

Mediterranean, vegetarian and vegan diets as practical outtakes of EAS and ACC/AHA recommendations for lowering lipid profile

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Abstract: Reduction of total cholesterol (TC) and LDL fraction (LDL-C) may be beneficial towards decreasing the risk of development of cardiovascular diseases (CVD). First and foremost, before implementing or simultaneously with pharmacological treatment, patients should be informed about lifestyle changes that may be critical to achieving a better lipid profile. Recommendations from ACC/AHA (American College of Cardiology and American Heart Association) and EAS (European Atherosclerosis Society) mainly focus on limitation of saturated fatty acids (SFA) and trans fatty acids (TFA) consumption, but additional support could be considered. This review presents selected guidelines of European scientific societies concerning lipid metabolism disorders. The main aim of this manuscript was to present the guidelines how to provide simple and transparent schemes of management in dyslipidemia therapy. Encouraging patients for increasing the intake of soluble fiber (SF) and phytosterols (PS) may also be promoted for achieving therapeutic goals. In the clinical point of view, restoring an appropriate lipid profile is important because it directly reduces the risk of developing atherosclerotic cardiovascular disease (ASCVD). The EAS and ACC/AHA guidelines introduce several new demands, so far absent from previous recommendations. Mediterranean diet (MD) or vegetarian lifestyles are an example of diet patterns that are deliberated as healthy for cardio-vascular system, since both consist of fresh, unprocessed vegetables and fruits with addition of desirable fats.

Key words: cardiovascular diseases, nutrition, lipid profile, cholesterol, prevention

Received: 11 October, 2020; **revised:** 23 November, 2020; **accepted:** 02 December, 2020; **available on-line:** 05 February, 2021

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Abbreviations: ACC/AHA, American College of Cardiology and American Heart Association; ASCVD, atherosclerotic cardiovascular disease; CHD, coronary heart disease; CO, coconut oil; CVD, cardiovascular diseases; DF, dietary fiber; EAS, European Atherosclerosis Society; FA, fatty acids; GI, glycemic index; HDL, high-density lipoprotein; HMG-CoA, 3-hydroxy-3-methylglutaryl-coenzyme A; hsCRP, high sensitivity C-reactive protein; LC-SFA, long chain saturated fatty acids; LDL-C, low-density lipoprotein; LDLR, low density lipoprotein receptor; MC-SFA, medium chain saturated fatty acids; MD, Mediterranean diet; MUFA, monounsaturated fatty acids; PS, phytosterols; PUFA, polyunsaturated fatty acids; SF, soluble fiber; SFA, saturated fatty acids; TC, total cholesterol; TFA, trans fatty acids; TG, triacylglycerides; WHO, World Health Organization

INTRODUCTION

Cardiovascular diseases (CVD) are the main cause of death worldwide – it is estimated that nearly 45% of

all deaths in European population are caused by them (Michas *et al.*, 2019). CVD include conditions as: coronary heart disease (CHD), vein thrombosis, cerebrovascular disease and other (Michas *et al.*, 2019; Stewart *et al.*, 2017). Most prevalent acute cardiovascular incidents, that may lead to sudden death, include myocardial infarction, stroke, and angina pectoris (Hinton *et al.*, 2018). Widely prevalence of CVD may be related to development of atherosclerosis plaque which is caused by factors that might be specified as unhealthy lifestyle choices (Kilkenny *et al.*, 2017; Eilat-Adar *et al.*, 2013). Excessive body mass and obesity, hypertension, western diet, smoking, stressful life, and limited physical activity may be associated with non-beneficial alterations in lipid profile correlated with higher risk of CVD development (Savji *et al.*, 2013). It seems relevant to put special emphasis on lifestyle changes of patients dealing with diabetes type 2, hypertension, or hyperlipidemia itself (Michas *et al.*, 2019).

European Atherosclerosis Society (EAS) and American College of Cardiology and American Heart Association (ACC/AHA) came up with recommendations for managing lipid profile in terms of primary prevention of CVD (Arnett *et al.*, 2019, Mach *et al.*, 2019). It is noticeable, that some of them were dedicated to lifestyle changes – as one of strategies of avoidance of CVD development, presenting that nutrition and weight management have crucial role in evidence-based medicine. It should be mentioned that majority of their implications have a level of evidence that determines the data collected from randomized clinical trials or meta-analysis. Mostly, for TC and LDL-C reduction it is suggested that diet should deliver trans and saturated fats in limited amount and be rich in dietary fiber. Reduction of alcohol intake may have positive influence in managing triacylglycerides (TG) levels. To achieve an increase in HDL cholesterol levels, physical activity should be maintained (Mach *et al.*, 2019). AHA suggestions are gathered in **Table 1** with EAS guidelines.

Similarity between both statements shows that the most crucial for lipid profile control are the quality of fats in diet, weight management and increased physical activity (Mannu *et al.*, 2013; Kelly, 2010). Soluble fraction of fiber and phytosterols are also considered as helpful in goal achievement (Islam *et al.* 2019; Solà *et al.*, 2010). Mediterranean, vegetarian, and vegan diets are based on vegetables, fruits, nuts, seeds and vegetable oils or lean meat and sea fish (Davis *et al.*, 2015; Misra *et al.*, 2018; Dyett *et al.*, 2014). Those components are sources of unsaturated fats, dietary fiber, and polyphenols, which may be relevant for patients with disturbed lipid profile.

Table 1. Recommendations from EAS and ACC/AHA (Arnett *et al.*, 2019, Mach *et al.*, 2019).

EAS guidelines
Trans fatty acids and SFA avoidance
Increased consumption of fiber
Increased consumption of food enriched with phytosterols
Introduction of red yeast rice nutraceuticals
Reduction of excessive body weight
Reduction of dietary cholesterol consumption
Increase habitual physical activity
ACC/AHA guidelines
Nutrition pattern increasing intake of vegetables, fruits, legumes nuts, whole grains and fish
Replacement of saturated fat with dietary monounsaturated and polyunsaturated fats
A diet containing reduced amounts of cholesterol and sodium
As a part of healthy diet, it is reasonable to minimize the intake of processed meats, refined carbohydrates, and sweetened beverages
The intake of trans fats should be avoided

Abbreviation: ACC/AHA, American College of Cardiology and American Heart Association; EAS, European Atherosclerosis Society; SFA, saturated fatty acids.

REDUCTION OF SATURATED FATTY ACID AND TRANS ISOMERS CONSUMPTION

Guidelines suggest the reduction of SFA to about less than 7% of consumed energy and almost total exclusion of TFA (Arnett *et al.*, 2019, Mach *et al.*, 2019). The most common SFAs in a typical omnivore diet are those with at least 12 atoms of carbon, described as long chain SFA (LC-SFA) (O'Sullivan *et al.*, 2013). Nutrition pattern based on animal derived products (meat, milk and dairy products, butter, lard) and with higher consumption of highly processed food may be detrimental for maintaining proper cardiovascular health (O'Sullivan *et al.*, 2013). It may be suggested that plant-based diet may be more beneficial for reducing CVD risk, however LC-SFA can be also found in plant delivered oils such as coconut (USDA, 2019), palm (Forouhi *et al.*, 2018) and cocoa (Nettleton *et al.*, 2017).

Based on widespread availability of SFA, specific education for patients is needed – information about sources of SFA and possible nutrition exchangers should be provided. The recommendations suggest an increased intake of MUFA and PUFAs towards a reduction in the consumption of SFA and TFA (Arnett *et al.*, 2019; Mach *et al.*, 2019). MUFA and PUFA can be found in vegetable oils, nuts, seeds, avocado, and sea fish. However, it is observed that consumption of SFA is still increased and should be limited (USDA, 2019). It should be mentioned that popular fats used in many cuisines (butter, coconut oil) may not be beneficial for patients with higher risk of developing CVD.

Worldwide growth in popularity of coconut oil (CO) was observed in recent years (Eyres *et al.*, 2016). CO was named as one of the superfoods, meaning it is a food product beneficial to human health, and it is relatively cheap, which may have contributed to increased interests in CO. Due to FA content, CO may be considered as MC-SFA (Medium Chain SFA) food source (USDA, 2019). MC-SFA are studied as one of strategies for Alzheimer's disease prevention (Courchesne-Loyer *et al.*, 2017), support of traditional therapy in hepatic disease and possible support in body mass reduction (Kasai *et al.*, 2003). In comparison to LC-SFA which are bonded into chylomicrons and absorbed via lymphatic system in small intestine, medium chain fatty acids are suddenly absorbed and transported to liver via portal venous system, providing quicker energy supply (Iggman & Risérus, 2011; Schönfeld *et al.*, 2016; Flock *et al.*, 2013).

However, it should be emphasized that coconut oil FA composition is far from being MC-SFA source. CO

contains lauric acid, which may be considered as MC-SFA, since it is absorbed rapidly and transferred to liver, nonetheless lauric acid is included into SFA group that have hypercholesteremic effect (Oliveira-de-Lira *et al.*, 2018). Other SFA that may influence increase of TC and LDL-C concentrations are myristic and palmitic acids, which are also present in CO composition (Hunter *et al.*, 2010).

Interestingly, several studies suggest that native inhabitants of regions of coconut palm cultivation, present overall good cardiovascular outcomes and those may relate to higher consumption of coconut oil (DiBello *et al.*, 2009). These studies and the potentially high MC-SFA content contributed to the growing interest in coconut oil, however comparing to the usual western diet it may have more detrimental outcome. Described native populations declare nutrition pattern based on fresh vegetables, fruits, nuts with the reduction of animal derived products. Increased intake of dietary fiber was also observed (DiBello *et al.*, 2009). Processed food such as meals ready to eat or semi-finished products traditionally do not occur in their nutrition. It is noticeable that in those studies, high daily intake of fats was observed, which varied from 26–49% delivered energy, however majority of those derived from plant or fish (DiBello *et al.*, 2009). It was observed that the consumption of fruit and vegetables exceeded the recommended 5 servings per day, which may implicate that dietary fiber intake also surpassed advised 30–45 g daily (DiBello *et al.*, 2009; Duthie *et al.*, 2018). Studies held in America and European countries show that there is no conclusion if coconut oil may be beneficial for maintaining or promoting good cardiovascular health (Oliveira-de-Lira *et al.*, 2018; Maki *et al.*, 2018; Vijayakumar *et al.*, 2016; Cardoso *et al.*, 2015; Harris *et al.*, 2017). Nonetheless, it is safe to assume that products rich in MUFA and PUFA will have more profitable influence on overall health, than dietary fats rich in SFA.

Butter is another popular food source of SFA and cholesterol. Debate whether milk fat may be present in a healthy diet is still ongoing – some scientific reports suggest that high content of SFA may be unbeneficial for subjects with elevated lipid profile (Khaw *et al.*, 2018; Hjerpsted *et al.*, 2011; Von Ruesten *et al.*, 2013), however some studies propose that dairy products and dairy fat may decrease the risk of CVD (Crichton & Alkerwi, 2014; Lordan *et al.*, 2018; Drouin-Chartier *et al.*, 2016). Furthermore, butter as an animal derived product contains dietary cholesterol and its higher consumption may lead to an increase in TC and LDL-C levels (Zhong *et al.*

al., 2019; Okami *et al.*, 2019). To summarize this discussion, if butter has more beneficial or detrimental influence on cardiovascular health, one of meta-analysis focusing on butter intake and all-cause deaths RR=1.01 (95% CI=1.00,1.03), atherosclerosis heart incidents RR=0.99 (95% CI=0.96,1.03) and heart attacks RR=1.01 (95% CI=0.98,1.03) and no strong correlation was observed between these results (Pimpin *et al.*, 2016). Further research is needed, especially among subjects from groups of higher CVD risk with different nutrition patterns. At the same time patients should be encouraged to decrease their intake of full-fat dairy products towards products with lowered fat content as it is safe to assume that butter can be replaced with vegetable oil with high content of MUFA or PUFA (e.g., olive or canola oil).

Another crucial element of maintaining correct cholesterol levels is consumption of trans isomers of polyunsaturated fatty acids. It is suggested that TFA should be completely limited in daily consumption to the point when they deliver less than 1% of whole energy (Manu *et al.*, 2013; Kelly, 2010). In nature, TFA occur in milk and meat of ruminants in limited amount. Due to technological development TFA are widely present in margarines, highly processed food, sweets, savory snacks and in a few vegetable oils (Ahmed *et al.*, 2018; Gupta *et al.*, 2019; Ford *et al.*, 2016). Margarines are often chosen and promoted as a healthier substitute for butter, since they do not contain dietary cholesterol and may be fortified with beneficial plant sterols, however some of them may contain trans FA (Gagliardi *et al.*, 2010). It is observed that higher intake of TFA may influence higher LDL serum concentrations (Grabovac *et al.*, 2018; Li *et al.*, 2017), thus World Health Organization (WHO) suggest replacing them with cis isomers delivered from MUFA and PUFA or at the same time with complex carbohydrates towards beneficial increase of HDL-C with simultaneous decrease of TC and LDL-C levels (Riccardi *et al.*, 2016).

For better outcomes in lipid control, vegetarian or vegan diets may be suggested. It is observed that lifestyles patterns based on increased plant products intake and exclusion of products of animal origin are correlated with improved lipid profile (Viguiouk *et al.*, 2019; Matsumoto *et al.*, 2019). Undoubtedly, those changes should apply to unprocessed products, free from TFA or SFA.

INTRODUCTION OF PLANT STEROLS INTO DAILY DIET

Except SFA and TFA content in ingested diet, consumption of dietary cholesterol may further be essential in human cholesterol metabolism (Zhong *et al.*, 2019; Okami *et al.*, 2019). The decrease in intestinal absorption leads to a shortage of cholesterol, encouraging internal mechanisms towards biosynthesis and an increase in activity of the LDL receptor (LDLR), to secure the body's requirements (Kapourchali *et al.*, 2015). As a consequence, reducing the cholesterol pool through limited consumption and increased receptor activity may lead to a reduction in blood TC concentrations (Alphonse *et al.*, 2015).

In practice, to obtain the state of cholesterol shortage, increased consumption of PS may be recommended (Ferguson *et al.*, 2018). Plant sterols or phytosterols have similar chemical structure as cholesterol, however they are mostly present in plant sources. That resemblance makes PS more susceptible to be absorbed in intestine and leads to decreased availability of dietary cholesterol by removing it with the feces (Sancllemente *et al.*, 2012).

As one of lifestyle changes and non-pharmacological approach dose of 1,3–2 g PS per day may be significant for lowering cholesterol concentrations (Ottestad *et al.*, 2013). In food sources, PS are found in fresh fruits, vegetables and vegetable oils, seeds, nuts, and legumes but it's observed that even a large consumption of these products may not be sufficient to meet the cholesterol lowering needs (Sancllemente *et al.*, 2012). Otherwise, diet rich in natural sources of PS may be adequate for preventive purposes for general population, based on observations of residents of European countries (Kapourchali *et al.*, 2015). For the best possible cholesterol reduction, PS dietary supplements or products fortified with PS may be considered (Malina *et al.*, 2015). Margarines enriched with PS are popular among patients with hyperlipidemia because they replace butter, and their plant sterol content is high enough to be sufficient for hypolipidemic outcomes (Eady *et al.*, 2011). It is also a beneficial solution for hypercholesterolemic patients to exchange butter with margarine, because the second does not include dietary cholesterol. However, it is crucial to educate about possibility of choosing products with higher TFA content.

INCREASED CONSUMPTION OF SOLUBLE FIBER

Dietary fiber (DF) is often mentioned as the basis of proper nutrition. DF ensures feeling of satiety after a meal, as a result of swelling capacities, have an influence on digestion with maintaining regular peristaltic movements and can be beneficial for gut microbiome (Maćkowiak *et al.*, 2016). It is recommended to consume about 25–40 g of fiber daily, including 7–13 g of its soluble fraction (Maćkowiak *et al.*, 2016). Food products with higher content of fiber have also lower glycemic index than processed or refined products (Dhingra *et al.*, 2012). Those properties may be beneficial for patients with diabetes or those who have difficulty feeling full after a meal, and fiber may be crucial in the diet of hypercholesterolemic subjects.

Cholesterol lowering properties of fiber are presumably achieved by two mechanisms:

- products with low GI reduce the release of insulin from the pancreas in contrast to food with high GI (1)
- and soluble fraction of fiber contributes to increasing hepatic bile synthesis (2) (Gunness & Gidley, 2010).

Foremost, cholesterol biosynthesis is based on alteration of 3-hydroxy-3-methylglutaryl-CoA to mevalonate (Cerqueira *et al.*, 2016). For this reaction HMG-CoA reductase is needed, as an enzyme regulating the whole process. HMG-CoA is coordinated by few hormones e.g., insulin and glucagon with antagonistic effect (Burg & Espenshade, 2011). Usually, glucagon is released in the situation of decreased blood glucose levels, which tends to be in states of fasting, during low carbohydrate diet and during intense physical activity. Contrarily, insulin is synthesized when glucose levels are increasing e.g., after meals rich in carbohydrates and in subjects with insulin resistance (Burg & Espenshade, 2011). Glucagon endorse HMG-CoA reductase inactivation with a cascade of phosphorylation, and insulin is needed for a reverse reaction – dephosphorylation, which activate enzymes and can initiate cholesterol synthesis (Cerqueira *et al.*, 2016). Increased consumption of soluble fiber may contribute to binding with cholesterol particles in the lumen of the small intestine, which inhibits cholesterol absorption. Moreover, SF influences extraction of bile acids

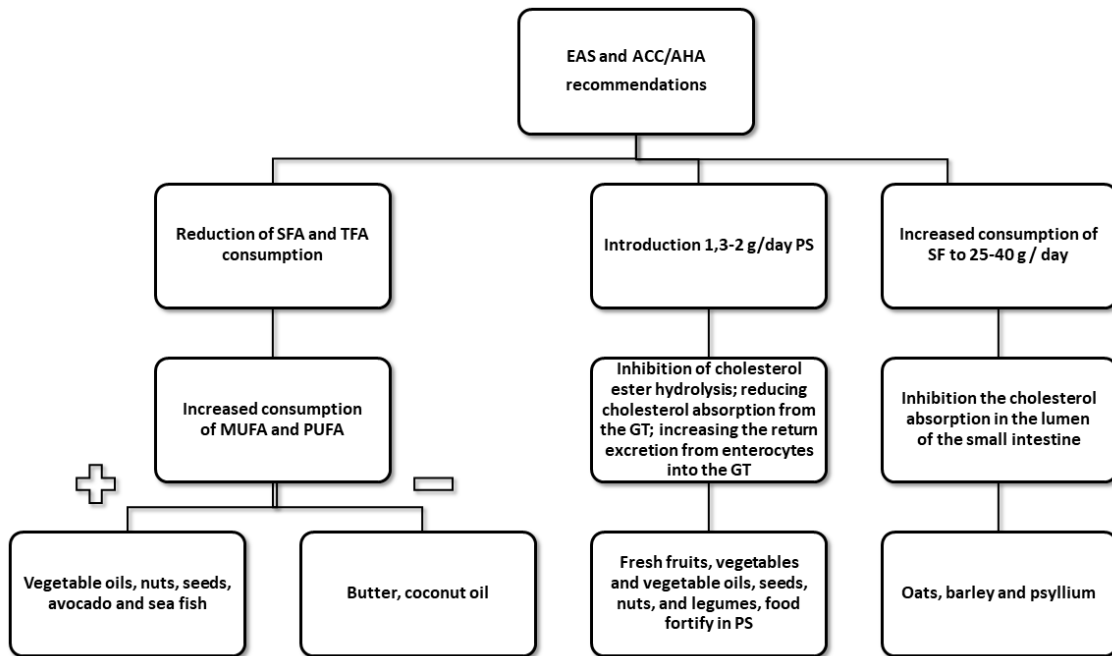


Figure 1. Recommended products to improve lipid profile according to the EAS and ACC/AHA.

with fecal matter, inducing cholesterol uptake by liver towards bile synthesis (McRae, 2017).

Soluble fiber is widely found in oats, barley and psyllium (Maćkowiak *et al.*, 2016). It is suggested that SF may be beneficial for patients not yet undergoing pharmacological treatment, although increased consumption of SF is considered safe when drugs are already taken (Solà *et al.*, 2010). However, SFs are especially beneficial for patients with cholesterol-lowering drug side effects and low tolerance to them – studies have shown that SF decrease TC and LDL-C concentrations about 2 to 24% and 2 to 20% respectively (Brum *et al.*, 2018). Increased consumption of fiber has one preeminent drawback – a rapid change in the amount of consumed fiber in the diet can contribute to the appearance of gastrointestinal discomfort such as diarrhea, flatulence or gases, but those complaints disappear after adjusting to higher doses of DF (Zhang *et al.*, 2020).

BODY MASS REDUCTION

Excessive body mass is correlated with higher risk of civilization diseases e.g., diabetes type 2, cancers and CVD (Na *et al.*, 2011). People with redundant fat content are more susceptible to develop higher TC and LDL-C concentrations, as a consequences of unhealthy lifestyle patterns such as western diet and limited physical activity (Kopp, 2019). EAS guidelines suggest that weight loss of 10 kg may decrease LDL-C levels by 8 mg/dl (0.2 mmol/l) and that may be relevant as an additional support in managing lipid profile (Mach *et al.*, 2019). However, reduction of 10 kg for some subjects may be not possible, e.g., for patients with familial hypercholesterolemia with BMI in normal ranges, that is why body mass reduction should not be the only approach for lipid control and rather a supportive approach for other possibilities. Several studies compared influence of various physical activity levels and diet (especially caloric deficit) on body mass reduction; therefore, improving lipid profile (Brouwers *et al.*, 2016; Igarashi & Nogami, 2019;

Mann *et al.* 2014; Romero-Moraleda *et al.*, 2015). In conclusion, patients, particularly those with increased body weight, should be encouraged to exercise regularly and rethink their eating habits to maintain the goal of reducing excess fat. Reduction of fat mass may lead to a decrease of TAG quantity, therefore improving LDL-C concentrations (Theodore *et al.*, 2007). What is more, obesity may lead to insulin resistance and an increased release of insulin from the pancreas, which is necessary in cholesterol synthesis (Burg & Espenshade, 2011). High quality diet with limited amount of processed products and ready to eat meals may be beneficial in maintaining correct body mass or reducing body mass, that is why nutrition plans based on fresh vegetables, fruits and whole-grain products may be helpful solutions for patients.

MEDITERRANEAN, VEGETARIAN AND VEGAN DIETS AS CARDIOVASCULAR FRIENDLY LIFESTYLE HABITS

Recommendations from AHA and EAS towards lifestyle changes mainly suggest high quality diet what may be described as a reduction of TFA, limitation of SFA consumption in favor of MUFA and PUFA content (Fig. 1) (Arnett *et al.*, 2019; Mach *et al.*, 2019). Inclusion of phytosterols and soluble fiber may be helpful in reduction of serum cholesterol concentrations, as well as restraint of dietary cholesterol intake. Weight reduction approaches should be considered for obese and overweight patients– introducing caloric restriction and regular exercise for improving lipid profile and reducing other CVD risk factors (Arnett *et al.*, 2019; Mach *et al.*, 2019). From nutritional perspective Mediterranean, vegetarian or vegan lifestyles may be a practical solution for implementing those guidelines.

Mediterranean diet (MD) is mostly based on fresh and seasonal fruits, vegetables, fish, olive oil and whole wheat products (Trichopoulou *et al.*, 2014). Theoretically, MD is composed from fresh, non-processed meals with variety of nutritional, high quality products (Trichopoulou *et al.*, 2014). It was observed that nations located

near Mediterranean Sea have lower risk of developing CVD and better overall cardiovascular outcomes (e.g., lipid profile) than residents of different European countries (Knoops *et al.*, 2004). Since influence of MD on overall health outcome was observed, food pyramids were proposed to make recommendations simple enough to implement without additional explanation (Vitiello *et al.*, 2016; D'Alessandro *et al.*, 2019).

Few studies analyzed influence of some food products – patients were encouraged to consume olive oil (1l per week per household, at the minimum of 4 tablespoons of oil for each person), mixed nuts (walnuts, hazelnuts and almonds; 30 grams daily) or to maintain healthy, balanced diet (Estruch *et al.*, 2013). After reaching median of 4,8 years, the study ended with observations that increasing consumption of olive oil to 10 grams per day was correlated with a decrease of 30% of CVD relative risk among patients from high-risk groups. Similar outcomes were observed in a group that was consuming 30 grams of nuts per day (Estruch *et al.*, 2013).

Possible correlation between quality of consumed fats and risk of developing CVD was also observed (Guasch-Ferré *et al.*, 2015). Long-term research of 7038 participants of PREDIMED study has shown that incorporating more MUFA into diet may result in lowering risk of CVD and may be especially beneficial when those are used as a substitute of SFA and TFA. It was noted that subjects with higher intake of those FA had 81% and 67% chances of developing CVD. There is no doubt, that both fatty acids are more detrimental for cardiovascular health and limited consumption should be included into healthy nutritional habits. PREDIMED study also shows that changes are relatively accessible to implement, with choosing olive oil instead of other vegetable oils or adding a portion of nuts every day. It was also noted that quality of consumed fat is more important than quantity, since MD is based in products with high fat content and may exceed recommended 20–30% of delivered energy (Guasch-Ferré *et al.*, 2015).

Nuts and vegetable oils, especially those derived from olive and canola, are great sources of PUFA n-3, which higher intake may be beneficial for increasing HDL-C concentrations and reducing LDL-C and TC levels (Leslie *et al.*, 2015). PUFA n-3 are also present in sea fish, specifically in those with higher fat content such as salmon, tuna, herring or mackerel (Shahidi & Ambigaipalan, 2018). People living near Mediterranean Sea, take advantage of the benefits of being close to the sea and exchange meat intake for fish consumption (Trichopoulos *et al.*, 2014). Moreover, due to increased consumption of vegetables, fruits and whole grain products, dietary fiber and phytosterols are introduced to daily diet, which may be another crucial cardioprotective effect of MD (Shahidi & Ambigaipalan, 2018).

Vegetarian or vegan diets are mostly plant based nutrition patterns, with exception of animal derived products such as dairy, eggs or butter (Nebl *et al.*, 2019). Both of them may be beneficial for patients with higher TC serum levels, since those do not provide any (or in limited amount) dietary cholesterol (Zhong *et al.*, 2019; Okami *et al.*, 2019). Those should be considered for subjects without lipid lowering drugs, specifically for patients experiencing side effects after taking medication (Huang *et al.*, 2014). Additionally, vegetarian diets are a rich source of nutraceuticals delivered in vegetables, fruits and nuts, which may be lacking in omnivore diet (Clarys *et al.*, 2014). Plant sterols, polyphenols such as resveratrol and other may be beneficial for patients with dyslipidemia or hypertension (Sosnowska *et al.*, 2017). Due to an in-

creased consumption of fruits, vegetables and whole grain products higher intake of fiber, with its soluble fraction, may be observed among subjects consuming vegan or vegetarian diet (Tong *et al.*, 2019). It is safe to assume that vegetarian or vegan diets are most profitable for maintaining a lipid profile in desirable ranges, since both of them are rich in phytosterols, fiber and are lacking in dietary cholesterol. Moreover, plant-based diets are proved to have beneficial influence on sudden cardiac incidents occurrence compared to omnivore provisions (Rogerson, 2017). However, those nutritional patterns are not safe from SFA and TFA, especially when exotic oils (such as coconut or palm oils) or ready to eat meals are used (Mani & Kurpad, 2016). Education about possible food sources of those fatty acids may be relevant to introduce vegetarianism/veganism for heart protective outcomes.

The presented dietary regimens have many similarities – increased dietary fiber intake, decreased consumption of SFA and TFA, and they are rich in nutritional food sources. Whole grain products, fresh and non-processed fruits and vegetables are the basis of those nutritional plans. It should be highlighted that fiber may be beneficial especially for subjects with excessive body weight, which is one of the CVD risk factors. It was observed that overweight and obese women after 10 weeks of diet with increased amount of dietary fiber have better cardiovascular outcomes such as lower LDL and TG levels with significantly noticeable weight loss (Fatahi *et al.*, 2018). Mean intake of DF was about 39 g per day, which exceeded recommended 25 g daily. In this research weight loss may be a major contributor to improving lipid profile (LDL 110 mg/dl *vs* 99 mg/dl and 114 mg/dl *vs* 94 mg/dl), however incorporating DF could be beneficial for hormonal balance especially insulin secretion after a meal which may result in preventing insulin resistance. Another research showed that increased consumption of DF can be related with lowering blood pressure, which is another risk factor of premature death from CVD (Kirwan *et al.*, 2016).

Prospectively, diet interventions could be matched to the expected results e.g., lowering different fractions of lipid profile or markers of inflammation. It was observed that vegetarian diet may be more effective in lowering total and LDL cholesterol, while Mediterranean diet is efficient with impact on TG levels, although both of these nutritional patterns are considered good for cardiovascular health (Sofi *et al.*, 2018). Another research has shown that vegan diet may be considered for patients at high risk of developing CVD with presence of atherosclerosis plaque (Shah *et al.*, 2018). It is well known that major risk factor of CVD is atherosclerosis development, which may be caused by prolonged inflammation (Shah *et al.*, 2018). It is observed that subjects with coronary heart disease have increased levels of inflammation markers such as hsCRP (high sensitivity C-reactive protein) (Geovanini & Libby, 2018; Abolhasani *et al.*, 2019). Research conducted on patients with CAD has shown that those who were on vegan diet, had about 38% lower hsCRP levels than those on recommended by AHA/ACC nutrition plan (Shah *et al.*, 2018). It was observed that vegan group had higher intake of fiber, carbohydrates and lower of SFA, TFA and cholesterol, which may suggest that the main advantage of veganism towards anti-inflammatory effect is fiber and complex carbohydrate content (Ma & Li, 2018). Moreover, DF is needed for the proper development of the human microbiota, one of the components of the immune sys-

tem, whose role in CVD prevention need further studies (Makki *et al.*, 2018; Visioli *et al.*, 2019).

Major difference between MD and VD is the presence of animal food products such as meat, milk and fat, however in comparison to western diet, both nutritional plans assume limiting intake of SFA, TFA and cholesterol. It may suggest that the biggest cardioprotective agents in MD and VD are high content of MUFAs and PUFAs, complex carbohydrates, dietary fiber and nutraceuticals present in fruits, vegetables, nuts and seeds. Besides plant sterols, some of them may be hydroxytyrosol, one of the phenols from olive oil, or soy derived products – such as lecithin or isoflavones (Visioli & Poli, 2019; Poli *et al.*, 2018). It is observed that those substances can be responsible for lowering LDL cholesterol as well as anti-inflammatory actions (Visioli & Poli, 2019; Poli *et al.*, 2018). However, there is no relevant data showing if increased consumption of nutraceuticals from diet may be as beneficial as supplementation.

CONCLUSION

Recommendations for managing dyslipidemias and reducing CVD risk are mostly helpful for medical professionals such as doctors, nurses or dietitians, nonetheless they may be incomprehensible for patients. Education about lifestyle changes may be helpful for implementing those guidelines in practice. Nutritional knowledge should be taught and explained due to growing popularity of non-medical and not evidence-based information. Superfood status of some products should also be taken with a grain of salt, since some of them, despite general opinion may not be suitable for subjects with higher CVD risk.

It is also crucial to encourage patients to increase the consumption of fruits and vegetables due to naturally occurring phytosterols and dietary fiber. Supplementation with plant sterols should also be considered to maximize traditional pharmacology treatment. Advice about the sources of soluble fiber should be provided, since some patients may choose supplements or plant extract for achieving visible decrease in TC and LDL-C concentrations. It should be emphasized that nutritional and lifestyle changes will be more beneficial than using supplements while maintaining unhealthy habits.

In order to make those changes more accessible, Mediterranean, vegetarian or vegan diets may be recommended. All of them have scientific background for decreasing TC and LDL-C levels, however diet plan should be chosen for patients individually, including dietary preferences, possibilities, and health limitations.

Conflicts of Interest

The authors declare no conflict of interest.

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