excludes from the diet products that may contribute to the development of insulin resistance, like red meat [29]. In a 24-week randomized, controlled trial, patients on a vegetarian diet had better insulin sensitivity than patients on a conventional diabetic diet [30]. In addition, animal proteins have a greater effect on the

hemodynamics of the kidneys than plant proteins. Using only plant-based proteins in the diet may theoretically reduce the risk of developing kidney failure by reducing renal hyperfiltration and proteinuria [31].

In conclusion, a plant-based diet will not cure patients with type 2 diabetes but may have a beneficial effect on its control and prevention of associated cardiovascular events.

Discussion

According to epidemiological studies, one of the significant risk factors for the development of CVDs is advanced age, so with the aging of the world population, the incidence of these diseases is expected to increase [32]. Studies show that eating using a diet rich in high-quality plant products is associated with a reduction in CVD mortality and overall mortality [33, 34]. According to the latest publications, vegetarians have better cardiovascular outcomes compared to those on omnivorous diets, including a reduced risk of morbidity and mortality from ischemic heart disease, a reduced risk of developing type 2 diabetes, reduced cancer incidence and a reduced risk of metabolic syndrome [35, 36, 37]. Studies show that change of the eating habits and introducing a vegetarian diet is associated with an improvement in the lipid profile, including a reduction in total cholesterol, low-density lipoprotein cholesterol, and triglycerides [38, 39]. A well-balanced plant-based diet may be used as an effective therapeutic method to treat hypercholesterolaemia, hypertension and other CVDs risk factors, while reducing overall drug intake [40].

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