Impact of Diet on Cardiovascular Diseases: Coronary Artery Disease

Part I: Healthy Macronutrients

Abstract

Diet is a major modifiable factor in the prevention and management of cardiovascular diseases. These diseases impart the greatest non-communicable diseases burden globally. They are the leading cause of deaths in the world and account for 17.9 million deaths annually. This represents 31% of the total mortality. In 2016, 85% of the cardiovascular deaths in the world were due to ischemic heart disease and stroke. Premature mortality due to cardiovascular diseases is one of the main obstacles in increasing the human lifespan. Coronary artery disease is a major cardiovascular disease. It is caused by arterial atherosclerosis. This leads to progressive narrowing of the coronary arteries limiting blood flow to the myocardium. Plaque rupture may cause sudden blockage to the blood flow resulting in myocardial death. This can be associated with malignant ventricular arrhythmias and lead to death. Several lifestyle factors can prevent, reduce the progression, or even regress atherosclerosis. Diet is a major modifiable factor. A healthy diet can lead to a lower risk of coronary artery disease. It can also stem the progression and improve outcomes in those with established coronary artery disease. The role of diet in the pathogenesis of coronary artery disease is discussed in this 3-part manuscript. Part I looks at the healthier choices.

Keywords: coronary artery disease, plant-based diet, fish, dairy, coffee, chocolate

Introduction

Atherosclerotic cardiovascular disease (ASCVD) continues to be the leading global cause of morbidity and mortality[1]. Hypertension (HTN), coronary heart disease (CHD), stroke, and congestive heart failure affect 48% of the US population or approximately 121.5 million Americans[2]. Coronary artery disease (CAD) is the most prevalent ASCVD[3]. The coronary arteries arise from the base of the aorta and supply the heart with blood. Their wall is made up of three layers: the innermost layer (tunica intima), the middle layer (tunica media), and the outermost layer (tunica adventitia)[4,5]. CAD results from an atherosclerotic process, affecting the structure and function of all these three layers[6]. It is characterized by a diseased endothelium, low-grade inflammation, monocyte recruitment, macrophage formation, lipid accumulation, and plaque formation within the intima[7]. Plaques may form in the coronary arteries but may also occur in different vascular beds resulting in peripheral artery disease, cerebrovascular disease, or aortic atherosclerosis[8]. In the coronaries, the plaque can grow, usually slowly, eventually impeding blood flow and clinically manifesting as angina[9]. Plaque rupture or erosion can occur suddenly. This is associated with local accumulation of tissue factors, platelet activation,

superimposed thrombosis, and rapid vessel occlusion, leading to myocardial infarction (MI), or even death[10]. Besides angina and MI, CAD may lead to other diseases of the heart (coronary heart disease or CHD) such as congestive heart failure, and malignant ventricular arrhythmias[11]. CAD has a global prevalence of 2%–3%[12]. It is estimated that it affected 110 million people in 2015 and was responsible for 8.92 million deaths that year[13]. Its incidence is increasing, especially in low to middle-income countries. It is expected that 82% of the future increase in CHD mortality will occur in these countries[14].

This part I of this 3-part manuscript will discuss the role of beneficial macronutrients in the diet. Part 2 will discuss unhealthy macronutrients while part 3 will look at the role of micronutrients in the development and progression of CAD/CHD. Throughout the 3-part manuscript, CAD and CHD are used interchangeably.

Discussion

Nutrition plays an increasingly significant role in the primary and secondary prevention of several diseases[15]. "Let thy food be thy medicine and thy medicine be thy food." Has been attributed to the Greek physician Hippocrates, indicating the concern regarding diet and health as far back as 400 B.C[16]. In 1747, James Lind, a Scottish surgeon in the Royal Navy, noted that citrus fruits treat scurvy[17]. The nutrition cardiovascular connection was first recognized in 1908, when a Russian scientist Alexander Ingatowski, demonstrated that high cholesterol intake caused the developdment of atherosclerosis in rabbits[18]. Diet has now become an important health issue, especially when it comes to coronary heart disease (CHD)[19]. A heart-healthy diet is associated with major CHD benefits[20-24].

Plant-Based Diets: A plant-based diet is low in fat, cholesterol, salt, animal products, and sugar[25]. Plant-based diets do not have to be vegan or vegetarian and many include a low intake of lean meats. These diets are rich in fruits, vegetables, whole grains, nuts, with a regular intake of green tea, dark chocolate, and coffee. They help reduce CHD[26]. This has been verified by several studies. A large Finnish study reported an inverse relationship between intake of vegetables and risk of both CAD and cardiovascular death[27]. Law, et al. reported that the risk of ischemic heart disease is about 15% lower at the 90th when compared to the 10th centile of fruit and vegetable consumption[28]. The Lifestyle Heart Trial found that 82% of patients diagnosed with heart disease who followed a plant-based diet program had some level of regression of atherosclerosis. In this study, 91% had a reduction in the frequency of angina episodes, compared to 53% of the control group. The control group was fed the American Heart Association diet. They also showed a progression of atherosclerosis[29]. Similarly, other researchers showed that compared with a control group, the plant-based diet group had a 73% decrease in coronary events and a 70% decrease in all-cause mortality[30]. There are several mechanisms via which plant-based diets exert their beneficial effects. The five major beneficial actions of plant-based diets are: decrease in blood pressure (BP), change in the lipid profile, decrease in HbA1c, reduction of inflammation, and reduction of oxidative stress. Several studies have shown that plant-based diets help reduce BP[31]. The DASH diet is predominantly plant-based, with a small amount of lean meat. DASH diet is associated with a reduction in BP by a mean of 5.5/3.0 mm when compared to a control diet (irrespective of being normotensive or hypertensive)[32]. In a meta-analysis of 7 clinical trials

that excluded the DASH diet trials, Yokoyama et al analyzed data from 311 participants and found that consumption of vegetarian diets reduced systolic BP by 4.8 mm Hg and diastolic BP by 2.2 mm Hg compared with omnivorous diets[32]. The impact of an elevated BP on coronary artery disease is significant - a 2-mmHg increase in BP increases mortality from coronary artery disease by 7 percent[33]. Plant-based diets also help lose body weight. Vegetable diet individuals eat 5% - 14% fewer calories than their meat-eating counterparts[34]. The associated weight loss has beneficial effects on BP and lipids. Studies have suggested that there are reductions of 0.5–1 mmHg in BP, and 0.02 mmol/L in total cholesterol for every 1 kg of weight loss[35]. Other studies have calculated that weight loss of 5–8 kg if sustained, resulted in a mean low density lipoprotein cholesterol (LDL-C) reduction of 5 mg/dL and an increase in high density lipoprotein cholesterol (HDL-C) of 2–3 mg/dL. A 3 kg weight loss reduced TG by 15 mg[36-38]. It has been shown that each 1% reduction in LDL-C or non-HDL-C is associated with a 1% decrease in CHD event risk (over 5 years)[39]. Weight loss also helps decrease type 2 diabetes mellitus (T2DM) – 1 kg weight loss results in a 0.1% glycated hemoglobin (HbA1c) reduction[40]. T2DM doubles the risk of developing coronary artery disease[40]. Plant-based diets decrease inflammation as evidenced by lower C-reactive protein levels in these patients[41-43]. Inflammation is associated with the progression of atherosclerosis and adverse CHD events[44-47]. Plant-based diets also have high antioxidant nutrients, resulting in a better vascular health[48]. Compared to omnivores, they have less oxidative stress[49], less endothelial injury[50,51], thinner intimal medial wall[50], and reduced atherosclerosis[50,51].

People eating plant-based diets also have lower mortality. In one study there was a 24% lower mortality from ischemic heart disease (IHD) in vegetarians compared to non-vegetarians during > 10 years of follow-up period[52]. As mentioned before, plant-based diets are the only dietary pattern to have shown reversal of CAD[53]. A significant number of patients (82%) in the Lifestyle Heart Trial noted a regression in atherosclerosis[54]. However, not all plant foods are created equal[55,56]. Prudent plant-based diets contain higher amounts of healthy foods such as fruits, vegetables, whole grains, nuts, legumes, polyunsaturated fatty acid (PUFA) oils, tea, and coffee and are associated with lower cardiovascular (CVD) risk[55]. However, plant-based diets which included higher amounts of less healthy plant foods, such as refined grains, potatoes/fries, and foods/beverages high in added sugar, are linked to an increased risk[56].

Fruits and vegetables

Consuming fruits, along with green and yellow vegetables, is beneficial for the coronary vasculature[57] and help prevent the development of atherosclerotic plaque[58]. The plaque vulnerability is also reduced[59]. This results in a decreased risk of cardiovascular events, Liu et al in a prospective cohort study of 39,876 female health professionals, found that the relative risk (RR) between those with the lowest vegetable and fruit consumption (median value: 2.6 servings/day) and those with the highest consumption (median value: 10.2 servings/day) was 1.0 and 0.68, respectively[60]. Joshipura and colleagues estimated that an increase in fruit and vegetable intake could reduce the burden of IHD by as much as 31%[61]. In a study of 42,148 men and 84,251 women, it was noted that the RR for CAD was 0.80 in the highest quintile of vegetable and fruit consumption[61]. In a systematic review and meta-analysis, for fruits and

vegetables combined, the summary RR per 200 g/day was 0.92 for CHD[62]. In a meta-analysis of nine cohort studies (222,081 men and women), there was a reduction in CHD risk by 4% for each additional portion of fruit and vegetable intake per day[63]. Fruits and vegetables are rich in several biological compounds, including polyphenols[64] with immense cardiovascular benefits[65].

Whole grain. Whole grains contain all three parts of the grain: the bran, the germ, and the endosperm. Refined grains contain only the endosperm. Whole grains commonly used are barley, brown rice, buckwheat, bulgur (cracked wheat), millet, oatmeal, corn, quinoa. brown rice, rye, sorghum, teff , triticale, and wheat. Whole-grain intake is associated with a reduced risk of CHD[66]. In the Atherosclerosis Risk in Communities study, done over 11 years, intake of whole grains was inversely associated with incident CAD[67]. Intake of > 6 servings of whole grains per week results in less progression in coronary artery stenosis even after adjustments for age, cardiovascular risk factors, and dietary intakes of saturated and polyunsaturated fat, cholesterol, and alcohol[68]. A reduced CHD risk was seen in a meta-analysis of 18 prospective studies, in individuals with a higher whole grain intake (RR 0.79)[69]. Aune et al., in a meta-analysis of 45 studies noted a reduction of 21%, in the relative risk of CHD for the highest versus lowest category of whole-grain intake. They also found an inverse association between whole-grain intake and CHD mortality[70].

Legumes: Legumes (pods with seeds that split into two halves) include beans, peas, lentils, soybeans, and peanuts. Legumes are a good source of plant protein[71]. They also provide several essential minerals, dietary fiber (both soluble fiber and resistant starch), and numerous phytochemicals[72]. Their intake helps decrease CHD risk[73,74]. Afshin, et al. in a systematic review and meta-analysis of five prospective cohort studies, found that consuming four 100-g servings of legumes weekly was associated with a 14% lower risk of CHD[73]. More recently, in a meta-analysis (eight prospective cohort studies), the highest versus lowest legume intakes were associated with a 10% decreased risk incident CHD and CHD-related mortality[74]. Benefits accrue from their effects in decreasing systolic BP[75], improving lipid profile[75], and improving insulin sensitivity[76].

Nuts: Common nuts such as almonds, hazelnuts, walnuts, pistachios, pecans, cashews, peanuts, Brazil nuts, macadamia nuts, and pine nuts are heart healthy[77]. They have no cholesterol, have a low glycemic index and are high in fiber and nutrients[78]. These nutrients include bioflavonoids, folate, vitamin E, and polyunsaturated fatty acids (PUFAs)[79]. Epidemiological studies and randomized controlled trials indicate that nut consumption helps in weight loss[80]. Further, the macronutrients and phytochemicals present in nuts lead to a reduced risk of CVD[81]. Eating one or two ounces of tree nuts per day helps decrease the risk MI, and cardiovascular death[82]. Cardiovascular benefits have also been noted in patients with T2DM. Diabetics who ate five 28-gram servings of nuts per week (compared to those eating less than a single serving per month) had a 20% lower risk of CHD, and a 34% lower risk of cardiovascular disease death[83].

Fiber: Dietary fiber is either water-soluble or water insoluble. The former is derived from the inner flesh of plants (such as oats, barley, legumes, lentils, apples, pears, plums, oranges, broccoli, Brussels sprouts, carrots, and peas, and most root vegetables) and helps reduce glucose and cholesterol concentrations[84]. Insoluble fiber is derived from the outer skin of plants and

helps form stool bulk, which promotes laxation. Good sources are potatoes, apples, bananas, and avocados, zucchini, green beans, celery, cauliflower, tomatoes, and kiwi[85]. Whole grains, nuts, and seeds are also good sources. In an umbrella review of 31 analytic studies, fiber intake was associated with a reduction in both total serum cholesterol and LDL-C concentration[86]. Higher intakes of cereal fiber and whole-grain products decrease the progression of coronary atherosclerosis and stenosis[87]. In addition, fiber intake is inversely associated with several other CAD/CHD risk factors such as metabolic syndrome[88], insulin resistance[89], HTN[90], and obesity[91]. Besides reducing lipid levels, fiber intake also causes high satiety, a decrease in the nutrient absorption rate, and may even affect the gut microbiota[92]. The American Heart Association (AHA) recommends >1.1 g fiber per 10 g of carbohydrate for good CVD health[93].

Dairy

Dairy products commonly consumed include fluid milk, fermented cheese, and fermented yogurt[94]. The AHA and the European Society of Cardiology promote the consumption of low-fat dairy products for cardiovascular production[95]. Milk and milk products lower BP, improve insulin resistance, and decrease inflammation and oxidative stress[96,97]. These actions may help reduce atherosclerosis and CHD[98,99]. Several meta-analyses indicate that dairy products may however have a neutral effect on CHD[100]. In a systematic review and meta-analysis published in 2017, consumption of milk, yogurt, and cheese had no effect on the risk of CHD[101]. Jakobsen, et al. also found no association between total intake of dairy (both low-fat and high-fat dairy) and CHD[102]. There is some suggestion that intake of cheese may be inversely associated with the risk of CHD[102]. It appears that dairy intake has a neutral or a slight protective effect on cardiometabolic health[100-102]. The AHA recommends the intake of low-fat dairy products for a healthy cardiovascular system[103].

Eggs:

The risk of eggs in increasing CAD due to their high cholesterol content (141-234 mg per egg) has been questioned in the past[104,105]. In a 2016 meta-analysis, Alexander et al. found that consumption of one egg per day did not increase the risk of CHD[106]. A systemic review and meta-analysis published in 2020, also found no association between egg intake and cardiovascular disease[107]. In a prospective cohort study of 37,121 participants ≥20 years of age with a median follow-up of 7.8 years, there was no significant effect of egg consumption on mortality in US adults[108]. A more recent population-based cohort study with 521,120 participants, with a mean follow-up of 16 years, suggested that whole egg consumption may result in higher CVD mortality and recommended that whole eggs be replaced with an equivalent amount of egg whites/egg substitutes[109]. Some studies have reported a positive association between a higher egg intake and the relative risk of CVD and all-cause mortality in patients with type 2 diabetes[110] - recent data appears to refute these findings[111]. The AHA suggests one egg (or two egg whites) per day for people who eat them, as part of a healthy diet[103].

Poultry:

Meats are broadly divided into two groups - red (such as beef, pork, lamb) or white (such as chicken, turkey, rabbit). Poultry meats or white meats have a lower content of saturated fat and a

better unsaturated fatty acid profile[112-114]. White meat is also lower in heme iron. Both saturated fat and heme iron are recognized factors that promote atherosclerosis[115,116]. Poultry intake was not associated with all-cause and CVD mortality in a meta-analysis[117]. A recent analysis of pooled data from 6 prospective cohort studies of US adults however found a positive association between poultry intake and incident CVD[118]. It is postulated that since fried chicken was included in the white meat category in this study, the results may have been skewed. Fried food consumption has been positively associated with adverse cardiovascular outcomes[119]. There is evidence that the substitution of one daily serving of red meat with white meat, mainly poultry, is associated with a 19% reduction of cardiovascular risk[120]. Overall, white meat (non-fried) consumption has a neutral or inverse relationship with CAD.

Fish:

Oily fish is rich in omega PUFAs - eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)[121], Several studies have demonstrated decreased CAD in fish eaters[122]. The reduction has also been seen in non-fatal myocardial infarction, fatal myocardial infarction, and sudden death[123-125]. In the Diet And Reinfarction Trial, consumption of oily fish twice a week was associated with a 32% reduction in CHD mortality[126]. A 36% decreased mortality was noted in those consuming fatty fish or seafood (providing 250–500 mg/day of marine n-3 PUFA) when compared to those who consumed little or no seafood[127]. Plant-based omega PUFA, alpha-linolenic acid (ALA), is also cardioprotective, although only 0.2% to 8% of ALA is converted to EPA. The risk reduction is 10% between the highest vs. lowest tertile of ALA intake[127].

Overall, higher fish intake (especially oily/fatty fish such as salmon, tuna, sardines, mackerel, and trout)1 - 2 times per week, is beneficial for the primary and secondary prevention of CHD[128]. The EPA and DHA fatty acids, besides having anti-inflammatory effects, induce a wide array of cardio-vascular effects. These include reduced platelet activation and aggregation and stabilization of atherosclerotic plaques[129].

Alcohol:

The relationship between alcohol intake and CAD is complex and appears to be J- or U-shaped[130-132]. It is well documented that low to moderate drinking imparts cardioprotection[133-135]. Low to moderate alcohol drinkers have less severe coronary lesions on angiography[136]. They also have a reduced risk of MI and CHD mortality[133,137]. On the other hand, heavier alcohol consumption[134] and binge drinking[138] is associated with increased CHD[133,139] and CHD mortality[140]. A recent Mendelian randomization study documented that heavy alcohol consumption was associated with an increased risk of subclinical coronary atherosclerosis[141]. The AHA recommends that men consume less than 2 standard drinks a day and women consume less than 1 standard drink a day. In the United States, one “standard” drink contains roughly 14 g of pure alcohol, which is typically found in 12 oz of regular beer (usually about 5% alcohol), 5 oz of wine (usually about 12% alcohol), and 1.5 oz of distilled spirits (usually about 40% alcohol)[103].

The beneficial effects of alcohol are due to several actions [142-149]. Low to moderate intake tends to increase HDL-C[142] and apolipoprotein A-I[143]. Alcohol intake has an inverse association with

T2DM[144]. Alcohol helps alter the atherosclerotic plaque composition and provide stabilization[145]. Alcohol also exerts several effects on factors involved in hemostasis, such as inhibition of platelet aggregation[146], lowering of fibrinogen levels[147], and decreasing plasma viscosity[148]. It also increases levels of tissue plasminogen activator[149].

Coffee

Coffee is a widely consumed beverage in the world (average consumption of 2.9 cups/day)[150]. Coffee intake in moderation appears to be cardiovascular protective[151,152.] In a dose-response meta-analysis of the relationship of coffee intake and CVD risk (36 studies with 1,279,804 participants), moderate coffee consumption (3 to 5 cups per day), was associated with the lowest CVD risk, while heavy consumption did not increase CVD risk compared to non-consumers[151]. The 2015–2020 Dietary Guidelines for Americans indicate that consumption of 3 to 5 cups/d of coffee is associated with a reduced risk of CVD in adults[152].

Its consumption has also been studied in relation to the incidence of CAD. Coronary artery calcium (CAC) detected by cardiac computed tomography is a subclinical marker of atherosclerosis, which predicts cardiovascular heart disease[153,154]. In a study of 1570 adults (Rotterdam Coronary Calcification Study), there was a lower risk of coronary calcification in women consuming more than 3 cups of coffee per day[155]. A lower prevalence of coronary atherosclerosis was also found in a cross-sectional study of 25,138 young and middle-aged adults, consuming 3 to 5 cups of coffee per day[156]. Another recent study found that the inverse association between coffee intake and coronary calcification persisted even after adjustments for potential confounders, including cardiovascular risk factors[157].

The effect of coffee on CAD health is primarily based on the effects of coffee on BP[158] and lipid levels[159]. Although coffee intake may increase the BP in the short-term, in the long-term, intake of coffee, over 2 weeks or more, does not appear to have a substantial impact on BP, in normotensive or hypertensive individuals[158]. Coffee is a complex mixture of several compounds including caffeine, minerals, fiber, and other biologically active components, such as diterpene alcohols, cafestol, kahweol, and phenolic acids, that influence human homeostasis and metabolism[160]. Coffee, particularly unfiltered coffee (such as French press, Scandinavian boiled coffee, or Turkish coffee) is rich in cholesterol-raising compounds (diterpenes, kahweol, and cafestol) and increases total cholesterol, LDL-C, and triglycerides (TG)[161,162]. Consumption of filtered coffee does not affect blood lipids[161,163]. The process of brewing releases oil droplets containing diterpenes from ground coffee beans and these are captured by the paper filter[161,164]. A high intake of unfiltered coffee (6 cups per day) increases LDL-C by 17.8 mg/dL[165]. Coffee also reduces the risk of T2DM – a major cause of CAD[166].

TEA

Tea is consumed in different parts of the world as green, black, or Oolong tea. Of the tea consumed worldwide, 78% is black tea; 20% and 2% is Oolong tea. Green tea is produced by steaming or drying the leaves of *Camellia sinensis* (without fermenting), leaving them rich in polyphenols and strong antioxidant actions. Green tea consumption was associated with a lower

incidence of CAD in a study population in Japan[167]. A subsequent meta-analysis of 18 studies included 13 studies on black tea and 5 studies on green tea. While no significant association was seen with the risk of developing CAD with the consumption of black tea, the results were different for green tea. An increase in the intake of 1 cup/day of green tea was associated with a 10% decreased risk of CAD incidence (RR: 0.90)[168]. The Harvard Health cites a study of 40,530 Japanese adults, where drinking more than five cups of green tea a day resulted in a 26% lower risk of death from a heart attack (and stroke) than people who drank less than one cup of green tea a day[169]. Oolong tea is also helpful. It increases plasma LDL particle size, and this helps prevent LDL oxidation and helps retard atherosclerosis[170].

Polyphenols are the main functional extracts from green tea[171]. They account for up to 40% of the dry weight of green tea[172]. About 60% of all polyphenols are flavonoids. These have a strong antioxidant actions and also exhibit some anti-inflammatory activity. These induce favorable effects on endothelial function[173]. Green tea also reduces LDL-C and TG levels[174]. Studies show that dietary flavonoid intake is inversely related to the rate of mortality from CAD[175,176].

Comment [PKH1]: A strong antioxidant action

Comment [PKH2]: action

Chocolate:

Comment [PKH3]:

The medical literature is full of studies on the health benefits of cocoa. Its benefits on coronary heart disease have been extensively studied[177]. Buijsse, et al. in 2006 reported that when comparing the consumption of >2.25 g cocoa/day (approximately equivalent to the cocoa contents found in 8.5 g of dark chocolate) with the consumption of <0.5 g cocoa/day (approximately equivalent to the cocoa contents in 1.4 g dark chocolate), the risk of CVD death was reduced by 50% in the former group[178]. The National Heart, Lung, and Blood Institute Family Heart Study reported an inverse relation between chocolate intake and the prevalence of CAD[179]. A subsequent study involving 20,915 adults reported a 12% reduction in CAD (Hazard Ratio=0.88)[180]. A Swedish prospective study found that chocolate consumption (≥3–4 servings/week) was associated with a lower risk of myocardial infarction and ischemic heart disease[181]. Two recent studies reported similar results[182,183]. A study by Ho et al., published in 2021, also reported CAD protective effects associated with chocolate intake[184]. Overall, chocolate is cardioprotective, but the amount needed varies according to the study. It may be safe to limit chocolate intake to <100 gm/week. Dark chocolate contains cocoa bean solids and is associated with most of the coronary health benefits[185]. On the other hand, milk chocolate contains, besides cocoa butter and cocoa, sugar, milk powder, and lecithin. It is an energy-dense food and contains a relatively high amount of saturated fat and added sugar[186]. In prospective studies, higher milk chocolate intake was associated with greater weight gain[187] and often worse cardiac outcomes[188].

Cocoa beans, the main ingredient of dark chocolate, contain several hundred plant chemicals with many of them exerting cardio-protective effects[189]. These include polyphenols, which constitute about 10% of a whole bean's dry weight[190]. These polyphenols exert beneficial effects on endothelial function, platelet aggregation, insulin sensitivity, oxidative damage, and inflammation[191,192]. There is also BP reduction and lipid profile improvement associated with cocoa intake[193,194]. Cocoa beans also contain fiber and methylxanthines (theobromine and caffeine)[195]. Several studies suggest that theobromine may enhance flavanol-related decrease of blood pressure, increase flow-mediated dilatation, and increase HDL-C[196,197]. The fat in cocoa (40–50% as cocoa butter - approximately 33% oleic acid, 25% palmitic acid, and 33% stearic

acid) appears to have a neutral effect on blood lipid levels[198]. Cocoa is also rich in several minerals including potassium, phosphorus, zinc, and magnesium, and these may also play a beneficial role[195].

Conclusion

Coronary artery disease is a major cause of global morbidity and mortality. Lifestyle factors play an important role in its prevention and progression. A plethora of scientific studies has clearly shown the benefits of a plant-based diet. This diet is rich in fruits and vegetables, whole grains, legumes, nuts, and fiber. Oily fish provides EPA and DHA, which are also beneficial. Consumption of dairy and eggs appears to be neutral. Beverages like tea, coffee, and dark chocolate, are also cardioprotective. Alcohol is a double-edged sword, being associated with a reduction in CAD in low to moderate consumption. The deleterious impact of obesity and the consumption of red meat, saturated fats, refined carbohydrates, ultra-processed foods, and sugar-sweetened beverages is discussed in part 2 of this 3-part manuscript.

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