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Review Article

Dietary Approaches to Stop Hypertension (DASH) Eating Plan: Beyond the Hypertension

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ABSTRACT

Background and Objectives: Dietary Approaches to Stop Hypertension (DASH) eating pattern, a diet rich in fruits, vegetables, whole grains and low-fat dairy with a reduced content of sodium, saturated fat, and total fat is introduced as an appropriate diet for hypertension. This eating pattern was basically designed to normalize blood pressure in patients with hypertension, and a large body of data could confirm its beneficial effects on blood pressure level. Here, we are going to discuss about the other aspects of this diet.

Materials and Methods: PubMed, Scopus and Google Scholar databases were searched for relevant publications up to November 2014. No limitation was considered regarding the language or publication date.

Results: Some studies have proposed more useful effects of this dietary approach, other than lowering blood pressure, such as reducing insulin resistance, and controlling the fasting blood sugar and lipid profiles, proposing it as a good dietary pattern to prevent cardiovascular diseases (CVDs). There is some evidence in prospective cohorts regarding the effect of DASH-style diet on CVDs or their major subclasses like coronary heart disease (CHD), stroke and heart failure (HF). A meta-analysis also showed the effects of this pattern on the indices of the glycemic control. Adherence to the DASH diet was inversely related to central obesity and metabolic syndrome features in observational studies in Iran. Furthermore, DASH is suitable for gestational diabetes mellitus, can have a role in the growth of the fetus, and may affect pregnancy outcomes.

Conclusions: It is emphasized that DASH diet is suitable for whole life span. Evidence also confirms the beneficial effects of DASH on obese children. Consumption of DASH diet for 6 weeks could reduce the circulating levels of hs-CRP among adolescents with MetS. Based on the existing facts, we can conclude that DASH is a good dietary pattern for both controlling the metabolic risk factors and being healthy.

Keywords: Dietary approaches to stop hypertension, metabolic disorders, diabetes, cardiovascular diseases

Introduction

Dietary approaches to stop hypertension (DASH) pattern refers to an eating plan to control blood pressure. The rational of DASH is findings from epidemiological studies showing that higher intakes of some specific minerals and fiber are associated with lower blood pressure (1). This dietary pattern, containing high amount of fruits, vegetables, whole grains and low-fat dairy products, has been designed to provide high amounts of potassium, calcium and magnesium. Other consideration in DASH eating plan is high consumption of fish, chicken and lean meats to reduce saturated fatty acids and cholesterol intake. Since DASH diet has been designed in the frame of a dietary pattern, it can account for any interactions among the individual foods or nutrients (2). Hence, prescribing DASH diet is preferred to individual dietary recommendations. Although DASH is focusing on food groups, there are no declarations about the percentage of various macronutrients. Most of previous studies have prescribed 40-60% carbohydrate, 10-20% protein and 25-39% fat of total daily energy intake. Since the introduction of DASH 1995, many investigations have been conducted to evaluate its metabolic outcomes. Favorable effects of

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DASH diet on lipid profile, metabolic syndrome (MetS), diabetes, gestational diabetes, hypertension and CVDs by several studies (3-11). It has been reported that DASH diet also contains high amounts of antioxidants (9). Longitudinal studies have revealed an inverse association between DASH diet scores and mortality (12). Note that DASH is a dietary pattern, which includes different components. It is possible that similar scores in different populations do not necessarily reflect similar dietary patterns. Indeed, different components might be in accordance with DASH recommendations that lead to different interactions, and consequently, different health outcomes. Based on the usual dietary intake of Iranians, the main difference between Iranian dietary pattern and DASH dietary pattern is related to the consumption of whole grains (Table1) (13-15). However, red meat intake is completely in accordance with the DASH guidelines (45.9 gr/d) (16). Due to differences in dietary patterns in different populations, assessing the health outcomes of DASH diet in different populations has been suggested. In this narrative review, we aim to summarize the health outcomes of DASH diet.

Materials and Methods

PubMed, Scopus and Google Scholar databases were searched for relevant publications up to November 2014. No limitation was considered regarding the language or publication date. We reached 3193 related papers. Most of the earlier researches were epidemiological (n=2776) which evaluated the adherence to DASH diet score. Among the published studies in this context, 407 were related to the association of DASH diet with blood pressure or hypertension (135 clinical trials), 115 to diabetes or insulin resistance and 127 about cancer (n=127). CVDs, mortality and metabolic syndrome have been considerably studied by fewer researchers (n= 48, 54 and 32, respectively) (Figure 1). An overview of the studies conducted in Iranian population is given Figure 2.

Table 1. Comparing the usual dietary intakes of Iranians with recommended amounts in DASH eating plan

Food groups	DASH index; sex specific (men/ women)	Usual intake of Iranians
Total fruits	≥4 servings/d	2.77 servings/d
Total vegetables	≥4/≥3 servings/d	3 servings/d (for female)
Whole grains	≥4.7/≥4 servings/d	1.1 servings/d (for female)
Total dairy products	≥2 servings/d	1.89 servings/d
Nuts, seeds, and legumes	≥4/≥3 servings/d	0.87 servings/d
Meat/meat equivalents	<6 oz (170 g)/d	130.5 g/d
Saturated fat	≤5% of total daily kcal	10% of total daily kcal

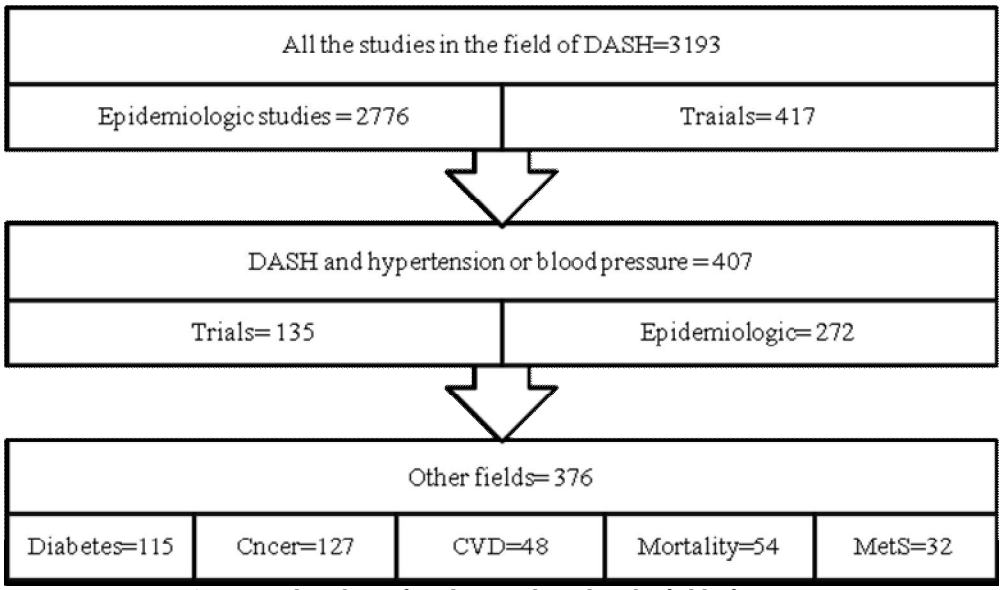

Figure 1. Flowchart of studies conducted in the field of DASH.

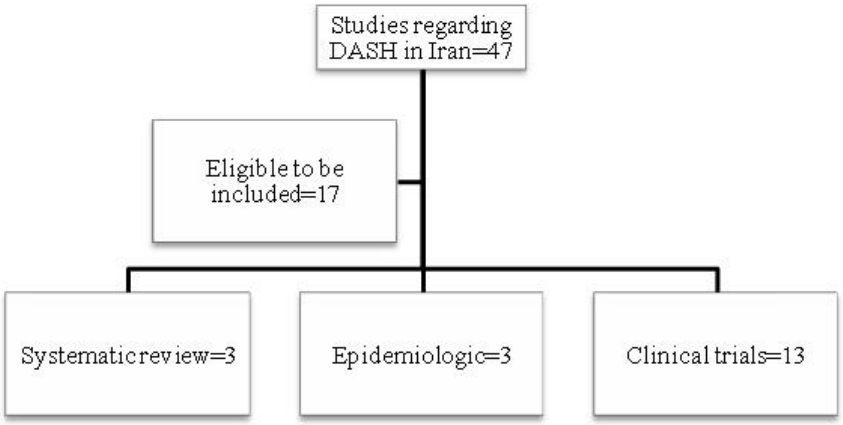

Figure 2. Flowchart of studies conducted in the field of DASH in Iran.

Hypertension

Hypertension (HTN), the most common cardiovascular disease, imposes a large burden of economic costs to the healthcare system. The growing prevalence of HTN has turned it into the leading cause of death in the world. Lifestyle modifications and different medications have been suggested to control HTN. Several epidemiological and clinical trials have assessed the effects of dietary components on blood pressure. However, dietary patterns have received more attention only during the last decades. Indeed, dietary patterns consider the overall effect of diet, and could reflect the interactions and synergist effects of different nutrients with each other.

Findings from large number of both epidemiological and interventional studies indicate that adherence to DASH diet is associated with lower systolic blood pressure (SBP) (3, 17, 18). In a study among Spaniards, hypertensive individuals had low accordance with the DASH diet (17). Consistently, in a cross-sectional study among Iranian female nurses, higher levels of DASH adherence reduced the risk of elevated blood pressure by 80 % (95% CI: 0.09, 0.67; P<0.01) (3). This association has been also observed in a general population of middle-aged men and women (18). However, there is debate over the beneficial effect of DASH diet on diastolic blood pressure (DBP). Another inconclusive aspect is regarding the effects of DASH diet in normotensive subjects in comparison with hypertensive individuals. On the other hand, it is not clear whether the magnitude of blood pressure change by prescribing DASH diet is equal in normotensive and hypertensive subjects or not. A recent meta-analysis on 17 clinical trials examining the influence of DASH diet on blood pressure revealed that it was more effective in reducing SBP than DBP in all subjects (both hypertensive and normotensive subjects) (-6.74 mm Hg vs. -3.54 mm Hg) (19). Beneficiary effect of DASH diet was greater in hypertensive subjects than normotensive individuals (SBP: -6.82 vs. -2.44 mm Hg; DBP: -3.59 vs. -1.69 mm Hg). Likewise, it has indicated that reducing the energy intake beside DASH diet led to more reduction in blood pressure. However, DASH diet could also reduce blood pressure independent of weight loss. Finally, by DASH eating plan, blood pressure was reduced more in men than in women (19).

Diabetes and metabolic syndrome

DASH eating plan appears to be appropriate for insulin resistance, and thereby, for metabolic syndrome. Indeed, because of high amounts of calcium, magnesium and fiber and low amounts of SFA in DASH pattern, it is expected that DASH diet is able to improve insulin resistance. However, few studies have assessed its impact in patients with diabetes or MetS. Findings from a meta-analysis on controlled clinical trials indicated a slight decrement in fasting insulin level by consuming DASH diet (-0.15; 95% CI: -0.22, -0.08 muIU/ml) (20). Subgroup analyses by the presence or absence of MetS showed that DASH diet reduced insulin level only in subjects without MetS (-0.16; 95% CI: -0.26, -0.05 muIU/ml), but not in subjects with MetS (-0.04; 95% CI: -0.44,

0.36 muIU/ml). Association of DASH eating pattern and diabetes has been also evaluated by several epidemiological studies. However, in spite of discrepant findings, no meta-analysis has been conducted on observational studies in this context. Findings from most of these studies have reported lower risk for diabetes in higher levels of DASH adherence (21-23). In a longitudinal study among women with the history of gestational diabetes mellitus, Tobias *et al*. found that higher levels of DASH adherence score reduced the risk of type 2 diabetes by 46% (21). Similarly, a multiethnic cohort study suggested that higher DASH scores significantly reduced the risk of diabetes in white men and women, as well as in Japanese-American women and Native Hawaiian men, whilst healthy eating index (HEI)-2010 was not significantly related to diabetes (23). Inconsistently, a cross-sectional study on 5867 adults demonstrated no differences in consistency with the DASH diet among diabetic and normotensive, diabetic and hypertensive, and healthy individuals (24). A large case-cohort analysis from EPIC-InterAct study also revealed no protective effect for DASH diet against diabetes incidence (25). These discrepancies may be attributable to different methods for dietary intake assessments, as well as distributions of dietary components and confounders. Additionally, the participants of EPIC-InterAct study were mainly vegans, lacto-ovo vegetarians, and other health-conscious people. Therefore, their high quality diet might not let DASH pattern provide more beneficiary effects.

It has been suggested that the associations between dietary patterns and diseases should be compared in populations with similar dietary habits and intakes (23). This statement is supported by the findings from an investigation which indicated a link between similar dietary patterns and diabetes in both American Framingham Offspring Study and American NHS, whilst the association was much weaker in the European population (26). Similar evidence was observed for the link between dietary patterns and diabetes in the EPIC-InterAct study. Here, the authors showed that greater fruit intake among UK population could explain the greater protective effect of DASH in this population in comparison with others. Favorable effect of fruit intake against diabetes has been reported in earlier publications (27).

Previous studies have confirmed the beneficiary effects of DASH diet on poly cystic ovary syndrome (PCOS), gestational diabetes and pregnancy outcomes (9). Asemi *et al*. showed that adherence to DASH diet improved lipid profile and glucose tolerance in GDM women and females with PCOS (9, 28). Additionally, more pregnant women in the control group needed to have a cesarean section compared with those in DASH diet (80.8 vs. 46.2%; P=0.01). Birth weight, head circumference and Ponderal index were lower in the infants born to mothers on the DASH diet compared with those born to mothers on the control diet (3222.7 vs. 3818.8 g; P<0.0001, 34.2 vs. 35.1 cm; P=0.01 and 2.50 vs. 2.87 kg/m^2; P<0.0001, respectively) (10).

Cardiovascular disease

CVDs are a group of disorders related to heart and vessels, including coronary heart diseases (CHDs), stroke, and heart failure. Dyslipidemia, inflammation and oxidative stress are known as the main risk factors for CVDs. There is a little evidence regarding the association of DASH diet with biomarkers of oxidative stress and inflammation. Besides having other healthy dietary components, DASH eating plan is a dietary pattern rich in antioxidants (9, 29, 30); hence, it is plausible that DASH attenuates common CVD risk factors. Although lipid profile has been assessed in several researches, we are aware of no meta-analysis to summarize the overall impact of DASH diet on lipid profile components. Despite the discrepancy between the results of different studies, most of them have reported beneficial effect of DASH eating plan on serum triglycerides and HDL-C (3, 7, 9, 28, 31). Nevertheless, effect of DASH diet on LDL-C and total cholesterol is more inconclusive (6, 9, 28, 31, 32). Whilst some studies have shown lower LDL-C and cholesterol concentrations following a DASH diet, some others failed to find significant association in this regard. Similar inconsistency is also observed in observational studies (6).

All previous studies have confirmed DASH diet's favorable impact in lowering oxidative stress (9, 29, 30, 33-35). It is also a useful strategy for preventing and managing CVD risks in youth with diabetes

mellitus (6). However, there is more debate regarding its reductive effect on inflammatory markers. While some researchers have suggested lower levels of C-reactive protein (CRP) following DASH diet consumption (8, 11, 36), others failed to find significant associations either for CRP or other inflammatory biomarkers (30, 36). There are other known risk factors for CDV; however, they have been poorly investigated in relation to DASH diet. It has been found that DASH eating plan could not significantly change the markers of fibrinolysis (37), venous thromboembolism (VTE) (38), Apo B and adipocytokines (6). However, it is not possible to determine the net effect of DASH diet on these risk factors, because of poor available literature about them.

Although it is difficult to conclude a clear link between DASH diet and lipid profile, oxidative stress and inflammations, findings from a meta-analysis revealed that DASH eating plan reduced the risk of fatal and nonfatal CVD incidence (39). This meta-analysis suggested 20% lower risk for all CVDs by consuming DASH diet in comparison with the control group. DASH diet decreased the risk of CHD by 21%, stroke by 19%, and heart failure by 29%. Nevertheless, few studies were enrolled in this meta-analysis (n=6); therefore, it is possible that future researches may change their findings, particularly regarding the magnitude of DASH diet's overall effect.

Weight management

Obesity is well-known risk factor for various non-communicable diseases. Weight loss has been recommended for management of different metabolic disorders. However, successful weight reduction needs some changes in lifestyle, including dietary intakes and exercise. To date, several dietary strategies have been suggested to reduce body weight, including higher vegetable, fruit, fiber, calcium and whole grains intake, and lower fat consumption. DASH eating plan considers all of these recommendations in the frame of a healthy dietary pattern.

To the best of our knowledge, no meta-analysis has so far been performed to determine the effect of DASH diet on obesity. Nevertheless, there are some epidemiological and interventional studies that evaluated effects of DASH eating plan on anthropometric measures. An inverse link between DASH adherence and body weight and waist circumference has been shown in several previous studies (3, 9, 11, 31, 40). Moreover, a cross-sectional investigation among Iranian female youths found an inverse link for DASH diet with central obesity, but not general obesity (41). Studies among children, adolescents and youth have also reported healthy outcomes for DASH diet. This dietary pattern could prevent weight gain and improve elevated SBP in adolescents (42, 43). In a prospective cohort study, higher concordance with DASH was associated with the lower risk of weight gain only in normal weight women at baseline while this association was not evident in overweight women (44).

Conclusion

DASH eating plan may have more beneficial effects, which have poorly been studied. Protective effect of DASH diet against cancers, particularly colorectal cancer, has been reported by epidemiological studies (45, 46). DASH dietary pattern reduces the rate of cognitive decline in elderly persons, and is associated with healthy aging (47, 48). Higher levels of accordance with DASH are related to lower risk of all-cause mortality (12, 49, 50). This association has been attributed to healthy foods in DASH diet including whole grains, vegetables, nuts and legumes, but not lower sodium intake (12). More studies are needed to confirm these associations.

Briefly, DASH eating plan is considered as a healthy diet throughout the most of periods in life span from childhood to old age. It is useful diet beyond the hypertension in general population, and populations with different metabolic disorders. However, different dietary patterns may affect the relation of DASH diet with diseases in different populations; hence, it is recommended to determine the association of DASH diet with various diseases in different populations, separately. To our knowledge, there is no report regarding the adherence rate to DASH eating plan in Iran. Nevertheless, based on the available studies, whole grains consumption is largely far from the recommended amount by this eating plan; hence, it needs more consideration rather than other components to improve DASH score in Iranian population.

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FH and LA contributed to studyconcept. FH and SO searched data bases, extracted data and drafted of the manuscript. LA supervised the study commented on the manuscript and edited it. All authors approved thefinal version of the manuscript. None of the authors had any personal orfinancial conflicts of interest.

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