SAS Journal of Medicine ISSN 2454-5112
SAS J. Med., Volume-3; Issue-7 (Jul, 2017); p-147-153
Available online at http://sassociety.com/sasjm/

Review Article

Dietary Factors in Cardiovascular Diseases: A Review Study

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Abstract: Globally, some of the top causes of morbidity and mortality are cardiovascular diseases. Since these diseases are chronic, they create a huge impact on the quality of life of the patients and economic burden on the family as well as the nation. The prevention and control of the diseases have not been quite as intended. While the reasons for the failure are not singular, non-pharmacological interventions play a pertinent role and yet they are often overlooked by the stakeholders. Since dietary factors form a major part of non-pharmacological interventions and can cause a universal impact with judicious choices, the present article aims at eliciting the various dietary factors affecting the cardiovascular health. Dietary habits like high salt intake, insufficient intake of fibre-rich diet and vegetables and fruits, high caloric foods with low nutritional value coupled with other unhealthy lifestyle cause unrestricted progress of cardiovascular diseases. Instead of being overly dependent on drug therapy, non-pharmacological interventions should be adopted to either complement drug therapy or treat milder form of cardiovascular diseases or prevent in the population at risk of development of the same.

Keywords: non-communicable diseases, cardiovascular diseases, hypertension, diet, salt, non-pharmacological interventions.

INTRODUCTION

Non-communicable disease (NCD) is a global public health burning issue, as they cause premature deaths, exacerbate poverty and is a burden on national economy. NCDs, sometimes called *diseases of longevity* or *diseases of civilization* or *chronic diseases*, are the diseases associated with the way a person lives and hence also known as *lifestyle diseases*. They mainly include cardiovascular diseases (CVD), diabetes mellitus (DM), obesity, cancer and chronic obstructive pulmonary disease (COPD).Among all NCDs, CVD is a major cause of morbidity and mortality [1]. It is a class of diseases that involve the heart and the blood vessels or both [2]. It includes increased blood pressure (BP) or hypertension (HTN), coronary heart disease (CHD), stroke amongst others. It is important to take a note that a substantial proportion of the deaths caused by CVDs (46%) are of people under 70 years of age, in the more productive period of life; also, 79% of the disease burden attributed to CVD is in this age group [3]. HTN happens to be the most common CVD as well as most common risk factor for other CVDs. It is a major cause of morbidity and mortality because of its association with CHD, cerebrovascular (CVA) disease and renal disease and also one of the leading behavioural and physiological risk factor to which a huge proportion of morbidity and mortality are attributed. CVD is a multi-factorial disease. The risk factors of CVD were not formally established until the initial findings of the Framingham Heart Study, a prospective study conducted in the United States in the early 1960s. The understanding of these factors is critical to the prevention of cardiovascular morbidities and mortality. The causative factors can broadly be classified into modifiable and non-modifiable risk factors. Among the various modifiable risk factors, the dietary factors play a pertinent role in prevention and control of the CVDs. In fact, *nutritional transition* plays a significant role in the rising burden of NCDs including CVDs globally and can be starkly felt in Indian context. Increased production and consumption of processed food, saturated fat, trans-fat, salt intake influence the changing pattern of morbidities from communicable to non-communicable ones. There are ample evidences to suggest that CVD is partially reversible using an intense dietary regimen coupled with regular exercise[4]. In uncomplicated stage I hypertension (systolic BP/ SBP of 140 to 159 mm Hg or diastolic BP/ DBP of 90 to 99 mm Hg) a trial of dietary therapy can be given before the start of drug therapy. Among hypertensive individuals who are already on drug therapy, dietary changes, particularly a reduced salt intake, can further lower BP and facilitate medication step-down. Some important dietary factors that influence the course of development and progression of CVDs in general are discussed below.

VEGETARIAN VS. NON- VEGETARIAN DIET:

Vegetarians have been shown to have a 24% reduced risk of dying of heart disease [5]. The 2005 US Dietary Guidelines for Americans recommend that consumption of red and processed meat should be moderated[6]. It has been recommended that people having meat and poultry should eat lean meat and skin from poultry should be removed before cooking [7]. Since egg yolk is high in dietary cholesterol, intake of egg yolks should be limited to two or fewer yolks per week in HTN or CHD patients. Egg whites or egg substitutes have no cholesterol and fewer calories than whole eggs[7].While several such studies found that consumption was associated with a lower risk of mortality[8], no significant differences in risk of mortality were observed between vegetarians and non-vegetarians in a British population[9]. In a study by Melby CL *et al.* [8] 44 percent of the Black non-vegetarians were medicated hypertensives, compared to only 18 percent of the Black vegetarians, 7 percent of the White vegetarians, and 22 percent of the White non-vegetarians. Black vegetarians exhibited lower age and sex-adjusted systolic BP (means = 122.9/74.4 mm Hg) than Black non-vegetarians (means = 132.2/75.9 mm Hg). After further adjusting BP for body mass index and waist/hip ratio, the systolic BP among Black vegetarians remained lower (122.8) than Black non-vegetarians (129.7) but higher than that of the Whites who showed no diet-related BP differences. Forty-four percent of the Black non-vegetarians were medicated hypertensives, compared to only 18 percent of the Black vegetarians, 7 percent of the White vegetarians, and 22 percent of the White non-vegetarians. Black vegetarians exhibited lower age and sex-adjusted systolic BP (means = 122.9/74.4 mm Hg) than Black non-vegetarians (means = 132.2/75.9 mm Hg). After further adjusting BP for body mass index and waist/hip ratio, the systolic BP among Black vegetarians remained lower (122.8) than Black non-vegetarians (129.7) but higher than that of the Whites who showed no diet-related BP differences.

FRUITS AND VEGETABLES:

Fruit and vegetable intake is related to mortality, including mortality from cardiovascular disease and cancer[10-15]. Around 10-30% lower risk of all cause mortality was found in most prospective studies comparing highest with lowest fruit and vegetable consumption[10, 13-15]. One meta-analysis by Wang Xia et al. provides further evidence that higher consumption of fruit and vegetables is associated with a lower risk of mortality from all causes, particularly from cardiovascular diseases [16]. However, such results could not be reproduced in other studies [9]. Based on the same, feeding trials were carried out to examine three dietary plans and their results lead to establishment of the dietary management of HTN using the DASH (Dietary Approach to Stop Hypertension) diet. None of the plans were vegetarian, but the DASH plan incorporated more fruits and vegetables, low salt intake, low fat or non-fat dairy, beans, and nuts than the others studied. The diet reduced SBP by 6 mmHg and DBP by 3 mmHg in pre-hypertensives. SBP and DBP dropped by 11 mmHg and 6 mmHg, respectively in hypertensives. These changes in BP occurred with no changes in body weight. In a DASH trial, the 2 groups that increased fruit and vegetable consumption and reduced salt intake both lowered BP[17].

OMEGA-3 FATTY ACIDS:

Omega-3 fatty acids are found in some fatty fish and in plant sources such as walnuts, canola and soybean oils, and flaxseed. They are increasingly used for the protection of CVDs. They do not affect low density lipoproteins (LDL) levels but may help prevent CVDs by helping to prevent blood clots from forming and inflammation from affecting artery walls; they also reduce the risk for cardiacarrhythmias and, at high doses, reduce triglyceride (TG) levels [7]. Some studies suggested that omega-3 fats reduce the risk for heart attack and death from heart disease for those who already have heart disease [7].The effect of fish oil appears to be dose dependent, with BP reductions occurring at relatively high doses—namely, ≥3 g/d. In hypertensive individuals, average systolic and diastolic BP reductions were 4.0 and 2.5 mm Hg, respectively [19]. However, some evidences do not support a beneficial role for omega-3 fatty acid supplementation in preventing cardiovascular disease [20].

HIGH FIBRE INTAKE:

The risk of CVDs is inversely related to the consumption of dietary fibres [21]. There are two main types of fibre—insoluble and soluble or viscous. Both have health benefits but only soluble fibre reduces the risk of CVDs. It does that by helping to lower LDL cholesterol [21] as well as decreasing insulin resistance [22]. Soluble fibre dissolves into a gel-like substance in the intestines. The substance helps to block cholesterol and fats from being absorbed through the wall of the intestines into the bloodstream. Research shows that people who increased their soluble fibre intake by 5–10 grams each day had about a 5 percent drop in their LDL cholesterol [21]. TLC (Therapeutic lifestyle change) recommends patients to get at least 5–10 grams of soluble fibre a day—and, preferably, 10–25 grams a day, which will lower the LDL even more [7, 21].

LEGUMES:

Legumes are high in protein and water-soluble fibre. Thus, it will deter CVD by reducing total and low-density lipoprotein cholesterol levels as well as insulin resistance [22]. In addition, legumes are generally low in sodium and rich in minerals such as potassium, calcium, and magnesium which are pro cardiovascular health [23]. Major observational study like the International Study on Macronutrients and Blood Pressure (INTERMAP) has documented significant inverse relationships between protein from plant sources and BP, whereas protein from animal

sources had no effect [23]. In a study done in 2013 by Zahradka P *et al*., it was concluded that a legume-rich diet can elicit major improvements in arterial function and serum cholesterol in the absence of changes in either body mass or BP. In the same study alteration in acylcarnitine levels was observed which indicated that an improvement in skeletal muscle metabolism was present due to enhanced tissue perfusion [24]. Another meta-analysis has shown that substituting protein from vegetable sources, specifically soybean, for protein from animal sources reduces serum cholesterol levels [25]. A study by Bazzano LA et al. indicates a significant inverse relationship between legume intake and risk of coronary heart disease, a CVD, and suggests that increasing legume intake may be an important part of the primary prevention of CHD in the general population

Nuts: While many studies have investigated the association between nut consumption and risk of HTN, CHD, CVA and type 2 DM. However, results have been inconsistent. Findings from a meta-analysis indicate that consumption of nuts (>2 servings/week) may be inversely associated with HTN and CHD risk [28].

SATURATED FATS AND TRANS-FATTY ACIDS

High saturated fat intake increases the risk of cardiovascular diseases through its effect on blood lipids and thrombosis.The consumption of trans-fat (commonly found in hydrogenated products such vanaspati and repeated heating of the same oil) has been shown to cause the development of endothelial dysfunction, a precursor to atherosclerosis and increase the risk of CHD [29-30]. Avoiding fats that are readily oxidized (e.g., trans-fats), and limiting carbohydrates and processed sugars may reduce LDL, triacylglycerol and apolipoprotein-B thus decreasing the risk[31].

CHOLESTEROL INTAKE:

Few studies have examined the effect of dietary cholesterol intake on BP. In the Multiple Risk Factor Intervention Trial (MRFIT) cohort, there were significant, direct relationships between cholesterol intake (in milligrams per day) and both systolic and diastolic BPs. The Keys score was also associated with DBP but not SBP [32].

POTASSIUM:

The effects of potassium on BP depend on the concurrent intake of salt and vice versa. Specifically, an increased intake of potassium has a greater BP-lowering effect in the context of a higher salt intake and lesser BP reduction in the setting of a lower salt intake. Conversely, the BP reduction from a reduced salt intake is greatest when potassium intake is low. For example, a high potassium intake (120 mmol/d) blunted the rise in BP in response to increased salt intake in 24 non-hypertensive black men and to a lesser extent in 14 non-blacks [34]. Potassium-rich foods like banana, orange, apricot, cucumber, cooked soy beans and kidney beans, milk, fish etc. are readily available and can be readily included in the daily diet. So, it is both cost-effective and healthier option to increase consumption of potassium by partaking potassium-rich foods such as fruits and vegetables rather than taking supplements. In the DASH trial, the two groups that increased fruit and vegetable consumption both lowered BP [17]. The 2100-kcal version of the DASH diet provides ≈4.7 g/d (120 mmol/d) potassium [33]. Another trial documented that increased fruit and vegetable consumption lowers BP, but it did not specify the amount of potassium provided in the fruits and vegetables [35].

CARBOHYDRATE:

There are growing evidences suggesting that both amount and type of carbohydrate intake affect BP [36].Worldwide, there are many populations that eat carbohydrate-rich, low-fat diets that have low BP levels as compared with Western countries [37]. Still, the results of observational studies that specifically examined the effect of carbohydrate intake on BP have been inconsistent. Direct association was found in one study [32], no association in another [38], and inverse association in another [23]. Also, in some early trials, increasing carbohydrate by reducing total fat generally did not reduce BP [39]. In contrast, the recently completed Omni Heart feeding study documented that in the setting of a healthy diet similar to the DASH diet, partial substitution of carbohydrate with either protein (about half from plant sources) or monounsaturated fat lowers BP; importantly, the total dietary glycemic index, an indicator of the type of carbohydrate, was moderate and similar in each diet [40]. It has been indicated that fructose consumption may lead to increased serum uric acid via phosphorylation of fructose by hepatocytes and generation of adenosine diphosphate, which is metabolized to uric acid [41], raised serum uric acid may influence BP by reducing levels of nitric oxide, a potent vasodilator [42]. Sugar consumption has also been linked to enhanced sympathetic nervous system activity and sodium retention [43-44].

OTHER MICRO-NUTRIENTS AND VITAMINS:

Menaquinone (Vitamin K_2), but not phylloquinone (Vitamin K_1), intake may reduce the risk of CHD mortality [45]. Cappuccio et al. reported an inverse association between BP and dietary calcium intake (as measured by 24-hour dietary recalls or food frequency questionnaires) [46]. In a pooled analysis of 29 observational studies, there was a negative association between dietary magnesium and BP [47]. However, in a meta-analysis of 20 randomized clinical trials (RCT), no clear effect of magnesium intake on BP was evident [48].

TEA AND COFFEE:

Summing up the evidence from a large number of cross-sectional, prospective outcome studies and meta-analyses it can be suggested that both green and

black tea are beneficial for CVDs, but the results may be confounded by lifestyle and other dietary factors. According to Deka A and Vita JA, who have done extensive research in this field, no RCT have examined the effects of tea on CVD and the existing results are mixed and likely confounded by lifestyle and background dietary factors [49]. In a systematic review and meta-analysis, Mesas AE et al. concluded that although caffeine intake produces an acute increase in BP for ≥3 h in hypertensive individuals, current evidence does not support an association between longer-term coffee consumption and increased BP or between habitual coffee consumption and an increased risk of CVD in hypertensive subjects [50].

SODIUM AND SALT:

One of the most important dietary constituent affecting the cardiovascular health is amount of sodium intake. The main source of sodium in our diet is salt (NaCl), although it can come from sodium glutamate, used as a condiment in many parts of the world [51]. Sodium is found naturally in a variety of foods, such as milk, meat and shellfish. It is often found in high amounts in processed foods such as breads, processed meat, ready-to-eat cereals, canned tomato juice, cannedfood items, snack foods, as well as in condiments like canned sauces, salad dressing, pickles etc. With increasing urbanization and nutritional transition, highly processed foods are increasing in availability and becoming more affordable leading to much higher salt consumption than days of yore. Sodium has been of interest in public health nutrition for decades, mainly because of its association with CVDs, especially HTN, CHD and stroke. High BP is a major risk factor for both stroke and CHD. Overall, the evidence suggests that, for most individuals, the higher their sodium consumption, the higher their BP [52]. High sodium consumption (>2 grams/day, equivalent to 5 g salt/day) and insufficient potassium intake (less than 3.5 grams/day) contribute to HTN and increase the risk of heart disease and stroke [51]. Salt intake of less than 5 grams per day for adults helps to reduce BP and risk of CVD, stroke and CHD. The principal benefit of lowering salt intake is a corresponding reduction in the BP [51]. High sodium intake also presents a challenge for excretion by the kidneys, which is another potential mechanism for affecting BP and risk of NCD. Increased sodium intake may lead to increased urinary protein excretion and may thus increase the rate of deterioration of renal function [53-54]. It has been estimated that a reduction in dietary intake of sodium of 50mmol/day would reduce the number of people needing antihypertensive therapy by 50%, the number of deaths from strokes by 22% and the number of deaths from CHD by 16% [53]. The current WHO recommendation for adults is to reduce the consumption of sodium to < 2 g or < 90mmol (< 5 g salt) per day. This value was deemed appropriate and was adopted as the recommendation on sodium consumption to prevent CVD [55]. However, it has been observed that most people consume an average of 9–12 grams salt per day, or around twice the recommended maximum level of intake [55]. Key salt reduction measures will generate an extra year of healthy life for a cost that falls below the average annual income or gross domestic product per person.WHO Member States have agreed to reduce the global population's intake of salt by a relative 30% by 2025 [51].

CONCLUSION:

High salt intake, insufficient intake of fibre-rich diet from whole grains and legumes, less consumption of vegetables and fruits, high caloric foods with low nutritional value coupled with other unhealthy lifestyle cause unprecedented burden of various cardiovascular diseases and also over-dependence on pharmacological management of CVDs increasing the economic burden on the family as well as the health care system. A favourable dietary plan, based on this, in persons with any CVD will render better control of the disease as well as less odds of developing complications. In addition, the same will serve as primary prevention in the community who are already having risk factors of developing CVDs related to diet, sedentary lifestyle, alcohol consumption, smoking or exposure to other air pollutants, family history and genetic make-up. Also special attention should be given to reducing salt intake as it has been identified as one of the most cost-effective measures countries can take to improve population health outcomes. Indian diet favours high salt intake in the form of pickles, papads, dry fish, fresh lime juice or buttermilk, salted tea in some regions and garnishing fruit and vegetable salads with salt. And now things are turning to a worse scenario with a tendency to have the western diet and processed foods. Instead of using salt or added fat to make foods tastier, use of spices and herbs can increase the palatability of food together with reducing sodium and fat intake.

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