9 Special Diets in Various Asian Populations and Their Effect on Hypertension and Cardiovascular Disease

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9.1 Introduction

Globally, cardiometabolic deaths can predominantly be attributed to dietary habits. The risk of cardiovascular disease (CVD) increases in direct proportion to hypertension across all ranges of blood pressure (BP) [1]. Although there are several risk factors for hypertension, including genetic and behavioural aspects, there is also evidence that diet plays an important role in the increasing prevalence of this disease. It is well known that chronic overconsumption of sodium-rich food, excessive calories, fats, and carbohydrates combined with reduced intake of plant-based food increases the risk of developing hypertension and CVD. From a public health and economic perspective, dietary strategies are viable options to mitigate the risks. To reiterate the importance that diet plays in the entire cardiometabolic conundrum, optimal lifestyle modification can reduce the risk of myocardial infarction by 81–94% [2, 3] compared to just 20–30% with the use of pharmacotherapy [4]. Of course, cultural norms and a population's traditional dietary habits may prove to be a challenge in the implementation of such strategies. Several studies explore the relationship between diet and these conditions. In some studies, the Dietary Approaches to Stop Hypertension (DASH) diet in a variety of versions [5–9], plus reduced salt intake [10–12] has been shown to be effective in reducing BP. Both individual foods and specific dietary patterns of certain geographical areas assume importance when we assess the relationship between hypertension and diet. However, a lot of existing data come from cross-sectional studies. Given that hypertension and CVD are major contributors to morbidity and mortality globally, it is imperative that we find preventive strategies, especially in the form of nutritional interventions, to try and reduce the prevalence of these diseases.

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9.2 Diet and Hypertension

9.2.1 The Relationship

Several nutrients, including sodium, potassium, fibre, whole grain, magnesium, nuts, protein, calcium, dairy products, and vitamin D, have all been shown to favourably or unfavourably affect BP, some with sufficient evidence and some without. The effects of sodium, potassium, fruits, vegetables, and fibre on BP are well known. However, there are many nutrients for which the relationship is not yet clear. More studies are needed to establish the relationship between nutrients such as magnesium, calcium and nuts, and hypertension.

Vegetarianism: There are convincing data supporting the beneficial effects of plant-based diets in the therapy of hypertension, as recently reviewed [13]. Historically, population studies and cross-sectional studies conducted as far back as 1929–1959 have shown a lower prevalence of hypertension in the indigenous populations of Africa, China, Germany, and Australia [14–16]. These were populations that consumed predominantly plant-based food. Vegetarianism is also practiced as a part of religious choices, and the effects are similar. For example, Seventh Day Adventists (vegetarians) had lower BP than Mormons (omnivores), although their lifestyles in other respects were comparable [17]. Similar results were obtained in another study, and the prevalence of hypertension was 8.5–10% in the omnivores compared with just 1–2% in the vegetarians [18]. A more recent meta-analysis of data from 32 studies showed that vegetarians had significantly lower BP than omnivores [19]. Data from prospective cohort studies have corroborated these findings, and all reported the significant superiority of plant-based versus meat-based diets with respect to BP levels and rates of hypertension [20, 21].

Several hypotheses could explain why plant-based diets are more successful in reducing BP. Predominantly plant-based diets are obviously higher in fibre and lower in calories, which facilitates weight loss [22], something that is known to lower BP. Secondly, many studies have noted an inverse relationship between high potassium intake and BP [23]. It is possible that vegetarians have a higher potassium intake than meat eaters [24], most likely due to the consumption of more fruits and vegetables by vegetarians. Another hypothesis explores the relationship between gut microbiota and hypertension but although there are many theories to explaining this connection, human studies on the subject are scarce.

DASH Diet: All the above studies paved the way for the formulation of the very effective DASH diet. It was used in the first ever randomized controlled trial to assess the effectiveness of a plant-based diet in hypertension, although limited amounts of lean meat were incorporated into this diet. To minimize confounding factors, dietary sodium was kept uniform across all the study groups. The results were very encouraging because the DASH diet significantly reduced systolic BP (SBP) by 5.5 mmHg and mean diastolic BP (DBP) by 3.3 mmHg compared with the control group [5]. Reductions in both SBP and DBP during consumption of the DASH diet were greater in patients with known hypertension than in those with normal BP at baseline. The combination of the DASH diet and sodium restriction

had additive effects on BP reduction in a later trial. Perhaps both these trials could have shown even better effects on BP had the nonvegetarian component been eliminated entirely [6].

9.2.2 Role of Diet in Treatment

Even small reductions in BP can significantly reduce CVD risk and events [25]. Regardless of the need for pharmacotherapy, lifestyle modification is an important part of disease management across all stages of hypertension. As noted above, the DASH diet and sodium restriction are two dietary approaches that have gained a lot of attention in the treatment of hypertension [5].

Salt intake: The recent SOTRUE randomized, double-blind feasibility study examined the effects of a low sodium diet on BP in older adults (age >60 years) [10]. Meals in both arms of the study were matched for all nutrients, including potassium and macronutrients, and differed only with respect to sodium. Compared with the typical sodium meal plan, the low sodium meal plan decreased SBP by 4.8 mmHg, but this was not statistically significant.

A recent meta-analysis of data from 185 trials investigated the effect of a low sodium diet on BP, hormones, and lipids in both normotensive and hypertensive individuals [26]. Most of the included studies were conducted in White participants and therefore the results were stratified by race. Although some studies provided only weak evidence, in general, the BP-lowering effects of a low sodium diet were more pronounced in Black populations and Asians than in the White population. However, this effect was more pronounced in patients with hypertension compared with normal BP, suggesting that low sodium diets may not prevent hypertension but could be an effective treatment. Importantly, the meta-analysis showed consistent potential harmful effects of a low sodium diet on hormones such as renin, aldosterone, noradrenaline, adrenaline and on lipids, especially in normotensive individuals.

Overall, data show that salt restriction is an important component of the nonpharmacological treatment of hypertension. Physicians need to be aware of the salt content of common diets. The sodium content of foods (per 100 g) in common Indian diets is shown in Table 9.1.

Combined DASH diet and salt restriction: In 2001, the DASH Collaborative Research Group published the DASH-Sodium Study, which investigated the combination of a DASH diet with different dietary sodium levels in patients with or without hypertension [6]. Thus, the two important modalities of lifestyle modification and diet to control BP, namely sodium intake and the DASH diet, were combined in this study. The results very clearly showed that a combination of the DASH diet and low sodium intake had a more profound BP-lowering effect in subjects with and without hypertension. Another important finding was that reducing dietary sodium could have a beneficial effect on BP independently of the DASH diet.

A more recent study examined the effects of the low sodium and DASH diets alone and in combination based on baseline BP [7]. Although reducing salt alone was beneficial across BP categories, there was a dramatic reduction in BP when the

Table 9.1 Sodium content of foods per 100 g—common Indian diets

<25 mg Low	25–50 mg Moderate	50–100 mg Moderately high	>100 mg High
• Amla • Bitter gourd (Karela) • Bottle gourd (Laukee) • Brinjal (Baingan) • Cabbage • Lady finger (Bhindi) • Cucumber • Peas, onion, potato • Tomato ripe • Milk • Wheat	• Raisins • Carrots • Black gram (Urad) dal • Green gram (Moth) dal • Bengal (Chana) gram • Banana • Pineapple • Apple • Mutton	• Cauliflower • Fenugreek (Methi) • Lettuce (Salad Patta) • Field beans Beetroot • Watermelon • Bengal gram dal • Tender liver • Prawns • Beef • Chicken	• Amaranth (Rajgira) • Bacon • Egg • Lobster

two dietary approaches were combined, especially in subjects with a baseline SBP ≥150 mmHg (−20.8 mmHg).

High fat DASH diet: More recent thinking has been that high fat diets do not have as much of a negative effect on metabolism as was thought at the time the DASH diet was conceived. Therefore, a recent study used a modification of the DASH diet that replaced low-fat components with high fat foods while all other components of the DASH diet were retained [27]. The results showed that the high fat DASH diet reduced BP to the same extent as the traditional DASH diet, and reduced plasma triglyceride and very low-density lipoprotein (VLDL) levels and not increasing low-density lipoprotein (LDL) cholesterol. The results of this study are particularly significant because they allow variety in the diet because there is variation in the macronutrient composition, allowing for some substitution of carbohydrates for fat. This could facilitate better adherence to the diet because it gives the individual more options.

Mediterranean diet: Another healthy diet that has possible beneficial effects on BP is the Mediterranean diet. This describes the staple foods of countries that border the Mediterranean Sea, such as Greece and Italy. The diet itself is mostly plant-based, much like the DASH diet. The main difference is a much higher fat content, mostly sourced from olive oil. In addition, seafood, dairy, and poultry are consumed in moderation. There are several randomized clinical trials on the subject [28–30], but with varied methodology.

9.2.3 Asian Perspective

It is well known that Asian communities living in the UK and other Western nations have a higher prevalence of hypertension and CVD than their Caucasian counterparts [31–33]. Unlike a few decades ago, the prevalence of hypertension has now increased in the countries of their origin, perhaps attributable to the increasing

adoption of Western lifestyles and dietary patterns, which increases the prevalence of obesity and its consequences, including hypertension and CVD [34]. All published guidelines for treatment of hypertension emphasize the role of dietary therapy [34–36]. However, the implications and implementation of this strategy need to be examined for Asian populations. Added to the environmental insult, undesirable dietary patterns are harmful for a thrifty genotype. Another racial difference seen is renin suppression that has been seen in Japanese and Chinese individuals with hypertension [37]. All of this is conducive to an explosion of metabolic disorders in the Asian population. The various aspects of diet that influence hypertension from an Asian perspective are described below.

DASH diet: As one of the two well-known diets that have been well studied and known to impact hypertension favourably, the DASH diet appears to be closer to Asian cultural norms in that it advocates the consumption of fruits, vegetables, low-fat dairy, and reduced amounts of fat and cholesterol. On the other hand, not all Asian communities would be able to adopt the Mediterranean diet in entirety because it includes the use of olive oil with moderate intake of fish and wine in addition to the plant-based food that the DASH diet is based on. A study conducted in Japan showed that a modified version of the DASH diet improved cardiovascular risk factors when followed for 2 months [8].

Salt: In general, the sodium content of Asian cuisines is higher than recommended by guidelines. For example, Chinese cuisine often uses monosodium glutamate, which makes a significant contribution to sodium intake. In Asian population reducing salt intake to acceptable limits has been shown to have a beneficial effect on BP [11]. Although there is some evidence to show that potassium supplementation can help reduce BP [38, 39], none of the Asian hypertension guidelines specifically address the issue. Therefore, consumption of potassium-rich foods needs to be encouraged. Of course, the DASH and DASH-like diets that have been advocated by Asian guidelines do provide the requisite amount of dietary potassium.

A cross-sectional study conducted in China found that dietary intakes in middle-aged adults fell into four distinct patterns: traditional Chinese; Western style; animal food; and high-salt diets [40]. The results showed that those who consumed the animal food and high-salt dietary patterns were at higher risk of developing hypertension compared with those with the other patterns of dietary intake. Data from a South Indian population ($n = 8080$) showed that sodium intake was higher than that advocated by guidelines and was an independent predictor of higher SBP [41]. Salt intake was higher in men than in women, with a correspondingly higher prevalence of hypertension in men versus women.

Modified versions of these two dietary patterns (vegetable-based diets and salt-restricted diets) have been advocated by guidelines from China, Japan, Korea, Taiwan, and India [34, 42–45]. These guidelines recommend that salt consumption should not exceed 5–6 g/day. However, they do not specify the potassium intake. The Indian guidelines (2019) specify alcohol consumption: no more than two drinks per day for most men and no more than one drink a day for women [34].

Whole grains: The nutritional benefits of whole grains are well known, especially in terms of preventing metabolic diseases including hypertension. However,

the consumption of whole grains is limited mostly to the affluent classes in the Asian region. A 3-year survey of Japanese adults showed that the chances of developing hypertension were considerably lower in those who consumed whole grain foods versus those who did not [46]. A population-based study performed in India showed that, among other variables, high dietary fat and low fibre intake were significant determinants of hypertension, as were urban location, obesity, and truncal obesity [47].

Monounsaturated fatty acids (MUFA): In another Asian study, 1529 Korean subjects without hypertension were followed for 4 years to investigate the effects of consuming MUFA and their metabolites on the incidence of new-onset hypertension. The results showed that MUFA and its metabolites had a protective effect against onset of hypertension in this population [48].

Obesity pattern: Higher BMI has been linked to higher BP [49]. The correlation is even stronger for visceral fat, which is reflected by waist circumference [50]. The Asian Indian phenotype with increased body fat is now a well-accepted entity. Managing and treating obesity optimally is an important component of dietary strategies to treat hypertension, especially in Asian populations.

9.3 Diet and Cardiovascular Disease (CVD)

9.3.1 The Relationship

There is a good body of evidence showing a correlation between healthy eating and a lower risk of CVD in Western populations. However, such evidence is quite scarce in Asian populations. It appears that Westernized diets high in sodium and low in potassium could cause oxidative stress, resulting in damage to the vascular endothelium. The underlying mechanism could be reduced availability of nitric oxide leading to defective relaxation of the vascular smooth muscle [51]. Westernized diets that are predominantly meat based and low in fruits and vegetables, as well as potassium, also lack phytochemicals, carotenoids, and other minerals present in plant-based foods. These substances are natural antioxidants that help to reduce oxidative stress. Indeed, the phytochemical content of the DASH diet was found it to be significantly higher than in the control group [9].

Another diet that has been shown to reduce cardiovascular outcomes is the Mediterranean diet. The ATTICA study conducted in Greece is worth mentioning in this regard [52]. It included 3042 individuals without CVD who were followed up for 10 years, at which time 2583 individuals could be assessed. Independent of any other factors, intake of the Mediterranean diet conferred considerable protection from CVD that was evident even in the presence of other risk factors, such as obesity and smoking. Reductions were also seen in levels of C-reactive protein and interleukin-6. Another analysis of the same study showed that a Mediterranean diet reduced cardiovascular risk by 29.3%, irrespective of statin use [53]. However, cardio protection was not seen in a subgroup of this population who followed a

DASH-like diet [54]. In a systematic review, the Mediterranean diet also protected against stroke [55].

Preliminary studies suggest that the gut microbiome could be altered by the consumption of soluble fibre to have a favourable effect on cardiovascular risk factors [56].

9.3.2 Role of Diet in Treatment

The DASH diet has been one of the mainstays of dietary treatment of CVD. The Nurse's Health Study showed that a DASH-type diet could reduce the risk of atherosclerotic heart disease and stroke [57]. One variation of the HF-DASH diet mentioned above replaces 10% of carbohydrates in the traditional low-fat DASH diet with unsaturated fats [58]. This was shown to lower triglycerides and improve HDL cholesterol, without any effect on LDL cholesterol, thereby improving the Framingham Risk Score. Given that adherence to very low-fat diets may be poor [59], this modification of the DASH diet may be beneficial in improving compliance while retaining the beneficial effects on cardiovascular risk.

Endothelial health is vital to the prevention of CVD and attenuation of CVD progression, and this is an area where diet can play a part. A meta-analysis of data from 1930 patients showed that the Mediterranean diet had a beneficial effect on endothelial health [28]. One measure of endothelial health, flow-mediated dilatation (FMD), was improved by 1.66%. This suggests that a Mediterranean diet could contribute to the early prevention of atherosclerotic vascular disease.

The CORDIOPREV study studied the comparative effects of a Mediterranean diet rich in olive oil and a low-fat diet on endothelial dysfunction and included some patients with diabetes [60]. Compared with baseline, FMD was significantly improved after 1.5 years in patients with type 2 diabetes or prediabetes who consumed a Mediterranean diet. Additionally, the FMD was significantly better in the Mediterranean versus low-fat diet group. This has implications for slowing the progression of CVD in patients with type 2 diabetes.

9.3.3 Asian Perspective

There is a comparative lack of studies that have evaluated the correlation between eating patterns and CVD in Asian populations. A recent cross-sectional study used food frequency questionnaires to explore the correlation between healthy eating patterns and cardiovascular risk factors in Chinese, Malay, and Indian individuals living in Singapore [61]. In all groups, healthy dietary patterns seemed most similar to the DASH diet and were associated with the healthiest individuals in terms of cardiovascular risk factors (i.e., BMI and serum lipid levels.

Many South Asians reside in the USA. A study of these individuals found that those who consumed meat, fried snacks and high fat food had a worse

cardiovascular risk profile than those who consumed a DASH-like diet [62]. The latter group also had a lower prevalence of hypertension and other metabolic risk factors.

Vegetarianism: It has always been thought that vegetarianism protects against the development of cardiometabolic disorders. A vegetarian diet appears to be quite similar to the DASH diet in terms of content. However, South Asia, which has a large population that practices vegetarianism, has recently seen a significant rise in the prevalence of cardiometabolic disorders. It is possible that the vegetarianism practised in South Asia is not optimal in terms of the food groups consumed. Indeed, differences have been found between food groups consumed by vegetarian adults in South Asia and the US [63]. The number of practicing vegetarians in South Asia was much higher than in the US (33% vs 2.4%). Common food groups in the two vegetarian populations were legumes, fruit, and vegetables. However, consumption of desserts and fried foods was much higher in vegetarians from South Asian versus the US, while the consumption of refined cereals, juices, and sodas was much lower in vegetarians from the US versus South India. These differences resulted in American vegetarians being considerably less overweight/obese and less likely to have central obesity compared with their nonvegetarian counterparts. In contrast, South Asian vegetarians were only slightly less overweight/obese than nonvegetarian individuals from the same region. These data suggest that being vegetarian alone may not ensure a better cardiometabolic risk profile, and that it is actually the food groups consumed by vegetarians that are most important.

Indian diets: Indian diets are heterogeneous in terms of cuisines across different states and have the common issue of being high in carbohydrates. There is recent data which shows a strong association between high carbohydrate intake and the incidence of cardiometabolic diseases in India [64]. India's consumption of sugar is huge and is the largest in the world [65]. In most states, carbohydrates can contribute as much as 70% of the total daily calorie intake. This increases the risk of type 2 diabetes and other cardiovascular risk factors. Also, Asian Indians are ethnically prone to have insulin resistance [66]. This results in post-prandial spikes in blood sugar, even in non-diabetic individuals, which are responsible for an increased burden of oxidative stress. This is known to adversely affect the cardiovascular risk profile [67].

9.4 Conclusions

Dietary strategies to alleviate cardiometabolic diseases and hypertension, and their risk factors, are an important adjunct to pharmacotherapy. Dietary strategies are cost-effective from a public health perspective, especially in developing countries, such as many of those in Asia. In general, a diet that is mainly plant-based, such as the DASH diet and its modifications, along with a salt intake that does not exceed 5 g/day must be implemented to reduce the burden of hypertension in Asian countries. Diets rich in potassium should also be advocated. Many traditional Asian diets fulfil these criteria and must be actively propagated as lifestyle interventions for the

prevention and management of hypertension. Many mechanisms explain the connection, but more studies are required to elucidate the association. Plant-based diets not only reduce BP, but also oxidative stress that impairs endothelial function, thereby reducing the intensity of major cardiovascular risk factors. More population-based studies are necessary in Asia to determine the dietary patterns and food groups consumed. Additionally, the focus should also be on attaining optimal BMI to achieve BP targets.

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