REVIEW ARTICLE

NUTRITIONAL NEEDS FOR CARDIOVASCULAR HEALTH IN PAKISTANI POPULATION. PART 1. THE BASIC CONCEPTS OF A HEALTHY HEART DIET

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Cardiovascular disease (CVD) is the leading cause of death worldwide; responsible for 30% of all deaths globally. Food and nutrition are evidently an integral part of human health and play a crucial role in the cardiometabolic health of an individual. Poor diet quality is strongly associated with elevated risk of CVD morbidity and mortality. There is also strong evidence showing the effectiveness of "healthy" diet and other lifestyle patterns in the primary and secondary prevention of cardiometabolic disease spectrum.

There has been much emphasis on the preventive aspect of CVD and overall cardiometabolic health over the last three decades. Western societies and health systems have done quite a lot in improving and promoting healthy lifestyle choices. Unfortunately, developing countries, despite the worrisome rise in these preventable conditions, have contributed little to address this major issue with significant health and economic implications. The emphasis in these countries is mostly on the therapeutic, pharmacological, and more expensive tertiary management of the conditions that arise from poor cardiometabolic health, lifestyle, and dietary patterns. There is a lack of relevant and easy to understand authentic patient information or any effort to disseminate it to the public and patient population. Furthermore, there is not much effort at the governmental level to implement any meaningful measures concerning prevention of these conditions for the public at large.

In this review about the nutritional needs and recommendations for cardiovascular health for Pakistani population, we have tried to encompass the relevant information into two papers. In the first, we cover the basic concepts, including mechanisms and other information relating to food and nutrition and their association with CVD and other cardiometabolic conditions (diabetes, dyslipidaemia, etc.). In the upcoming second issue, we will discuss more specific recommendations for the Pakistani population and dietary advice for CV health.

Keywords: Cardiometabolic disorders, healthy diet, diabetes, lifestyle, dyslipidaemia, obesity, micronutrient, macronutrient

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FOOD AND NUTRITION: BASIC CONCEPTS

Why is food important?

Food is a substance that provides the components of nutrition. These components or nutrients provide the energy to sustain the body, to survive, grow, repair, and develop immune systems to fight off diseases and other elements of the nature. Healthy diet and food choices are protective and beneficial, whereas unhealthy and poor nutritious dietary patterns have been shown to be associated with several types of morbidities including CVD and other cardiometabolic disorders.[1-3] The WHO describes a healthy diet as essential for good health that provides protection against many chronic noncommunicable diseases (NCD) such as heart disease, diabetes, and cancer. Eating a variety of foods and avoiding excessive salt, sugars, and saturated and industrially produced trans-fats are the mainstay of a healthy diet.[4]

Association of foods, nutrients, and dietary patterns with cardiovascular disease risk

In the development of chronic diseases, multiple risk factors and metabolic cascades interact with and contribute to pathological processes and disease-causing mechanisms. CVD and metabolic disorders are a spectrum of conditions that are associated with excessive caloric intake, insulin resistance, truncal obesity, visceral fat deposition, prediabetes, and dyslipidaemia. This milieu together with other lifestyle factors such as smoking can initiate

atherosclerosis, dysglycemia and their sequelae.[5] The term cardiometabolic disease is used as a collective term to bring these conditions as an interrelated process and seem to share or relate to risk factors such as adverse weight, dyslipidaemia and high blood pressure (Figure 1).[6] There is no single prevention strategy, rather a "whole package" is required for a comprehensive management of these mostly associated conditions. With regards to food and nutrition for healthy CV health, there is no single "magic bullet". It is the totality of what we eat and the use of dietary patterns that plays the most important role.

Figure 1: Cardiometabolic disease spectrum

A wide array of research has shown the roles different nutrients or components of food play in CV health.[7]

Table 1: Summary of associations of nutrients and foods with cardiovascular disease risk[7]

Nutrients	Cardiovascular Disease	Association
Fatty acids		
Replacing five en% SFA with PUFA	CHD	25% lower
Replacing five en% SFA with MUFA	CHD	15% lower
Replacing five en% SFA with complex carbohydrates	CHD	9% lower
Replacing SFA with refined carbohydrates	CHD	None
Replacing SFA with TFA	CHD	5% higher
Minerals		
Sodium: 1 g/day reduction	CVD	20% lower
Potassium: high versus low intake (<120 mmol/L)	Stroke	24% lower
Fiber		
7 g/day higher intake	CHD	9% lower
10 g/day higher intake	Stroke	16% lower
10 g/day higher intake	Type 2 diabetes	6% lower
Fruits and vegetables		
200 g/day higher intake	CVD	8% lower
200 g/day higher intake	CHD	8% lower
200 g/day higher intake	Stroke	16% lower
Pulses		
Per 4 weekly servings of 100 g	CHD	14% lower
Nuts		
Per 28 g/day	CVD	21% lower
Per 28 g/day	CHD	29% lower
Per 28 g/day	Stroke	7% lower
Whole grain foods		
90 g/day versus no intake	CHD	25% lower
Red meat		
Unprocessed: 2 versus 0 servings/week	CVD	3% higher
Processed: 2 versus 0 servings/week	CVD	7% higher
Fish		
Per 20 g/day	CHD incidence	4%
Per 20 g/day	CHD mortality	4%
Sugar-sweetened beverages Two servings/day versus one serving/month	CVD mortality	31% higher
Alcoholic beverages		
Per 12.5 units/week	Myocardial infarction	6% lower
Per 12.5 units/week	Stroke	14% higher

Modified and adopted from Verschuren WMM, et al.[7]

CVD, cardiovascular disease; CHD, coronary heart disease; En%, percentage of total energy intake; DASH, dietary approaches to stop hypertension; PUFA, polyunsaturated fatty acid; MUFA, monounsaturated fatty acid; RCT, randomised controlled trial; TFA, trans fatty acid; SFA, saturated fatty acid.

Understanding the concept of balanced caloric intake, body needs, and the importance of healthy weight

Maintaining the balance of caloric intake over a longer period is important to sustain a healthy weight and the closely associated with the overall health of an individual. Excessive consumption of calories in any form will lead to excess weight gain and in some cases obesity. High body mass index and body habitus caused by excessive caloric intake is the foremost important lifestyle factor shown to be linked with overall poor health outcomes. There is, therefore, a strong association with premature mortality as well as a higher prevalence of NCDs such as CVD, hypertension, diabetes and cancer with overconsumption of calories and its sequelae.[8-10] For individuals to maintain an "optimal weight", energy expenditure should equal the amount of caloric intake. This usually warrants limiting caloric consumption whilst also engaging in the recommended level of physical activity. Total energy expenditure for recommended caloric intake is a daily basis is based on age, weight, gender, and activity level (Table 2).

Table 2: Estimated caloric needs per day, by age, sex, and physical activity levels as per 2015-2020 Dietary Guidelines[109]

Age (years)	Sedentary*	Moderately active¶	Active Δ
Males			
2	1000	1000	1000
3	1000	1400	1400
4	1200	1400	1600
5	1200	1400	1600
6	1400	1600	1800
7	1400	1600	1800
8	1400	1600	2000
9	1600	1800	2000
10	1600	1800	2200
11	1800	2000	2200
12	1800	2200	2400
13	2000	2200	2600
14	2000	2400	2800
15	2200	2600	3000
16	2400	2800	3200
17	2400	2800	3200
18	2400	2800	3200
19 to 20	2600	2800	3000
21 to 25	2400	2800	3000
26 to 30	2400	2600	3000
31 to 35	2400	2600	3000
36 to 40	2400	2600	2800
41 to 45	2200	2600	2800
46 to 50	2200	2400	2800
51 to 55	2200	2400	2800
56 to 60	2200	2400	2600
61 to 65	2000	2400	2600
66 to 70	2000	2200	2600
71 to 75	2000	2200	2600
76 &up	2000	2200	2400
Females◊			
2	1000	1000	1000
3	1000	1200	1400
4	1200	1400	1400
5	1200	1400	1600
6	1200	1400	1600
7	1200	1600	1800
8	1400	1600	1800
9	1400	1600	1800
10	1400	1800	2000
11	1600	1800	2000
12	1600	2000	2200
13	1600	2000	2200
14	1800	2000	2400
15	1800	2000	2400
16	1800	2000	2400
17	1800	2000	2400
18	1800	2000	2400
19 to 20	2000	2200	2400
21 to 25	2000	2200	2400
26 to 30	1800	2000	2400
31 to 35	1800	2000	2200
36 to 40	1800	2000	2200
41 to 45	1800	2000	2200
46 to 50	1800	2000	2200
51 to 55	1600	1800	2200
56 to 60	1600	1800	2200
61 to 65	1600	1800	2000
66 to 70	1600	1800	2000
71 to 75	1600	1800	2000
76 and up	1600	1800	2000

** Sedentary means a lifestyle that includes only the physical activity of independent living.*

¶ Moderately active means a lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, in addition to the activities of independent living.

Δ Active means a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour, in addition to the activities of independent living.

◊ Estimates for females do not include women who are pregnant or breastfeeding.

The concept of high satiety and low caloric foods

To consume a satisfying diet with high inter-meal and intra-meal satiety, a diet should ideally be based on low-energy-dense foods; however, such foods do not usually exist. To get a sense of fullness while eating (high meal satiation), limit the overconsumption of food, and to get high inter-meal satiety; a balanced diet low in fat, sufficient fibre and protein portioned with an adequate quantity of whole grains, fruits, vegetables, and other foods with high water content should be consumed.

What are major components of nutrition?

Nutrition has two major components. The first component is comprised of macronutrients that form a major part of our diet and include proteins, lipids, and carbohydrates. These account for almost 500 grams/day in mass of our diet. These macronutrients are necessary for performing various physiological functions involving metabolic activities, protein synthesis, and energy metabolism. The second is comprised of micronutrients which are not direct energy sources and facilitate various metabolic processes. These micronutrients are required in small amounts. So, for example the quantity of vitamins required by an adult are about 300 milligrams/day and minerals about 20 grams/day. Micronutrients carry out much subtler biochemical and physiological processes at cellular levels. Deficiencies in micronutrients can affect growth, survival, and reproduction. The last nutrient category is water, which provides the medium in which all the body's metabolic processes occur. A nutrient is considered "essential" if it must be taken in from outside the body—in most cases, from the food sources.[11]

MACRONUTRIENTS AND THEIR ASSOCIATION WITH CARDIOVASCULAR HEALTH

Fats

Fat from animal sources include poultry, fish, meat, and dairy (including butter, cheese and cream). Eggs

are not considered as part of fats due to their low-fat content. Dietary fats are divided into saturated fatty acids (SFAs) and unsaturated fatty acids (UFAs). UFA are further divided into polyunsaturated fatty acids (PUFAs), monounsaturated fatty acids (MUFAs) and trans fatty acids (TFA). The fat content in meat can vary substantially depending upon the proportion of total and saturated fatty acids. Animal feed directly affects its fatty acid profile. Lower total fat content is observed for grass-fed beef than grain-fed beef. Fatty fish (salmon, mackerel, sardines, trout and herring) containing omega 3; docosahexaenoic acid and eicosapentaenoic acid are considered to be the healthier form of animal fats.[12]

Plant fat is obtained from seeds, nuts, and vegetables (including vegetable oils). The vegetable oils have varying fatty acid profile. Walnut, soybean, safflower, sunflower oil contain high content of n6 polyunsaturated fats. While walnut, flaxseed, and rapeseed contain high content of n3 polyunsaturated fatty acids. Olive oil predominantly contains n9 monounsaturated fats. Saturated fat (SFA) is predominantly found in coconut oil (a plant-based oil) (Table 3). Dietary fats have been focus of much interest and research and work due to their effect on blood lipid levels.[13, 14]

Table 3. Sources and main effects of dietary fat; adapted from Nurses' Health Study[13]

Type of fat	Chief food sources	Leading food contributors in diets of adults in the United States*	Effects on cholesterol	Effects on coronary heart disease
Trans fatty acids obtained from vegetable oils	Stick and full-fat margarine; commercial baked goods; deep-fried foods	Fast food; margarines; commercial baked goods (cookies, sweet rolls, donuts)	Increased LDL cholesterol, lower HDL cholesterol	Increased risk of coronary heart disease
Saturated fatty acids	Red meat; dairy foods; some plant oils (coconut, palm)	Dairy foods, especially cheese, milk, ice cream; red meat	Increased total cholesterol	May increase the risk of coronary heart diseases
Polyunsaturated fatty acids; n-6	Safflower, corn, sunflower oil	Margarines; mayonnaise; nuts; salad dressing; peanut butter; chicken	Lowered LDL cholesterol and triglycerides, increases HDL	May reduce risk of coronary heart disease
Polyunsaturated fatty acids; n-3	Canola, soybean, flaxseed, walnut oil, wheat germ, vegetables of cabbage family For longer-chain n-3 fatty acids: seafood, especially fatty fish	Alpha-linolenic acid (18:3): mayonnaise, salad dressing, margarines, beef; longer-chain n-3: tuna, other dark fish, shrimp	Lowered LDL cholesterol and triglycerides, maintains HDL cholesterol	May reduce risk of coronary heart disease
Monounsaturated fatty acids	Vegetable sources (olive oil, canola oil); also, from dairy and meat	Beef; margarines; chicken; olive oil	Lowered LDL cholesterol and triglycerides while maintaining HDL cholesterol	Probably has no contribution

LDL: low-density lipoprotein; HDL: high-density lipoprotein.
* Data from participants in the ongoing Nurses' Health Study (women) and Health Professionals' Follow-up Study (men)[13].

In short-term non-epidemiological dietary intervention work, SFAs and TFAs have been shown to be associated with raised levels of total cholesterol (SFA) and TC and LDL cholesterol levels (TFA). In some of the more long-term longitudinal cohort studies however, increased intake of saturated fats has not been found to be associated with raised CVD mortality.[11] One major study, the Prospective Urban Rural Epidemiology (PURE) study, actually showed association of reduced CV mortality and morbidity with higher intake of SFA.[15] However, there appear to be many methodological flaws and deficiencies in studies showing favourable results of use of saturated fats. It is, however, obvious from several other studies where SFAs intake is replaced by healthier alternatives for example MUFAs, the CHD risk reduction is substantial. Similarly, if complex carbohydrates replace SFAs, there is CHD risk reduction. However, if instead of complex carbohydrates, refined carbohydrates are used, the risk of CHD doesn't decrease. Furthermore, if TFA is used as the main dietary fat as a replacement to SFA, it significantly increases the CHD risk. In essence therefore, there is good evidence of the practice of avoiding TFA and significantly reducing SFA with PUFA to prevent and lower the risk of CVD.[16-18]

Omega-3 fatty acids are essential fatty acids acquired from dietary sources. Cold water oily fish are the best

food source of omega-3 fatty acids (also called ω-3 or n-3). There are two main types of omega-3 fatty acids in fish — eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Some plants also contain omega-3 fatty acids. The form of omega-3 in plants is called alpha-linolenic (ALA). Oily fish consumption has been shown to be inversely associated with CVD in most of the observational studies. A review of 11 cohort studies involving 116,764 individuals proposed that in high risk but not in low-risk patient populations, 40–60 g daily fish consumption is associated with noticeably reduced CHD mortality.[19] A significant decrease in mortality rate was observed in a meta-analysis including 7951 individuals treated with omega-3 compared to 7855 controls.[20]

Statins, when taken with omega-3, have been shown to be the most effective combination in a meta-analysis of 97 studies, having different lipid management strategies, with a 23% reduction in relative-risk for total mortality.[21] However, treatment with omega-3 in high-risk patients (such as diabetes or CHD) has shown mixed results. Some studies support the significant benefit of the treatment while others show only a slight additional benefit.[22] Three different meta-analyses have found little evidence of the beneficial effect of omega-3 supplementation for the incidence of atrial fibrillation, CVD and cerebrovascular disease.[23] In another meta-analysis containing 20 studies, no significant association was observed with omega-3 PUFA supplementation and lowered all-cause mortality, sudden death, cardiac death, stroke or MI.[24]

Fish oil, walnut oil, and flaxseed oil are used as commercially made supplements containing omega-3 fatty acids. These fish-based omega-3 fatty acid supplementations are considered safe as per FDA but some concerns about their purity have been raised due to contamination with mercury, polychlorinated biphenyls (PCBs) and pesticides. Clinical trials using different esters of omega-3 fatty acids have reported a change in bioavailability and metabolism.[25] Side effects are not reported with commonly used daily doses of up to 1 g. However, GI upset, deteriorating glycaemic control and high LDL-C levels have observed with high doses.[19]

Protein

Protein is a macromolecule and is one of the vital macronutrients which can be obtained from both plant and animal sources. It is a great source of strength and developmental functions. However, meat protein has been shown to be associated with an increase in risk of CHD. Increased caloric consumption of processed meat or red meat has been associated with increased risk of various chronic illness and premature mortality.[26] In meta-analyses of prospective cohort studies, an association has been found between increased consumption of red meat and increased risk of diabetes, stroke, and increased CVD mortality.[27] In addition to this, increased consumption of processed or red meat has been found to be associated with increased risks of CHD and all-cause mortality.[28]

In the Nurses' Health Study, diets low in red meat, containing nuts, low-fat dairy, poultry, or fish, were associated with a 13% to 30% lower risk of CHD compared with diets high in meat.[29] In the study on the dietary proteins and proteins sources, lean animal protein has been shown to be a safer choice than fattier types.[30] A weaker association has been shown with plant protein or dairy as compared to animal protein. Stronger associations are observed in comorbid patients or those with predisposing factors such as diabetes.[31-33] There is also a long-standing view that high protein intakes can be a potential cause of renal failure which was highlighted in an observational study. Deterioration in renal function was observed in post-myocardial infarction patients with high protein intake.[34]

Carbohydrates

Carbohydrates sources include breads, pastas, cereals, vegetables, and fruit. Due to differences in chemical structure, fibre content, and degree of processing, different forms of carbohydrates have varied biological functions and effects on health. There is no clear evidence that the percent of dietary energy from total carbohydrates has an important effect on health outcomes, although the nature and the amount of the carbohydrate source may differentially affect postprandial glycemia, metabolic response, bodyweight, and major health outcomes including CHD.[35] Of great interest in carbohydrates is the presence and amount of fibre.

In a review of 10 studies that included 56–85 g of fibre conducted on patients suffering from CHD, or its associated risks were reviewed. An association was found between the consumption of whole grains and reduction of total cholesterol levels by 7.7 mg/dL and LDL-C levels by 6.9 mg/dL.[36] In a meta-analysis of 67 controlled trials, intake of 2–10 g/day soluble fibre resulted in the reduction of LDL-C by 2.2 mg/dL with no noteworthy changes in triglycerides or HDL-C.[37]

The American Heart Association (AHA) guidelines, The National Cholesterol Education Program (ATP III) guidelines and The American Dietetic Association guidelines; all recommend consumption of dietary

soluble fibres due to its health benefits. The beneficial effects of dietary fibre in the form of supplementation have not been explored. Despite this, the health benefits of soluble fibre obtained from sources such as whole grain, barley, and whole oats have been approved by Food and Drug Administration (FDA). The ADA recommends intake of 14 g dietary fibre per 1000 kcal.[38]

The association of protein and carbohydrate use with the risk of CVD has also been studied to a lesser extent. These studies mostly consisted of low carb and high protein content. Some are very low carbs and high protein (ketogenic diet) and have shown significant weight loss and improved glycaemic and lipid levels in patients with Type 2 diabetes mellitus (T2DM).[39] There is however not enough data to advocate this strategy to improve CV risk especially those with T2DM and obesity. In long term studies, such so called ketogenic diets may cause an increase in the all-cause mortality.[40]

MICRONUTRIENTS

Vitamins and minerals

The human body has high sodium and potassium content and they have a very important role in CVD prevention because of their effect on blood pressure and rhythm generation besides many other functions. There has been some debate about this much known and emphasized relation between sodium taken mostly as table salt and its link to blood pressure.[41] Overall, however, there is good evidence about reducing salt (sodium) as a measure to prevent CVD. It is therefore recommended that the maximum amount of sodium should not exceed 2g/day (5g of salt/day) and more optimal dose perhaps is around 1.2 g of sodium (3g of salt/day). Potassium mostly present in food such as fruit, green leafy vegetables, whole grains and meat have a BP lowering effect and its higher use is shown to reduce the incidence of stroke.[42]

Vitamins:

Vitamins are required in small amounts to help in numerous bodily functions. They act as cofactors in energy metabolism and hence are essential micronutrients. The association between different vitamin deficiencies and chronic diseases has been established through observational studies. There is however a lack of data that support the role of vitamin supplementation for the treatment or prevention of chronic diseases. The paucity of evidence in this area is due to the technical and methodological issues associated with such work.[43]

High levels of homocysteine are observed to be associated with an increased risk of CVD. Elevated levels of homocysteine can be reduced with supplementation with vitamin B12, folic acid vitamin B6. However, data from interventional meta-analyses of randomized trials for secondary prevention with these elements has not shown prevention of cardiovascular disease.[44-46]

Folate deficiency is linked with increased risk of hypertension. Nurses' Health Study, a large prospective study showed lower risk of developing hypertension in a sub group taking supplemental folate.[47] The evidence however is considered insufficient for folic acid supplementation to be routinely used to reduce the risk of hypertension.

Vitamin D has been studied extensively for a potential causal and prevention role in chronic diseases including CVD. However, no relationship between poor vitamin D status either in the cardiovascular and metabolic diseases, has been found. Vitamins A, C, and E have antioxidant roles. No reduction in risk of CVD or cancer has been found in randomized trials with antioxidant supplements as an intervention.[48,49] In a large observational study of 43,738 men, no link was found between supplemental vitamin C and reduction in the risk of stroke.[49] Almost all of the well-designed randomized control trials using vitamin E supplementation for the prevention of CHD showed no benefit for the prevention of coronary heart disease.[48] One study showed supplemental vitamin E to be associated with increased incidence of heart failure.[50] A meta-analysis of nine randomized trials, showed no link with vitamin E supplementation and risk of total stroke.[49] In essence therefore, vitamin supplementation is not recommended for prevention or treatment of CVD.

FOODS AND FOOD GROUPS

Fruits and vegetables

Fruits and vegetables are high in nutrients and based on extensive epidemiological data are considered to be cardioprotective. In a meta-analysis of 9 cohort studies (including 129,701 women, 91,379 men, and 5007 CHD events), CHD risk was shown to be reduced by 7% for each extra fruit serving a day. The association between the risk of CHD and intake of vegetables however was more varied. The use of vegetables was more linked with CV mortality and less so for fatal and nonfatal myocardial infarction (MI).[51]

There are no interventional studies which specifically assessed the effect of fruits and vegetables on CHD risk. Carrying out interventional studies associated with nutrition is not easy and fraught with

methodological and technical issues. The epidemiological studies recommending the consumption of fruit and vegetables showed lowered risk of CHD.[52] Several studies have shown the link between the use of fruits and vegetables with reduced incidence of hypertension, CHD, stroke, and CVD mortality.[53] However, no definite recommendations about the optimal amount of fruit and vegetables for maximum CV benefit are currently available. There are recommendations of CHD benefit over 400 g/day[54] while others showing little further benefit of over 300 g/day.[33] This study has also highlighted the cardioprotective benefits of the use of raw vegetables. Canned fruit on other hand has been shown to be strongly associated with increased all-cause and CVD mortality.[55] Several studies have reported a reduction in blood pressure with optimum vegetable and fruit consumption.[56] However, the association with other risk factors of CHD is well understood.

American Heart Association (AHA) recommendations suggest a daily intake of at least 8 fruits and vegetables.[3] The beneficial effects of its intake can be attributed to the antioxidants, flavonoids and dietary fibre content.[57] Fruits and vegetables are mostly low-calorie, less energy dense food group and usually contain high potassium and low-sodium and have low glycaemic index and high satiety value. It should therefore be an important and vital constituent of a healthy diet.

Eggs

Eggs are a rich source protein and certain nutrients such as vitamin D, B6 and B12. They typically contain 150–230 mg of cholesterol per egg.[58] The association between egg consumption and CVD remains controversial for the medical practitioner and patients alike, particularly those with predisposing factors and heart disease. Due to the lack of evidence supporting the restriction towards the consumption of eggs, guidelines have made changes to remove any reference to limiting egg and cholesterol intake[59, 60] ,although it is still emphasised in the most recent American guidelines from primary prevention of CVD.[61]

In a recent analysis of prospective cohort data, Zhong et al suggested a positive association between intake of eggs and dietary cholesterol and incident CVD and all-cause mortality. However, these findings are inconsistent from prospective cohort studies.[33,62,63] A study of half a million Chinese population by Qin et al observed a lower risk of CVD with the consumption of <1 egg per day. Greater the egg intake, greater the risk of CHD and CVD.[64] In summary, eggs are high in protein content, low in calories and contain beneficial micronutrients and can form part of a healthy cardioprotective diet.

Dairy

Dairy products are considered relevant for CV health because of the SFA content in the whole milk, butter, yoghurt, cheeses and other full fat dairy products. There is however increasing amount of data that has endorsed neutral effects of the use of dairy on CVD risk. Several studies have also shown the inverse and beneficial association between dairy intake and CVS health.[65-68]

A comprehensive review and assessment of several systematic reviews and several meta-analyses showed no association between the amount of total dairy intake and incidence of CVD. The use of high-fat dairy was not found to be linked with increased risk of CHD. However, the consumption of low-fat dairy products significantly reduced CHD risk. Use of dairy was shown to have no or in some studies inverse relation with the risk of CHD, CVD and stroke incidence. Moreover, their use did not show any considerable change in the TC and LDL-C levels. There was also no significant or discernible effect on blood pressure.[68]

In essence therefore, the caloric content of dairy products if taken in excess may cause weight gain and therefore deleterious long-term effects. However, this food class overall is enriched in amino acids and is known to potentiate muscle growth. It is a great source of calcium and phosphorus and has no significant causal role in CVD and therefore should be constituent of a healthy diet.

Nuts

Nuts are nutrient-rich foods and contain UFAs, are a good source of fibre and contain high-quality vegetable protein. They are also a good source of minerals, phytosterols, tocopherols and phenolic compounds. Walnuts and some other nuts also contian of ALA.[69] Peanuts, although, ground nuts but are included in this group since they share a similar nutrient profile with tree nuts.[70]

Epidemiological studies have shown a consistent inverse correlation between consumption and use of nuts and CHD risk.[71] The beneficial CV health effects of nuts are attributed to their low SFA and higher PUFA content. Some studies have observed a dose-response pattern of association. A meta-analysis of four studies showed a significant 35% risk reduction for CVD with high intake of nuts.[70] Another analysis of 25 intervention trials data on the use of different nuts (that included walnuts, macadamias, pistachios, almonds and pecans) in 583 subjects with or without hypercholesterolemia showed that a mean

consumption of 67 g / day of nuts is associated with a considerable reduction in the LDL-C of 10.2 mg/dL and no significant changes in HDL-C levels. The effects on cholesterol level were associated with the amount and dose of the nuts. The effect on the lipids was similar across the board for all varieties of the nuts used in the studies. The lipid-lowering effects were more pronounced in those with low BMI and high baseline cholesterol levels.[71]

In conclusion, the consumption of nuts overall has a beneficial effect on CV health. This is proposed to be exerted through lowering of lipid levels and their anti-inflammatory and antioxidant actions and replacement of SFA with PUFA, fibre and micronutrients. They are useful for CV health and a modest amount may be used as part of diet for primary and secondary prevention.

Soy

Soy protein is found in soybeans and can be used as a replacement and alternative to animal protein since it's a source of all essential amino acids. Soybeans have low saturated fat content with no cholesterol. Soybeans contains abundant amount of fibre, B vitamins, iron and calcium.[72]

In 22 randomized trials, a comparison of isolated soy protein with isoflavones was done with other proteins including milk protein, casein, wheat protein and animal proteins. In most of these studies, compared to other proteins, soy was shown to reduce non-HDL and LDL-C concentrations. Meta-analysis of several studies of soy protein isolate use showed mean reduction of 1.99 mmHg of diastolic blood pressure in 9 studies and mean reduction of 7.3 mg/dL LDL-C in 39 studies.[73] Although the benefit in the lipid profile and blood pressure by soy protein is of little clinical significance, the consumption of soy protein-rich foods may indirectly lower risk of CVD if it is used as a more healthier lifestyle choice as an alternative animal proteins that contain higher proportion of saturated fats and cholesterol.[3]

Coffee and Caffeine

Coffee contains a substantial amount and proportion of caffeine which is a CNS stimulant. Besides caffeine, other main ingredients of coffee include chlorogenic acid flavonoids, maltol, melanoidins, pyrroles and furans. Caffeine is also constituent of cocoa, tea, soft drinks, and energy drinks.[74] Figure 2 summarises caffeine content in different food products. Coffee has been shown to exert harmful as well as beneficial effects on CVD through its different constituents. Coffee is proposed to have effects on serum cholesterol, blood pressure, oxidative pathways, inflammatory processes and levels of homocysteine.[75]

The consumption of coffee in the past was assumed to be causally associated with CVD based on several case-control studies.[76] However, the recent data does not suggest any significant or harmful effects of coffee consumption on CV system.[75,77,78] Some of the work has shown a possible preventive role of reasonable intake of coffee on CHD morbidity and CVD mortality.[79,80] In a study on the association of coffee intake with diabetes, the risk of developing T2DM was lower in the participants of the study who consumed more than four cups of coffee daily compared to the ones having less than two cups on a daily basis.[81]

In conclusion, although there are studies suggestive of a protective role for moderate quantities of coffee consumption on CAD, there is no substantial and meaningful data from randomized controlled trials to support and advise this practice. There is also little evidence of any significant health risks for adults who consume moderate amount of coffee (considered as 3–4 cups of coffee a day or around 300–400 mg of caffeine). Some groups that include children, adolescents, elderly, patients with a diagnosis of hypertension and pregnant women, however, may be more susceptible to the adverse effects of caffeine and should avoid the use of caffeine containing drinks and beverages.[82]

Tea

Tea is obtained from the plant Camellia sinensis, and it is consumed extensively worldwide. Green and black teas are processed differently during manufacturing. Typically, tea contains 30%–42% polyphenol flavonoid catechins and 3%–6% caffeine. Catechins are considered to be the component associated with the majority of the beneficial effects of tea.[83]

The Ohsaki Study, a large epidemiological study enrolling 40,530 participants in northern Japan assessed the reduction in mortality with increasing green tea consumption[84] . It showed decreasing CVD mortality with increasing green tea consumption (occasional, 1–2 cups/day, 3–4 cups/day, and 5 or more cups/day where one cup contained 100 ml green tea) at 1.00, 0.84, 0.69, 0.69, respectively. Within the CVD spectrum, the strongest data of inverse association was seen for stroke mortality. Another meta-analysis looked at the link between the use of black tea (13 studies) and green tea (5 studies) with CAD. It did not show significant association of tea consumption with the risk for developing CAD. A one-extra cup increase in the use of green tea was actually shown to be associated with 10% decreased risk of CAD incidence. One other meta-analysis of 9 studies comprising of 194,965 participants, those who consuming $\geq$3 cups of tea per day had a 21% lower

risk of stroke than those with a much lesser intake of less than 1 cup per day.[85]

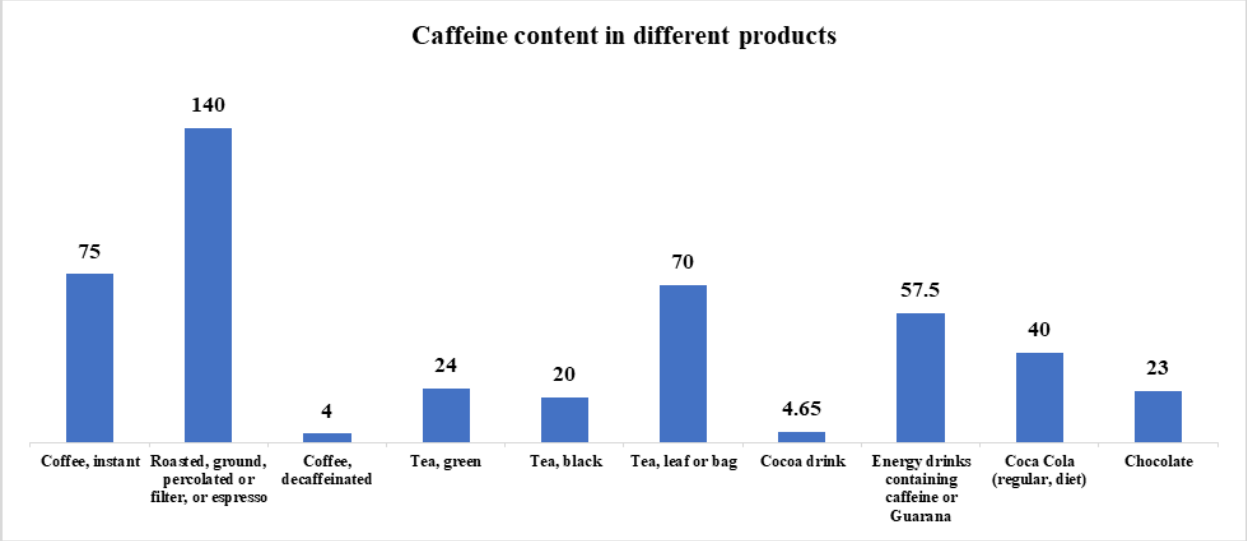

Figure 2. Caffeine content in different food products[80]

Several studies have been carried to assess the role of tea use on CVD risk factors. Beneficial effects of green tea for CVD risk have been ascertained through randomized controlled trials. In a meta-analysis of 133 trials assessing the effect of black tea consumption on systolic and diastolic blood pressure, there was an initial and short-term increase in both systolic and diastolic blood pressure. The long-term use of black tea however was not associated with any significant effect on blood pressure. Another study showed green tea consumption causing an average reduction in LDL cholesterol levels of 9 mg/dL.[73] The beneficial role of tea consumption and reduced CVD risk is possibly mediated by therians-oxidant, anti-inflammatory and anti-proliferative effects, as well as positive effects on endothelial function.[86] However, no randomized controlled clinical trials have been done to formally evaluate the effect of tea consumption its on CVD morbidity or mortality.

Chocolate

Chocolate is made from cocoa and its other major components are fat and sugar giving chocolate a higher caloric value. Cocoa obtained from cocoa liquor made from finely ground cocoa beans. Similar to green tea, cocoa is rich in polyphenols.[87] The fatty acids in cocoa (chocolate) including oleic and stearic acid in studies, have shown to have a neutral effect on blood lipid level.[88] Studies have linked chocolate use with positive effects on general human health. The consumption of chocolate is shown to have antioxidant, anti-inflammatory, and anti-thrombotic effects. Moreover, chocolate use has also been shown to have effects on cardiometabolic profile and function. It lowers insulin resistance, lowers blood pressure, activates vasodilating nitric oxide and improves endothelial function.[89] A meta-analysis of seven observational studies is reported to show favourable association between use of chocolate and the risk of CVD. Increased chocolate consumption was associated with reduced risk of CVD including 29% risk reduction of stroke.[89] However, the favourable results for chocolate use may have been influenced by the confounding factors including socioeconomic status of participants. In conclusion, therefore, despite some favourable data, there is lack of good and well-designed clinical work exhibiting CV benefits associated with chocolate use. Moreover, the high caloric composition of chocolate should also be taken into consideration before allowing its unrestricted use for any health benefits.[90, 91]

Garlic

Most of the dry weight of garlic consists of fructose-containing carbohydrates. Other main constituents include sulfur compounds, proteins, some fibre, and free amino acids. In addition, there are high levels of saponins, many minerals and few vitamins (A and C) and a considerable proportion of phenol. The beneficial CV effects of garlic is thought to be due to high content of thiosulfinates.[92] The active compound Allicin is formed when alliin, one of the sulphur-containing amino acid, is activated by enzyme alliinase when garlic in raw form is crushed, chopped, or chewed. The enzyme alliinase is however broken down by heat. Hence cooked garlic compared to raw one is pharmacologically less potent and considered of lesser benefit.[93]

Because of the medicinal value of garlic, different garlic preparations have been extensively studied for their effectiveness in preventing or managing of CVD. It is however not easy to compare these preparations for their effectiveness since their composition and content vary and differ significantly.[94] There are also no long-term observation epidemiological studies looking at the association between garlic use of CVD. Intervention trials have mostly been carried out on the CVD risk factors. A meta-analysis of 29 trials, garlic use was shown to significantly reduce total cholesterol level but had no significant effect on the values of LDL-C or HDL-C.[95] However, a metanalysis of 13 trials where garlic use was compared with placebo, no significant difference was found on all outcome measure.[96] A review of the studies carried out to investigate the effect of garlic on thrombosis has shown modest but statistically significant reduction in platelet aggregation with garlic when it was compared with placebo.[97] Garlic has also been studied for its effect on hypertension with no conclusive results or favourable outcomes have been found.[96]

Non-alcoholic beverages (sweetened, unsweetened, juices, carbonated and energy drinks)

The use of sweetened, low sugar or non-sweetened non-alcoholic drinks is on the rise. The sweetened beverages in particular can add a significant amount of refined sugar and extra calories in the diet.[98] Use of sugar added drinks is shown to be associated with weight gain and obesity.[99] In addition, the excessive use of sugar-added drinks is shown to increase the risk of ischaemic heart disease, may raise blood pressure, and other cardiometabolic disorders (prediabetes, T2DM).[54,100-103]

Low-calorie sweetened beverages are usually sweetened with low-calorie or no-calorie sweeteners (e.g., saccharin, aspartame, stevia, sucralose). Consumption of low-calorie sweetened beverages should be limited in all age groups especially children and adolescents.[104] They have not been shown to have any benefits over plain water. Evaluation of adverse effects of low-calorie beverages is an active area of research; potential adverse effects include decreased intake of healthier alternatives (e.g., cow milk), development of a taste preference for sweetened beverages, and altered sensations of fullness and hunger.[105-108]

CONCLUSION

In the first part of our review, we focused on the concepts and definitions associated with nutrition. Moreover, we reviewed the data about several nutrients shown to have association with cardiovascular health. Healthy nutritious diet, appropriate caloric intake and associated weight are shown to be associated with improved cardiovascular health and lower morbidity and mortality. Complex carbohydrates, polyunsaturated fatty acids and low-fat content meat and use of fish are also better alternative to refined carbohydrates, saturated, industrially hydrogenated fats. Similarly nuts, fruit and vegetables, low sodium and higher potassium use is linked with better outcomes. In the second part of the review on the nutrition for cardiovascular health for Pakistani population, we will assess the data available about nutrition in context of the Pakistani population and specific recommendations for a healthy heart diet.

AUTHORS' CONTRIBUTION

SUS, TW, TA, and MIS: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work.

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REFERENCES

1. Mozaffarian D. Dietary and policy priorities for cardiovascular disease, diabetes, and obesity: a comprehensive review. Circulation. 2016;133(2):187-225.
2. Dai H, Much AA, Maor E, Asher E, Younis A, Xu Y, et al. Global, regional, and national burden of ischaemic heart disease and its attributable risk factors, 1990–2017: results from the Global Burden of Disease Study 2017. Eur Heart J Qual Care Clin Outcomes. 2022;8(1):50-60.
3. Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. Circulation. 2006;114(1):82-96.
4. Organization WH. Healthy diet: WHO; 2022. Available from: https://www.who.int/initiatives/behealthy/healthy-diet.
5. Guo F, Moellering DR, Garvey WT. The progression of cardiometabolic disease: validation of a new cardiometabolic disease staging system applicable to obesity. Obesity. 2014;22(1):110-8.
6. Vasudevan AR, Ballantyne CM. Cardiometabolic risk assessment: an approach to the prevention of cardiovascular disease and diabetes mellitus. Clin Cornerstone. 2005;7(2-3):7-16.
7. Verschuren WM, Boer JM, Temme EH. Optimal diet for cardiovascular and planetary health. Heart. 2021:heartjnl-2019-316373.
8. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. N Engl J Med. 2006;355(8):763-78.
9. Renehan AG, Tyson M, Egger M, Heller RF, Zwahlen M. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. Lancet. 2008;371(9612):569-78.
10. Willett WC, Dietz WH, Colditz GA. Guidelines for healthy weight. N Engl J Med. 1999;341(6):427-34.
11. Nissen SE. US dietary guidelines: an evidence-free zone. Ann Intern Med. 2016;164(8):558-9.
12. Nogoy KMC, Sun B, Shin S, Lee Y, Li XZ, Choi SH, et al. Fatty Acid Composition of Grain-and Grass-Fed Beef and Their Nutritional Value and Health Implication. Food Sci Anim Resour. 2022;42(1):18.

13. Colditz GA, Manson JE, Hankinson SE. The Nurses' Health Study: 20-year contribution to the understanding of health among women. J Womens Health. 1997;6(1):49-62.
14. González-Becerra K, Ramos-López O, Barrón-Cabrera E, Riezu-Boj JI, Milagro F, Martínez-López E, et al. Fatty acids, epigenetic mechanisms and chronic diseases: a systematic review. Lipids Health Dis. 2019;18(1):1-18.
15. Mazidi M, Mikhailidis DP, Sattar N, Toth PP, Judd S, Blaha MJ, et al. Association of types of dietary fats and all-cause and cause-specific mortality: a prospective cohort study and meta-analysis of prospective studies with 1,164,029 participants. Clin Nutr. 2020;39(12):3677-86.
16. Jakobsen MU, O'Reilly EJ, Heitmann BL, Pereira MA, Bälter K, Fraser GE, et al. Major types of dietary fat and risk of coronary heart disease: a pooled analysis of 11 cohort studies. Am J Clin Nutr . 2009;89(5):1425-32.
17. Mozaffarian D, Micha R, Wallace S. Effects on coronary heart disease of increasing polyunsaturated fat in place of saturated fat: a systematic review and meta-analysis of randomized controlled trials. PLoS Med. 2010;7(3):e1000252.
18. guidelines D. Dietary guidelines for Americans: US Department of Agriculture; 2020 [May 23, 2022]. Available from: https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf.
19. Kris-Etherton PM, Harris WS, Appel LJ. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. Arterioscler Thromb Vasc Biol. 2003;23(2):e20-e30.
20. Bucher HC, Hengstler P, Schindler C, Meier G. N-3 polyunsaturated fatty acids in coronary heart disease: a meta-analysis of randomized controlled trials. Am J Med. 2002;112(4):298-304.
21. Studer M, Briel M, Leimenstoll B, Glass TR, Bucher HC. Effect of different antilipidemic agents and diets on mortality: a systematic review. Arch Intern Med. 2005;165(7):725-30.
22. Galan P, Kesse-Guyot E, Czernichow S, Briancon S, Blacher J, Hercberg S. Effects of B vitamins and omega 3 fatty acids on cardiovascular diseases: a randomised placebo controlled trial. BMJ. 2010;341.
23. Kwak SM, Myung S-K, Lee YJ, Seo HG, Group KM-aS. Efficacy of omega-3 fatty acid supplements (eicosapentaenoic acid and docosahexaenoic acid) in the secondary prevention of cardiovascular disease: a meta-analysis of randomized, double-blind, placebo-controlled trials. Arch Intern Med. 2012;172(9):686-94.
24. Rizos EC, Ntzani EE, Bika E, Kostapanos MS, Elisaf MS. Association between omega-3 fatty acid supplementation and risk of major cardiovascular disease events: a systematic review and meta-analysis. JAMA. 2012;308(10):1024-33.
25. Neubronner J, Schuchardt JP, Kressel G, Merkel M, von, von Schacky C, Hahn A. Enhanced increase of omega-3 index in response to long-term n-3 fatty acid supplementation from triacylglycerides versus ethyl esters. Eur J Clin Nutr. 2011;65(2):247-54.
26. Wolk A. Potential health hazards of eating red meat. J Intern Med. 2017;281(2):106-22.
27. Abete I, Romaguera D, Vieira AR, de Munain AL, Norat T. Association between total, processed, red and white meat consumption and all-cause, CVD and IHD mortality: a meta-analysis of cohort studies. Br J Nutr. 2014;112(5):762-75.
28. Wang X, Lin X, Ouyang YY, Liu J, Zhao G, Pan A, et al. Red and processed meat consumption and mortality: dose–response meta-analysis of prospective cohort studies. Public Health Nutr. 2016;19(5):893-905.
29. Clifton PM. Protein and coronary heart disease: the role of different protein sources. Curr Atheroscler Rep. 2011;13(6):493-8.
30. Virtanen HE, Voutilainen S, Koskinen TT, Mursu J, Kokko P, Ylilauri M, et al. Dietary proteins and protein sources and risk of death: the Kuopio Ischaemic Heart Disease Risk Factor Study. Am J Clin Nutr. 2019;109(5):1462-71.
31. O'Connor LE, Paddon-Jones D, Wright AJ, Campbell WW. A Mediterranean-style eating pattern with lean, unprocessed red meat has cardiometabolic benefits for adults who are overweight or obese in a randomized, crossover, controlled feeding trial. Am J Clin Nutr. 2018;108(1):33-40.
32. Rosenson RS, Brewer Jr HB, Davidson WS, Fayad ZA, Fuster V, Goldstein J, et al. Cholesterol efflux and atheroprotection: advancing the concept of reverse cholesterol transport. Circulation. 2012;125(15):1905-19.
33. Kwok CS, Gulati M, Michos ED, Potts J, Wu P, Watson L, et al. Dietary components and risk of cardiovascular disease and all-cause mortality: a review of evidence from meta-analyses. Eur J Prev Cardiol. 2019;26(13):1415-29.
34. Esmeijer K, Geleijnse JM, de Fijter JW, Kromhout D, Hoogeveen EK. Dietary protein intake and kidney function decline after myocardial infarction: the Alpha Omega Cohort. Nephrol Dial Transplant. 2020;35(1):106-15.
35. Liu S, Willett WC. Dietary glycemic load and atherothrombotic risk. Curr Atheroscler Rep. 2002;4(6):454-61.
36. Kelly SA, Summerbell CD, Brynes A, Whittaker V, Frost G. Wholegrain cereals for coronary heart disease. Cochrane Database Syst Rev. 2007;2007(2):CD005051.
37. Brown L, Rosner B, Willett WW, Sacks FM. Cholesterol-lowering effects of dietary fiber: a meta-analysis. Am J Clin Nutr. 1999;69(1):30-42.
38. Marlett J, McBurney M, Slavin J. Posición de la Asociación de Diabetes Americana: implicancias de la fibra dietaria para la salud.(Position of the American Dietetic Association: health implications of dietary fiber). J Am Diet Assoc. 2002;102:993-1000.
39. Yuan X, Wang J, Yang S, Gao M, Cao L, Li X, et al. Effect of the ketogenic diet on glycemic control, insulin resistance, and lipid metabolism in patients with T2DM: a systematic review and meta-analysis. Nutr Diabetes. 2020;10(1):1-8.
40. Pallazola VA, Davis DM, Whelton SP, Cardoso R, Latina JM, Michos ED, et al. A clinician's guide to healthy eating for cardiovascular disease prevention. Mayo Clin Proc Innov Qual Outcomes. 2019;3(3):251-67.
41. Mente A, O'Donnell M, Rangarajan S, McQueen M, Dagenais G, Wielgosz A, et al. Urinary sodium excretion, blood pressure, cardiovascular disease, and mortality: a community-level prospective epidemiological cohort study. Lancet. 2018;392(10146):496-506.
42. He FJ, Tan M, Ma Y, MacGregor GA. Salt reduction to prevent hypertension and cardiovascular disease: JACC state-of-the-art review. J Am Coll Cardiol. 2020;75(6):632-47.
43. Heaney RP. Vitamin D—baseline status and effective dose. N Engl J Med. 2012;367(1):77-8.
44. Marti-Carvajal AJ, Sola I, Lathyris D, Dayer M. Homocysteine-lowering interventions for preventing cardiovascular events. Cochrane Database Syst Rev. 2017;2017(8):CD006612.
45. Miller III ER, Juraschek S, Pastor-Barriuso R, Bazzano LA, Appel LJ, Guallar E. Meta-analysis of folic acid supplementation trials on risk of cardiovascular disease and risk interaction with baseline homocysteine levels. Am J Cardiol. 2010;106(4):517-27.
46. Lee M, Hong K-S, Chang S-C, Saver JL. Efficacy of homocysteine-lowering therapy with folic acid in stroke prevention: a meta-analysis. Stroke. 2010;41(6):1205-12.
47. Forman JP, Rimm EB, Stampfer MJ, Curhan GC. Folate intake and the risk of incident hypertension among US women. JAMA. 2005;293(3):320-9.
48. Vivekananthan DP, Penn MS, Sapp SK, Hsu A, Topol EJ. Use of antioxidant vitamins for the prevention of cardiovascular disease: meta-analysis of randomised trials. Lancet. 2003;361(9374):2017-23.
49. Schürks M, Glynn RJ, Rist PM, Tzourio C, Kurth T. Effects of vitamin E on stroke subtypes: meta-analysis of randomised controlled trials. BMJ. 2010;341.
50. Lonn E, Bosch J, Yusuf S, Sheridan P, Pogue J, Arnold JM, et al. Effects of long-term vitamin E supplementation on cardiovascular

events and cancer: a randomized controlled trial. JAMA. 2005;293(11):1338-47.
51. Yip CSC, Chan W, Fielding R. The associations of fruit and vegetable intakes with burden of diseases: a systematic review of meta-analyses. J Acad Nutr Diet. 2019;119(3):464-81.
52. Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr. 2010;92(5):1189-96.
53. Aune D, Keum N, Giovannucci E, Fadnes LT, Boffetta P, Greenwood DC, et al. Dietary intake and blood concentrations of antioxidants and the risk of cardiovascular disease, total cancer, and all-cause mortality: a systematic review and dose-response meta-analysis of prospective studies. Am J Clin Nutr. 2018;108(5):1069-91.
54. Aminger W, Hough S, Roberts SA, Meier V, Spina AD, Pajela H, et al. Preservice secondary science teachers' implementation of an NGSS practice: Using mathematics and computational thinking. J Sci Teacher Educ. 2021;32(2):188-209.
55. Bechthold A, Boeing H, Schwedhelm C, Hoffmann G, Knüppel S, Iqbal K, et al. Food groups and risk of coronary heart disease, stroke and heart failure: a systematic review and dose-response meta-analysis of prospective studies. Crit Rev Food Sci Nutr. 2019;59(7):1071-90.
56. Blumenthal JA, Babyak MA, Hinderliter A, Watkins LL, Craighead L, Lin P-H, et al. Effects of the DASH diet alone and in combination with exercise and weight loss on blood pressure and cardiovascular biomarkers in men and women with high blood pressure: the ENCORE study. Arch Intern Med. 2010;170(2):126-35.
57. Van Horn L, McCoin M, Kris-Etherton PM, Burke F, Carson JAS, Champagne CM, et al. The evidence for dietary prevention and treatment of cardiovascular disease. J Am Diet Assoc. 2008;108(2):287-331.
58. Soliman GA. Dietary cholesterol and the lack of evidence in cardiovascular disease. Nutrients. 2018;10(6):780.
59. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice. Kardiol Pol. 2016;74(9):821-936.
60. Board JBS. Joint British Societies' consensus recommendations for the prevention of cardiovascular disease (JBS3). Heart. 2014;100(Suppl 2):ii1-ii67.
61. Arnett DK, Blumenthal RS, Albert MA, Buroker AB, Goldberger ZD, Hahn EJ, et al. 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2019;140(11):e596-e646.
62. Qin C, Lv J, Guo Y, Bian Z, Si J, Yang L, et al. Associations of egg consumption with cardiovascular disease in a cohort study of 0.5 million Chinese adults. Heart. 2018;104(21):1756-63.
63. Alexander DD, Miller PE, Vargas AJ, Weed DL, Cohen SS. Meta-analysis of egg consumption and risk of coronary heart disease and stroke. J Am Coll Nutr. 2016;35(8):704-16.
64. Qin C, Lv J, Guo Y, Bian Z, Si J, Yang L, et al. China Kadoorie Biobank Collaborative Group Associations of egg consumption with cardiovascular disease in a cohort study of 0.5 million Chinese adults. Heart. 2018;104(21):1756-63.
65. Alexander DD, Bylsma LC, Vargas AJ, Cohen SS, Doucette A, Mohamed M, et al. Dairy consumption and CVD: a systematic review and meta-analysis. Br J Nutr. 2016;115(4):737-50.
66. Soedamah-Muthu SS, De Goede J. Dairy consumption and cardiometabolic diseases: systematic review and updated meta-analyses of prospective cohort studies. Curr Nutr Rep. 2018;7(4):171-82.
67. Buziau AM, Soedamah-Muthu SS, Geleijnse JM, Mishra GD. Total fermented dairy food intake is inversely associated with cardiovascular disease risk in women. J Nutr. 2019;149(10):1797-804.
68. Fontecha J, Calvo MV, Juarez M, Gil A, Martínez-Vizcaino V. Milk and dairy product consumption and cardiovascular diseases: an overview of systematic reviews and meta-analyses. Adv Nutr. 2019;10(suppl_2):S164-S89.
69. Brufau G, Boatella J, Rafecas M. Nuts: source of energy and macronutrients. Br J Nutr. 2006;96(S2):S24-S8.
70. Kris-Etherton PM, Hu FB, Ros E, Sabaté J. The role of tree nuts and peanuts in the prevention of coronary heart disease: multiple potential mechanisms. J Nutr. 2008;138(9):1746S-51S.
71. Sabaté J, Ang Y. Nuts and health outcomes: new epidemiologic evidence. Am J Clin Nutr. 2009;89(5):1643S-8S.
72. Montgomery KS. Soy protein. J Perinat Educ. 2003;12(3):42-5.
73. Hooper L, Kroon PA, Rimm EB, Cohn JS, Harvey I, Le Cornu KA, et al. Flavonoids, flavonoid-rich foods, and cardiovascular risk: a meta-analysis of randomized controlled trials. Am J Clin Nutr. 2008;88(1):38-50.
74. Cornelis MC, El-Sohemy A. Coffee, caffeine, and coronary heart disease. Curr Opin Lipidol. 2007;18(1):13-9.
75. Silletta MG, Marfisi R, Levantesi G, Boccanelli A, Chieffo C, Franzosi M, et al. Coffee consumption and risk of cardiovascular events after acute myocardial infarction: results from the GISSI (Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto miocardico)-Prevenzione trial. Circulation. 2007;116(25):2944-51.
76. Cainzos-Achirica M, Bilal U, Kapoor K, Ayala RQ, McEvoy JW, Pladevall-Vila M, et al. Methodological issues in nutritional epidemiology research—sorting through the confusion. Curr Cardiovasc Risk Rep. 2018;12(2):1-9.
77. Mesas AE, Leon-Muñoz LM, Rodriguez-Artalejo F, Lopez-Garcia E. The effect of coffee on blood pressure and cardiovascular disease in hypertensive individuals: a systematic review and meta-analysis. Am J Clin Nutr. 2011;94(4):1113-26.
78. Di Castelnuovo A, Di Giuseppe R, Iacoviello L, De Gaetano G. Consumption of cocoa, tea and coffee and risk of cardiovascular disease. Eur J Intern Med. 2012;23(1):15-25.
79. de Koning Gans JM, Uiterwaal CS, Van Der Schouw YT, Boer JM, Grobbee DE, Verschuren WM, et al. Tea and coffee consumption and cardiovascular morbidity and mortality. Arterioscler Thromb Vasc Biol. 2010;30(8):1665-71.
80. Sugiyama K, Kuriyama S, Akhter M, Kakizaki M, Nakaya N, Ohmori-Matsuda K, et al. Coffee consumption and mortality due to all causes, cardiovascular disease, and cancer in Japanese women. J Nutr. 2010;140(5):1007-13.
81. Muley A, Muley P, Shah M. Coffee to reduce risk of type 2 diabetes?: a systematic review. Curr Diabetes Rev. 2012;8(3):162-8.
82. Higdon JV, Frei B. Coffee and health: a review of recent human research. Crit Rev Food Sci Nutr. 2006;46(2):101-23.
83. Clement Y. Can green tea do that? A literature review of the clinical evidence. Prev Med. 2009;49(2-3):83-7.
84. Kuriyama S. The relation between green tea consumption and cardiovascular disease as evidenced by epidemiological studies. J Nutr. 2008;138(8):1548S-53S.
85. Arab L, Liu W, Elashoff D. Green and black tea consumption and risk of stroke: a meta-analysis. Stroke. 2009;40(5):1786-92.
86. Deka A, Vita JA. Tea and cardiovascular disease. Pharmacol Res. 2011;64(2):136-45.
87. Cooper KA, Donovan JL, Waterhouse AL, Williamson G. Cocoa and health: a decade of research. Br J Nutr. 2008;99(1):1-11.
88. Ding EL, Hutfless SM, Ding X, Girotra S. Chocolate and prevention of cardiovascular disease: a systematic review. Nutr Metab (Lond). 2006;3(1):1-12.
89. Buitrago-Lopez A, Sanderson J, Johnson L, Warnakula S, Wood A, Di Angelantonio E, et al. Chocolate consumption and cardiometabolic disorders: systematic review and meta-analysis. BMJ. 2011;343:d4488.
90. Fernández-Murga L, Tarín J, García-Perez M, Cano A. The impact of chocolate on cardiovascular health. Maturitas. 2011;69(4):312-21.

91. Sobenin IA, Myasoedova VA, Iltchuk MI, Zhang D-W, Orekhov AN. Therapeutic effects of garlic in cardiovascular atherosclerotic disease. Chin J Nat Med. 2019;17(10):721-8.
92. Amor S, González-Hedström D, Martín-Carro B, Inarejos-García AM, Almodóvar P, Prodanov M, et al. Beneficial effects of an aged black garlic extract in the metabolic and vascular alterations induced by a high fat/sucrose diet in male rats. Nutrients. 2019;11(1):153.
93. Tattelman E. Health effects of garlic. Am Fam Physician. 2005;72(1):103-6.
94. Rahman K, Lowe GM. Garlic and cardiovascular disease: a critical review. J Nutr. 2006;136(3):736S-40S.
95. Reinhart KM, Talati R, White CM, Coleman CI. The impact of garlic on lipid parameters: a systematic review and meta-analysis. Nutr Res Rev. 2009;22(1):39-48.
96. Khoo Y, Aziz Z. Garlic supplementation and serum cholesterol: a meta- analysis. J Clin Pharm Ther. 2009;34(2):133-45.
97. Ackermann RT, Mulrow CD, Ramirez G, Gardner CD, Morbidoni L, Lawrence VA. Garlic shows promise for improving some cardiovascular risk factors. Arch Intern Med. 2001;161(6):813-24.
98. Bowman SA. Added sugars: definition and estimation in the USDA Food Patterns Equivalents Databases. J Food Compost Anal. 2017;64:64-7.
99. Chatelan A, Gaillard P, Kruseman M, Keller A. Total, added, and free sugar consumption and adherence to guidelines in Switzerland: results from the first national nutrition survey menuCH. Nutrients. 2019;11(5):1117.
100. Malik VS, Li Y, Pan A, De Koning L, Schernhammer E, Willett WC, et al. Long-term consumption of sugar-sweetened and artificially sweetened beverages and risk of mortality in US adults. Circulation. 2019;139(18):2113-25.
101. Yin J, Zhu Y, Malik V, Li X, Peng X, Zhang FF, et al. Intake of sugar-sweetened and low-calorie sweetened beverages and risk of cardiovascular disease: a meta-analysis and systematic review. Adv Nutr. 2021;12(1):89-101.
102. Kwak JH, Jo G, Chung H-K, Shin M-J. Association between sugar-sweetened beverage consumption and incident hypertension in Korean adults: a prospective study. Eur J Nutr. 2019;58(3):1009-17.
103. Xi B, Huang Y, Reilly KH, Li S, Zheng R, Barrio-Lopez MT, et al. Sugar-sweetened beverages and risk of hypertension and CVD: a dose–response meta-analysis. Br J Nutr. 2015;113(5):709-17.
104. Johnson RK, Lichtenstein AH, Anderson CA, Carson JA, Després J-P, Hu FB, et al. Low-calorie sweetened beverages and cardiometabolic health: a science advisory from the American Heart Association. Circulation. 2018;138(9):e126-e40.
105. Daniels SR, Hassink SG, Nutrition Co, Abrams SA, Corkins MR, de Ferranti SD, et al. The role of the pediatrician in primary prevention of obesity. Pediatrics. 2015;136(1):e275-e92.
106. Valerio G, Maffeis C, Saggese G, Ambruzzi MA, Balsamo A, Bellone S, et al. Diagnosis, treatment and prevention of pediatric obesity: consensus position statement of the Italian Society for Pediatric Endocrinology and Diabetology and the Italian Society of Pediatrics. Ital J Pediatr. 2018;44(1):1-21.
107. Busey, E (2020) Sugary Drink Taxes around the World. The Global Food Research Program. Chapel Hill, NC: University of North Carolina.
108. Mytton OT, Clarke D, Rayner M. Taxing unhealthy food and drinks to improve health. BMJ. 2012;344.
109. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition. December 2015. Available at https://health.gov/our-work/food-nutrition/previous-dietary-guidelines/2015.

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