Diet and Cardiovascular Diseases: Heart Failure Part I: Plant Based Diet, Beneficial Macronutrients

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Review Article

ABSTRACT

Diet is a major modifiable factor in the prevention and management of cardiovascular diseases. Optimal body weight with a BMI between 20 and 24.9 (18.5 to 24.9 for Asians), and a diet rich in non-starchy vegetables, fruits, whole grains, legumes, moderate in consumption of nuts, seafood, lean meats, low-fat dairy products, and unsaturated vegetable oils, and limited in saturated fats, sodium, red meat, refined carbohydrates, and sugar-sweetened beverages is cardiovascular protective. Trans fats are extremely unhealthy. The benefit of a healthy diet extends to heart failure (HF). Dairy, coffee, tea, and chocolate may also be vascular friendly. Alcohol has a U-shaped relationship, with low to moderate intake cardiovascular healthy, while heavy intake usually causes harm. Some minerals and vitamins are also helpful in the prevention and management of HF. HF is increasing in incidence and prevalence in most world countries. It is associated with severe disability and is a major cause of death globally. The impact of a healthy diet on the development and progression of HF is discussed in this manuscript (in 2 parts).

Keywords: Heart failure; plant-based diet; processed red meat; mediterranean diet; DASH diet.

1. INTRODUCTION

Heart failure (HF) is a common global disease [1], affecting between 1% and 2% of all adults [2]. There were 56.2 million prevalent cases of HF in 2019 [3] with the older population is disproportionately affected [4]. At the age of 55, men have a 33% lifetime risk of having HF and women have a 28% lifetime risk [5]. With growing aging population and increasing worldwide obesity, the prevalence of HF is projected to increase by nearly 50% between 2012 and 2030 [6]. HF results from an abnormality of cardiac structure or function [7]. The Heart Failure Association (HFA) of the European Society of Cardiology (ESC) defines HF into three subtypes depending on the left ventricular ejection fraction: HF with a reduced EF (HFrEF) [EF is < 40%], HF with a mid-range or mildly reduced EF (HFmrEF) [EF 40–49%], and HF with preserved EF (HFpEF) [EF ≥ 50%] [8]. The most prevalent kind in men is HFrEF, while the most common form in women is HFpEF [9]. In HFrEF, the systolic function is impaired, while in HFpEF, the diastolic function is abnormal. Several conditions act as etiologies for HF – these include hypertension (HTN) [10], coronary artery disease (CAD) [11], dilated cardiomyopathy [12], hormonal dysfunction [13], infections (such as Chagas' disease)14, and drug use [15]. The pathological processes leading to structural abnormalities and functional problems involved include hemodynamic stress [16], neuro-endocrine activation [17], and inflammation [18].

Despite significant advances in the prevention and treatment of HF having developed in the last decades [19], life continues to be difficult for these patients. Forward failure results in HF patients complaining of excessive fatigue, due to reduced aerobic capacity, decreased muscle strength, and limited exercise intolerance [20]. With increasing reduction in peripheral circulation, signs of cardiac cachexia develop. Backward failure due to volume or pressure overload leads to high pulmonary pressure and pulmonary congestion, leading to dyspnea. Liver congestion, ascites, and edema develop in the

chronic stage due to volume overload, partly resulting from the permanent activation of compensatory neurohumoral systems [21]. Consequently, HF patients have a poor quality of life [22]. They are frequently hospitalized [23]. It is estimated that 83% of HF patients are hospitalized at least once, and almost 45% are hospitalized four times or more times [2]. HF is also associated with a high frequency of disability [24] and increased mortality [25]. Almost 32.9% of patients with decompensated HF die within one year following hospital discharge [26]. HF patients also frequently have multiple cardiovascular and non-cardiovascular comorbidities, which contribute to poor outcomes, increased rates of hospitalization, and higher mortality [27,28]. HF is responsible for extremely high healthcare costs globally [29,30]. A healthy diet plays a major role in the prevention and decreased progression of heart failure.

According to the World Health Organization (WHO), improvements in lifestyle can prevent nearly three-quarters of fatalities from cardiovascular disease (CVD) [31]. Diet is an established modifiable risk factor involved in the prevention, development, and management of CVDs [32]. Healthy dietary patterns are associated with lower cardiovascular morbidity [33], lower disability [34], and improved quality of life (QOL) [35]. A healthy diet also lowers CVD mortality rates [36]. Heart failure patients are no exception. In a prospective cohort study of 20,900 healthy men, healthy lifestyle habits significantly decreased the lifetime risk of heart failure [37]. Lack of exercise, smoking, excessive alcohol intake, obesity and a poor diet are major modifiable risk factors for HF [38-40]. Modification of diet remains an easy, cheap, non-drug, and non-interventional method of beneficially impacting HF. This manuscript discusses the various benefits and harms of different dietary patterns in the development and progression of HF. A healthy diet helps improve many features of HF [41]. Diet also plays a significant role in affecting the several risk factors for HF, including hyperlipidemia, HTN, and diabetes mellitus (T2DM) [42].

2. PLANT-BASED DIET

Various meta-analyses have found that eating a plant-based diet rich in fruits, vegetables, whole grains, nuts, seeds, and other plant-based foods lowers the risk of heart disease, including heart failure [43-45]. Greater consumption of fruits and vegetables was linked to a lower risk of HF [46] in the Physicians' Health Study, which included 20,900 healthy male physicians. Higher vegetable consumption was linked to a decreased incidence of HF in men, but not in women, in a sample of 38,075 Finns over a median of 14.1 years [47]. After a 12.9-year follow-up period, higher fruit and vegetable consumption was linked with a decreased rate of HF [48] in a prospective cohort of 34,319 Swedish women who did not have CVD or cancer at the time of initial evaluation. Patients with a closer adherence to plant-based dietary patterns had a decreased risk of incident HF after a median follow-up of more than 7 years, according to the Reasons for Geographic and Racial Differences in Stroke research (cohort of 15,569 adults with no CAD or HF diagnosis at enrollment) [49]. The beneficial role of plant-based diets in improving ejection fraction and positively remodeling the cardiac muscle is now well accepted [50,51]. Plant-based diets reduce inflammation [52], decrease oxidative stress [53], reduce blood pressure (BP) [54], lower Hba1c [55], produce less trimethylamine-N-oxide (TMAO) [56], and lower serum lipid levels [57].

3. VEGETABLES AND FRUITS

Fruits and vegetables contain several micronutrients that help protect against HF. In a cross-sectional study, Polidori et al. found lower plasma concentrations of lutein, zeaxanthin, β-cryptoxanthin, lycopene, α-carotene. and β-carotene in patients with heart failure compared with healthy controls [58]. A retrospective study reported marked decreases in HF incidence with increasing tomato consumption [59]. Tomatoes like papaya and watermelon have high levels of lycopene, and lycopene is cardio protective [60]. Several subsequent studies have confirmed the clinical implications of high fruit and vegetable consumption in HF [46,47]. In a study of middle-aged and older women followed for >10 years, there was an inverse association between higher fruit and vegetable intake (esp. >5 servings/day) and the rate of HF incidence [48]. Rautianen et al, in a study published in 2015, reported that the consumption of apples, pears, and berries as well as green leafy vegetables, was inversely associated with HF risk in a dose-response manner [48]. Moderate vegetable (about 1 cup of green leafy vegetables (providing about 60 mg/day of vegetable nitrate) intake was associated with a 15% reduction in HF [61]. Besides the benefits mentioned before [52-57], fruits and vegetables also increase ejection fraction [62] and improve functional capacity [63]. These studies support recommendations of

intake of five servings per day of fruit and vegetables, for good HF health.

4. CHOCOLATE

A meta-analysis showed that chocolate consumption in moderation may be associated with a decreased risk (16% less) of HF [64]. However, higher amounts may lead to weight gain as chocolate, especially milk chocolate, often has a high calorie content [65]. Obesity is a known risk factor for developing HF [66,67].

5. FISH

Fish eating has been linked to a lower risk of heart failure in a number of studies [68-73]. A meta-analytic study reported an inverse association between HF risk and oily fish consumption [74]. Fried fish, however, increases the risk of HF [68,75]. It is postulated that unfried fish is beneficial due to its high content of omega-3 fatty acids [76].

6. EGGS

High egg consumption has been linked to an increased prevalence of HF (28–64%) in prospective studies [77,78]. According to a 2017 meta-analysis, persons who consume the most eggs had a 25% higher risk of incident HF than those who consume the least eggs [79]. Another recent study showed that intake of one egg per day was associated with an increased risk of heart failure when compared to no consumption, in US cohorts [80]. The risk increased as the number of eggs consumed per week increased – for 7 eggs [summary relative risk or SRR = 1.15), for 8 eggs per week (SRR = 1.19 and for 9 eggs per week (SRR = 1.23) especially in men [80]. The American Heart Association guidelines consider one egg per week safe for patients who are healthy [81].

7. ALCOHOL

The majority of epidemiologic evidence supports the idea that moderate drinking can reduce the risk of HF [82]. This relationship has been frequently studied. In the Framingham Heart Study, there was a 59% lower risk of HF in men consuming 8 to 14 drinks per week when compared to abstainers [83]. The Cardiovascular Health Study reported a 34% lower risk of HF in people who consumed 1 to 6 drinks per week (Hazard Ratio=0.66) when compared with abstainers [84]. In people who had previously had a myocardial infarction(MI), Klatsky et al. discovered that light-to-moderate alcohol use was associated with a 40% to 50% decreased risk of HF [85]. In another large study, compared with abstainers, US male physicians reporting alcohol consumption of 7 or more drinks per week had a 38% lower risk of HF [86]. More recently, Larsson et al., in meta-analysis, (total of 13 prospective studies, with 13,738 HF cases and 355,804 participants), reported that light alcohol drinking (0.1-7 drinks/week) was inversely associated with the risk of HF (Risk Ratio or RR=0.86) [87]. They found that compared with non-drinkers, the RR across levels of alcohol consumption was 0.90 for 3 drinks/week, 0.83 for 7 drinks/week, 0.84 for 10 drinks/week, 0.90 for 14 drinks/week, and 1.07 for 21 drinks/week [87]. This study demonstrated that the risks of HF go up as the amount of alcohol consumed increases. Two other meta-analyses confirmed that high levels of alcohol consumption increase the risk of heart failure [88,89]. In the United States, one "standard" drink is 12 ounces of regular beer, which is usually about 5% alcohol, 5 ounces of wine, which is typically about 12% alcohol, and 1.5 ounces of distilled spirits, which is about 40% alcohol [90]. The detrimental effects HF were reported in 2005 by Klatsky and collegues [85]. They discovered that heavy drinkers had a 1.7-fold greater incidence of HF without prior MI than abstainers. The dose–response relationship between alcohol intake and HF appeared to be curved in some of the most recent meta-analysis [87]. Compared to non-drinkers, the risk for 1–84 g per week, 85–168 g per week, 168–336 g per week, and >336 g per week was RR = 0.86, 0.88, 0.91, and 1.16, respectively. In the United States, a ‘standard drink’ (as described earlier) contains 14 g of pure alcohol [91]. Larsson et al., based on a meta-analysis of eight studies, concluded that former drinkers were at a higher risk for HF compared to lifetime abstainers (RR = 1.22) [87]. Klatsky et al. found no association between beverage types (beer, wine, or spirits) and HF [85]. Moderate alcohol intake also reduces the risk of two major risk factors for HF - MI and T2DM [92,93]. The beneficial effects are mediated through raising high-density lipoprotein cholesterol94, improving insulin sensitivity [95,96], raising plasma levels of adiponectin [97], inhibiting inflammation98, improving endothelial function [99], influencing platelet aggregation [100], coagulation factors [101], and fibrinolysis [102,103], and increasing the plasma concentration of atrial natriuretic peptide [104].

8. WHOLE GRAIN

Whole grain (kernel) is made up of three key edible parts – the bran, the germ, and the endosperm – covered by an inedible husk. The husk protects the kernel from external assaults such as sunlight, pests, water, and disease. Whole grains contain all three edible parts of the kernel. Whole grain is rich in biologically active compounds, such as fiber, vitamins, minerals, antioxidants, and other beneficial plant compounds including lignans and phytosterols [105-107]. These biological compounds help the cardiovascular system by several mechanisms, including altering glucose homoeostasis, lipids, and lipoproteins, and endothelial function [108]. Several prospective cohort studies and their meta-analyses have reported a lower risk of CVD with a higher consumption of whole grains [109]. Refined grains have the bran and germ removed and, as a result, lack several beneficial ingredients. The benefit of whole grain intake has been reported in HF. A prospective study of individuals consuming seven servings of whole grain breakfast cereal weekly, during a 19.6-year follow-up period, reported a 29 % decrease in HF risk when compared to individuals with no intake of these cereals [110]. A subsequent prospective study confirmed the beneficial effects and reported a 7 % decrease in HF risk with each additional wholegrain serving [111].

9. DAIRY

There is a sparsity of studies on the effect of dairy on heart failure. Dairy consumption was linked to an 8% increase in the incidence of heart failure in a prospective study published in 2008 [111,112]. However, a recent systematic review and meta-analysis of prospective studies found that biomarkers of dairy intake and HF incidence are inversely related [113].

10. NUTS

Nuts (such as almonds, Brazil nuts, cashews, hazelnuts, macadamias, peanuts, pecans, pine nuts, pistachios, and walnuts) are rich sources of mono and poly unsaturated fatty acids, protein, fiber, several minerals (e.g., magnesium, potassium, and zinc), vitamin E, folic acid, and other bioactive micronutrients such as phenolics and phytosterols [114]. Meta-analyses of prospective studies have shown that nut consumption is beneficial for cardiovascular diseases [115-117]. Data from prospective studies on nut consumption in relation to heart failure is, however, limited [111,118,119]. Nut eating has been demonstrated to have cardiovascular benefits in observational studies and clinical trials. Compared to non-consumers, one study reported that walnut consumption was associated with better diastolic function in young to middle-aged adults [120]. Nut consumption is also associated with a decrease in BP [121]. HTN is known to increase the risk of HF by 2–3 fold [122]. Nut intake also helps to reduce the risk of T2DM [123] which is also a risk factor for HF [124]. There is also a helpful weight loss with nut intake, provided the intake is not high [125]. Two previous prospective studies found no link between nut consumption and the occurrence of heart failure [118,119]. However, in a recent study, nut consumption was inversely related to heart failure. Compared with no nut consumption, for heart failure, the corresponding Hazard Ratio for (frequency of nut consumption: none;1–3/month;1–2/week; ≥3/week were 0.87, 0.80, and 0.98 respectively [126]. The fact that high nut consumption raises rather than decreases body weight may explain the lowered risk of heart failure linked with moderate but not high nut intake. Nut consumption may favorably influence cardiovascular health by improving blood lipid levels [127,128], and its anti-inflammatory [129], and antioxidant effects [130]. It also helps improve endothelial function [131].

11. COFFEE

It is estimated that 400 million cups of coffee are drunk every day in the US. An 8-ounce cup of coffee contains 80 to 100 mg of caffeine, while an 8-ounce cup of decaf coffee typically has only 2-15 milligrams. The FDA cites four to five cups of coffee (about 400 mgs) per day as a safe amount of consumption [132]. Studies have found that this amount of intake is not associated with any increased risk of heart failure [133]. Even consumption at higher levels – up to 600 mg/day, although may be associated with some cardiovascular symptoms, these are mild, transient, and reversible, with no lasting adverse effects [133]. The ARIC study reported that increased coffee consumption also appears to correlate with a reduced risk of developing HF later in life (even after controlling for known risk factors) [134]. Kolb et al. proposed in 2020 that filtered coffee, without sugar or other additions, may be regarded a dietary source of phenolic phytochemicals that could provide antioxidant protection in HF patients, similar to whole grains and vegetables [135]. There is some suggestion that increasing decaffeinated coffee consumption may increase HF risk, but the data is limited [136].

12. CONCLUSION

Nutrition may play a significant role in the development and progression of HF. A plant-based dietary pattern is a recognized cardiovascular risk mitigating lifestyle [137]. Antioxidants, micronutrients, dietary nitrate, and fibre are abundant in this diet, while saturated/trans fats and sodium are limited. Plant-based diets reduce the incidence and severity of HF [138]. They help to reduce oxidative stress, homocysteine levels, and inflammation, as well as increasing nitric oxide bioavailability and improving the gut microbiome. Part II of this manuscript covers the relationship between HF and harmful macronutrients, obesity, and its relationship with several special diets.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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