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Research Article

Assessment of the Awareness, Effect, Impact and Sustainability of Dash Diet on Hypertension; As Perceived by Practicing Dietitians: An Observational Survey-Based Study

Ms. Arushi Chandragiri *[1], Dr. Kaushal Kapadia [2]

1. Texila American University.

2. Clinical Research Professional.

***Correspondence to**: Ms. Arushi Chandragiri. Texila American University.

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Abstract

Objective: *Nutrition and diet play an important role in the overall wellbeing of an individual and is known to have a major role in preventing and management of many non-communicable diseases like hypertension. This study aimed to understand the role of Dietary Approaches to Stop Hypertension in controlling and management of high blood pressure. A survey-based questionnaire was circulated among the dietitians to understand the effect, impact and awareness of DASH diet among patients seeking their dietetic consultation.*

Methods: *The sample size consisted of 50 dietitians who gave dietetic consultation to hypertensive patients. A questionnaire consisting of 35 questions was circulated among dietitians and their responses was captured either in paper/digital format.*

Results: *The awareness of DASH diet among the dietitians was very high. Among the 50 dietitians, majority (98%) of the dietitians were aware of DASH diet. The awareness of DASH diet amongst the patients who visited them was however varying in nature. Majority of dietitians recommended their hypertensive patients to follow DASH diet (sometimes / always). While dietitians agreed that DASH diet contributes in controlling hypertension, they believed that the diet on its own is not effective, and they had mixed opinion on its effectiveness when it was followed along with taking medication. Dietitians observed reduction in both systolic and diastolic BP reading in their patients who followed DASH diet. Within the five independent approaches of DASH diet, dietitians saw reduction in BP reading for their patients who "increased fruits, vegetables, nuts and whole grains", or "increased intake of potassium rich food". Dietitians however did not see significant reduction in BP readings in their patients who "reduced their salt intake", "reduced sugar intake", or "reduced saturated fatty foods and red meat". Around 57.14% dietitians said that their patients found DASH diet to be sustainable as the diet was trackable/measurable and was easy to follow. In today's age of growing technology only 44% dietitians reported that trackers and smart apps helped their patients only sometimes to adhere to dietary modifications plan.*

Conclusion: *The study clearly found that there was reduction in both systolic and diastolic BP readings in patients who followed DASH diet. The study conducted clearly highlighted the lack of awareness among the general patient population regarding DASH dietary intervention method. The results from the study highlights the need for implementing awareness campaigns as a public health initiative, having frequent health check campaigns, use to social media to create awareness and implementing government health initiatives.*

Keywords: *hypertension, DASH diet, dietitians, systolic, diastolic, tracker, sustainability.*

Introduction

Hypertension, which is also known as high blood pressure is a medical condition that occurs when the force of blood flow through the blood vessels is persistently elevated. Every time the heart beats, blood is pumped into the blood vessels or arteries. Blood pressure is the force created when the blood pushes against the wall of arteries during the pumping of the heart. Higher the pressure the harder the heart has to pump thereby putting strain on the heart over long run. Hypertension is a complex medical condition with varied underlying causes like physical inactivity, lifestyle factors, diet rich in salt, genetic factors, family history etc[1].

Blood pressure is often denoted as two numbers and is commonly expressed as the ratio of systolic BP and diastolic BP. The systolic blood pressure (SBP), denotes the pressure exerted in the blood vessels when the heart contracts and the diastolic blood pressure (DBP), denotes the pressure exerted on the blood vessels when the heart relaxes. Blood pressure can be quite variable, even in the same person and can go up and down with normal daily activities like exercise, eating salty food etc. Hypertension is diagnosed when a patient's BP is recorded at or above 130mmHg with two or more readings taken on two or more occasions. As per World Health Organization (WHO) guidelines, individuals having systolic blood pressure ≥ 140 mmHg or diastolic blood pressure of ≥ 90 mmHg are considered to be hypertensive and require pharmacological intervention. Hypertension is a common and serious medical condition, and is the leading comorbidity factor for deaths globally[2].

Uncontrolled and prolonged hypertension is known to have an adverse impact on various vital organs. Hence a timely intervention, treatment and management of hypertension is crucial and important. Lifestyle intervention acts as a first line management strategy for the treatment and control of hypertension. This includes dietary adjustments like Dietary Approaches to Stop Hypertension (DASH) diet, low intake of sodium, minimum 30min of physical activity daily, weight reduction, moderate consumption of alcohol, reduction of sodium and stress management[3].

DASH diet is a flexible and balance eating plan that creates a heart healthy eating style for life. It was named "Best Heart Healthy Diet" and "Best diet for High blood pressure" by US News and World Report in 2025 [4,5]. DASH diet is a scientifically developed nutritional regimen developed in 1990s by the National Heart, Lung and Blood Institute (NHLBI) for the American population to support hypertension prevention and control. This diet recommends increased intake of fresh fruits and vegetables, low intake of fat and dairy products, increased intake of whole grains, poultry, fish and nuts while limiting the intake of salt, saturated fatty acids, red meat, sweets and sugar containing beverages[5,6].

Since the formulation of this diet pattern, DASH diet has been extensively studied over the years. Many clinical trials have been formulated and conducted over the years to study its significance and effectiveness in managing hypertension. The initial DASH study which was sponsored by NHLBI showed reduction in BP

readings in individuals who followed DASH diet when compared to those who followed the American diet[7,8,9]. The PREMIER trial investigated the effect of lifestyle interventions including the DASH diet on blood pressure reduction. Findings of this study showed a decrease in systolic blood pressure of 11.1mmHg in the DASH diet group[10]. The OMNIHEART TRIAL (Optimal Macronutrient Intake Trial to Prevent Heart Disease) aimed to evaluate the effect of three different diets, including a variation of DASH diet on blood pressure. Results of this trial showed a greater reduction in BP readings in patients who were on modified DASH diet than DASH diet alone[10,11]. Furthermore, a study published in the American Heart Association Journal in 2001 investigated the efficacy of the DASH diet in treating Stage 1 Isolated Systolic Hypertension (ISH). Individuals in the DASH diet group experienced a significant decrease in systolic blood pressure by 11.8 ± 9.3 mmHg and a notable reduction in diastolic blood pressure. While urinary sodium levels remained consistent[10].

Since DASH diet was mainly developed by the NHLBI for the US population awareness of this diet among Asian countries is generally low. Awareness about the disease and its associated morbidity has an important role in managing and controlling hypertension among the general population. Various studies in the past have shown that the awareness level among the rural and urban Indian population was varied and low and that this diet needs to be promoted as routine in patient care by healthcare personnel to increase the awareness.[12,13].

Materials and Methods

The current study was survey-based observational research conducted among the Dietitians. Sample size consisted of 50 licensed Dietitians who had a good footfall of hypertensive patients specifically of Asian origin. A questionnaire consisting of 35 questions were circulated among the dietitians and their responses were captured either in digital/paper format. The target population was chosen from various geographical locations across India (Pan India). All the responses the dietitians provided pertained to their patients diagnosed with hypertension and of Asian origin only. Ethics committee approval was sought before enrolling the dietitian cohort into the study (EC No.HCH-EC_05/20230722).

Results

Awareness of DASH diet among the dietitians was high as majority (98%) of the dietitians who were enrolled in the study were aware of DASH diet and only 1 was unaware of the diet ($p= 1.135 \times 10^{-11}$)

Awareness of DASH Diet	No. of dietitians
No	1 (2%)
Yes	49 (98%)
Total	**50**

Table 1: Awareness of DASH among dietitians

Fig 1: Awareness of DASH among dietitians

However, the awareness of DASH diet in patients who visited the dietitians was spread across "Never", "Sometimes" and "Often" in varied percentages as represented in table 2. None of these categories were found to be significant (p=0.295)

Patients aware of DASH diet	# of dietitians
Never	17 (34%)
Sometimes	21 (42%)
Often	12 (24%)
Total	**50**

Table 2: Awareness of DASH among patients visiting dietitian

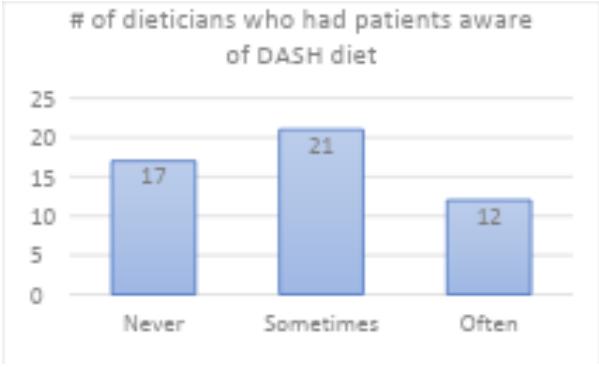

Fig 2: Awareness of DASH among patients dietitian

Among the 49 dietitians who were aware of DASH diet, 28 (57.14%) of them always recommended their patients to follow the diet, and 21 (42.85%) of them recommended it only sometimes (table 3). The exact reason for not recommending the diet by some dietitians was however not captured in our study.

Recommend DASH diet?	% of patients recommended	# of dietitians
Never	0%	1
Sometimes	0-30%	12
	30-60%	9
Always	100%	28
Total		**50**

Table 3: Percentage of patients to whom DASH was recommended

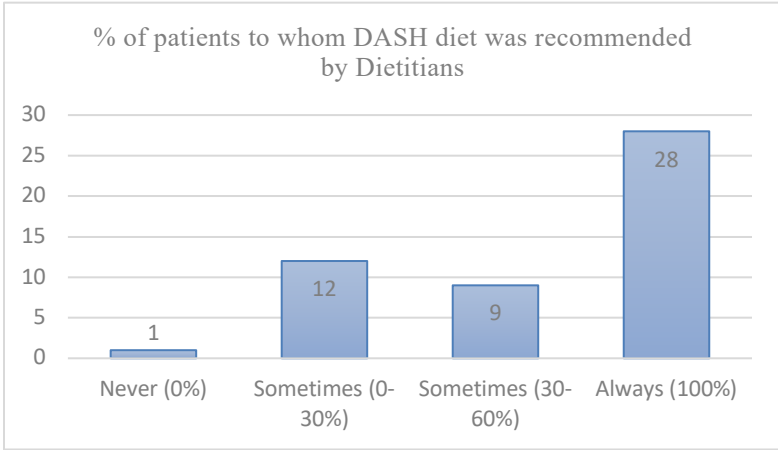

Fig 3: Percentage of patients to whom DASH was recommended

Although all the 49 dietitians (100%) who were aware of DASH diet felt that DASH diet plays a major role in controlling and managing hypertension they however, felt only diet cannot be effective in reducing BP readings (table 4) indicating a possibility of other factors also playing a role in management of hypertension.

Effectiveness of DASH diet alone	Obs (O)
Yes	5 (10.20%)
No	44 (89.80%)
Total	**49**

Table 4: Effectiveness of DASH in controlling BP controlling BP

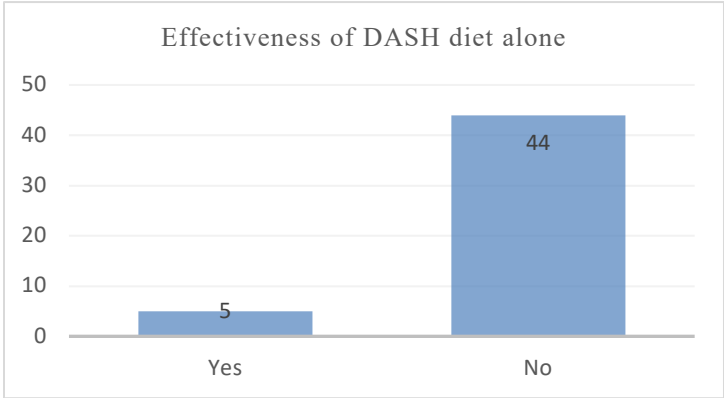

Fig 4: Effectiveness of DASH in controlling BP

30 (61.22%) dietitians believed that diet along with only medication is not effective which means that they believed that DASH diet in combination with some other factors (for e.g., exercise, emotional well-being, etc.) may be effective in controlling hypertension. We however do not have the data to understand what these factors are.

Chi-Square Goodness of Fit Test was done to establish whether any of the observations in the table below were statistically significant.

Effectiveness of DASH along with medication	**Obs (O)**
Yes	19 (38.78%)
No	30 (61.22%)
Total	**49**

Table 5: Effectiveness of DASH diet along with medication

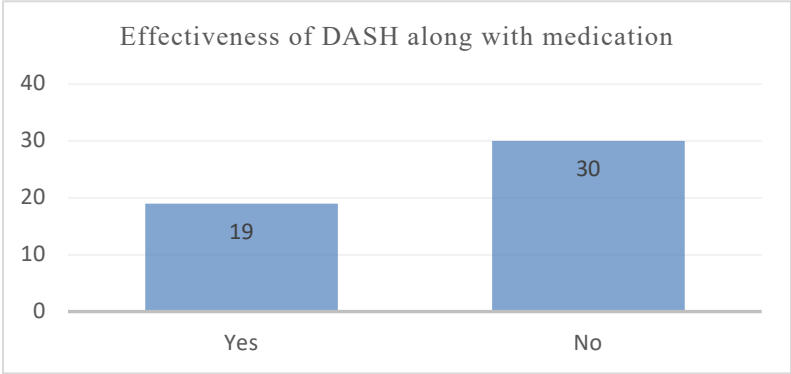

Fig 5: Effectiveness of DASH diet along with medication

As per the above tables, it is clear that although the dietitians agreed that DASH diet was effective in controlling hypertension, DASH diet alone didn't show any significance. However, they had mixed opinions on its effectiveness when it is followed along with taking medication.

47 (95.92%) dietitians said they saw reduction in BP readings in their patients who followed DASH diet in general. Similar reduction was seen when each of the independent approaches of DASH diet was employed (table 6). Chi-Square Goodness of Fit Test was applied (on each of the 6 scenarios independently) to test which of the scenarios is successful in reduction of BP readings.

Reduction observed in BP readings by:	**Yes**	**No**	**Total**
following DASH diet	47 (95.92%)	2 (4.08%)	49
reducing sugar intake	20 (40.82%)	29 (59.18%)	49
increasing fruits, vegetables, nuts and whole grain	**47 (95.92%)**	2 (4.08%)	49
reducing salt intake	**28 (57.14%)**	21 (42.86%)	49
reducing saturated fatty foods and red meat	**25 (51.02%)**	24 (49.98%)	49
increasing intake of potassium rich food	**44 (89.80%)**	5 (10.20%)	49

Table 6: Reduction in BP readings observed by dietitians in their patients

Note: "Following DASH diet" means the application all 5 approaches together, while the individual five approaches of DASH diet are taken as independent to each other for the purpose of this study. Significance is at 95% confidence level ($p < 0.05$)

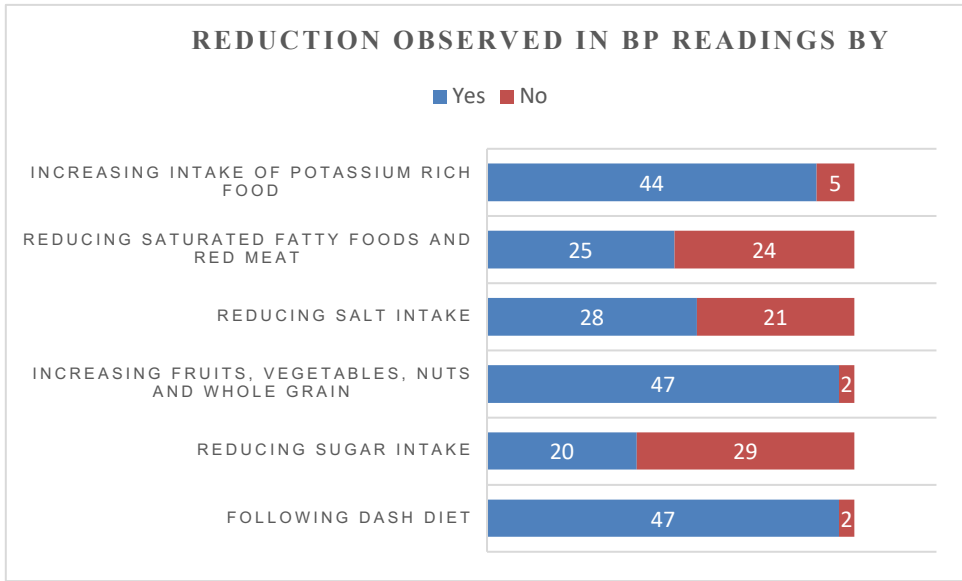

Fig 6: Reduction in BP readings observed by dietitians in their patients

A significant reduction in BP readings in patients who followed DASH diet as a whole (χ^2=41.327, p=1.29x10-10) and in patients who increased fruits, vegetables, nuts and whole grains (χ^2=41.327, p=1.29x10-10) and increased potassium rich food (χ^2=31.041, p=2.53x10-08) was observed.

The amount of reduction in SBP and DBP when DASH diet was followed in general as well as when independent approaches of DASH diet was followed is highlighted in table 7 and 9 respectively.

Reduction observed in **Systolic** BP readings → Approaches within DASH diet ↓	**1-3mm /Hg**	**3-7mm /Hg**	**7-10mm /Hg**	**>10mm /Hg**	**Total**
following DASH diet	10 (21.28%)	**26 (55.31%)**	8 (17.02%)	3 (6.38%)	47
reducing sugar intake	6 (30%)	**12 (60%)**	1 (5%)	1 (5%)	20
increasing fruits, vegetables, nuts, whole grain	12 (25.53%)	**22 (46.80%)**	10 (21.27%)	3 (6.38%)	47
reducing salt intake	**15 (53.57%)**	10 (35.71%)	3 (10.71%)	0	28
reducing saturated fatty foods and red meat	4 (16%)	**15 (60%)**	3 (12%)	3 (12%)	25
increasing intake of potassium rich food	8 (18.18%)	**26 (59.09%)**	10 (22.72%)	0	44

Table 7: Reduction in Systolic BP readings found by dietitians in their patients

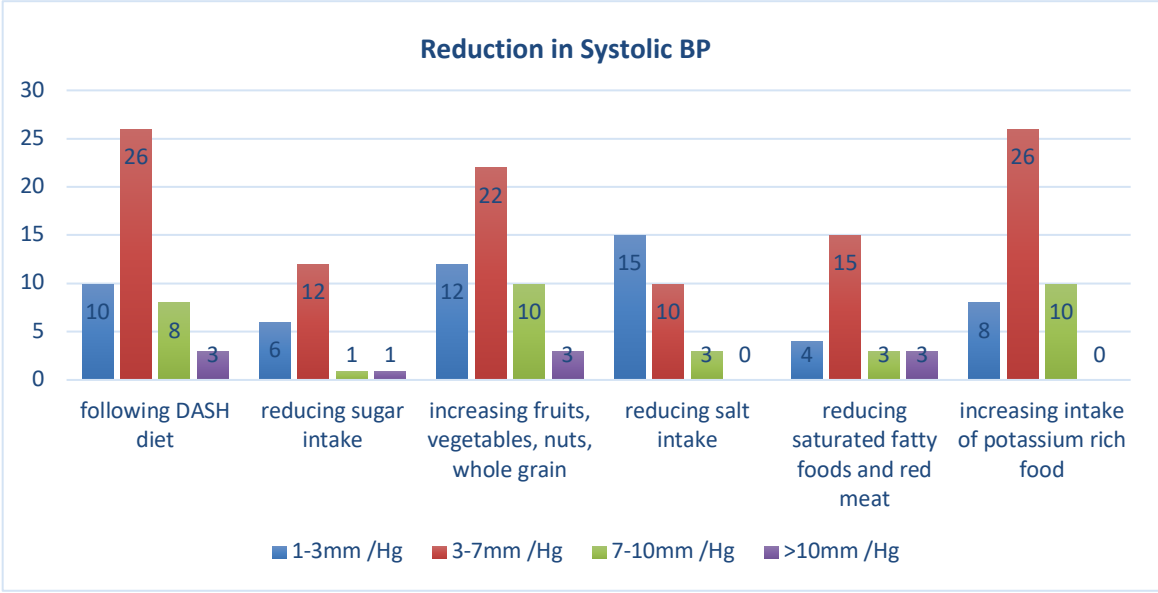

Fig 7: Reduction in Systolic BP readings found by dietitians in their patients

Reduction observed in systolic BP readings → Approaches within DASH diet ↓	1-3mm /Hg	3-7mm /Hg	7-10mm	>10mm /Hg
following DASH diet	-0.511	4.157	-1.094	-2.553
reducing sugar intake	0.447	3.130	-1.789	-1.789
increasing fruits, vegetables, nuts, whole grain	0.073	2.990	-0.511	-2.553
reducing salt intake	3.024	1.134	-1.512	-2.646
reducing saturated fatty foods and red meat	-0.900	3.500	-1.300	-1.300
increasing intake of potassium rich food	-0.905	4.523	-0.302	-3.317

Table 8: The heat map for the standard residuals calculated for each approach independently

Note: Significant positive values (> +1.96) are in yellow.

Reduction observed in **Diastolic** BP readings → Approaches within DASH diet ↓	**1-3mm /Hg**	**3-5mm /Hg**	**>5mm /Hg**	**Total**
following DASH diet	**26 (55.31%)**	18 (38.29%)	3 (6.38%)	47
reducing sugar intake	**13 (65%)**	6 (30%)	1 (5%)	20
increasing fruits, vegetables, nuts and whole grain	**32 (68.08%)**	12 (25.53%)	3 (6.38%)	47
reducing salt intake	**25 (89.28%)**	3 (10.71%)	0	28
reducing saturated fatty foods and red meat	**15 (60%)**	7 (28%)	3 (12%)	25
increasing intake of potassium rich food	**25 (56.81%)**	18 (40.90%)	1 (2.27%)	44

Table 9: Reduction in diastolic BP readings found by dietitians in their patients

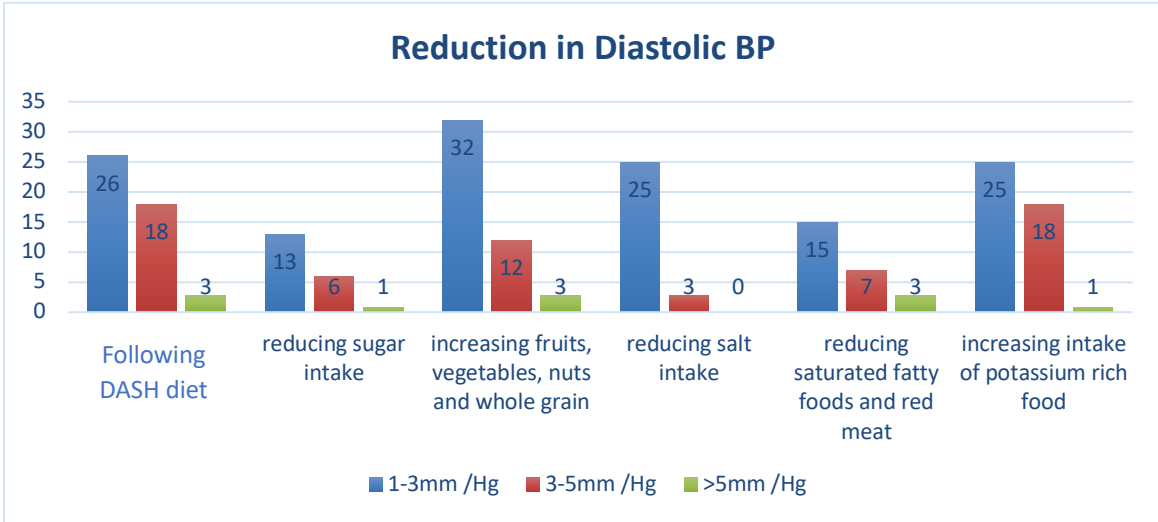

Fig 8: Reduction in diastolic BP readings found by dietitians in their patients

Reduction observed in diastolic BP readings → Approaches within DASH diet ↓	1-3mm /Hg	3-5mm /Hg	>5mm /Hg
following DASH diet	2.61	0.59	-3.20
reducing sugar intake	2.45	-0.26	-2.19
increasing fruits, vegetables, nuts, whole grain	4.13	-0.93	-3.20
reducing salt intake	5.13	-2.07	-3.06
reducing saturated fatty foods and red meat	2.31	-0.46	-1.85
increasing intake of potassium rich food	2.70	0.87	-3.57

Table 10: The heat map for the standard residuals calculated for each approach independently

Note: Significant positive values (> +1.96) are in yellow

Table 11 summarizes the reduction in BP readings observed by the dietitians in their patients who followed DASH diet in general and in those who adhered to each of the five approaches to DASH diet independently.

Reduction observed in BP readings → Approaches within DASH diet ↓	Significant no. of patients see reduction	Most occuring Systolic BP reduction				Most occuring Diastolic BP reduction		
		1-3mm /Hg	3-7mm /Hg	7-10mm /Hg	>10mm /Hg	1-3mm /Hg	3-5mm /Hg	>5mm /Hg
following DASH diet	✔		✔			✔		
reducing sugar intake			✔			✔		
increasing fruits, vegetables, nuts and whole grain	✔		✔			✔		
reducing salt intake		✔				✔		
reducing saturated fatty foods and red meat			✔			✔		
increasing intake of potassium rich food	✔		✔			✔		

Table 11: Reduction in BP readings found by dietitians in their patients

Around 28 (57.14%) of the dietitians felt that DASH diet was sustainable over a long run, however 6 (12.24%) of them felt that it wasn't sustainable, and the remaining 15 (30.61%) of them were not sure of its sustainability.

Sustainability of DASH diet	
Yes	28 (57.14%)
Not sure	15 (30.61%)
No	6 (12.24%)
Total	**49**

Table 12: DASH diet Sustainability

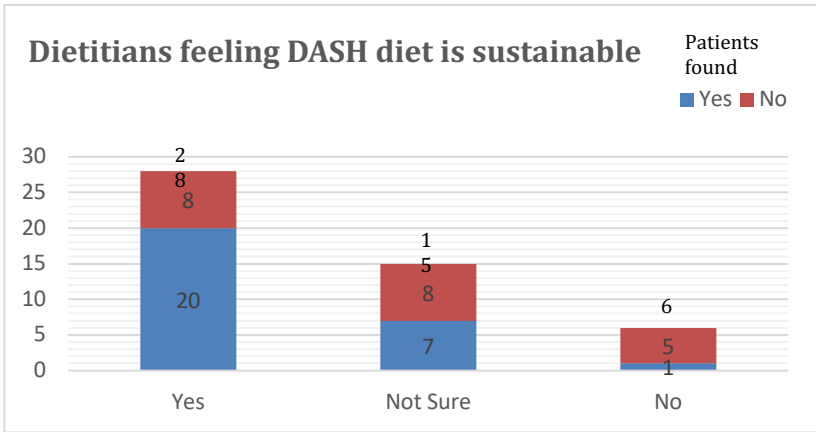

Fig 9: DASH diet Sustainability

When the dietitians were asked if their patients felt following DASH diet difficult. 21 (42.86%) of them said that their patients found it difficult to sustain, while 28 (57.14%) of them said their patients didn't find any difficulty in following the diet. Of the 28 dietitians whose patients felt that the diet was sustainable, 13 (46.42%) reported that their patients found the diet sustainable because the diet was "trackable and measurable", while the remaining 15 (53.57%) said it was because the diet was "easy to follow".

Sustainability of diet	
Trackable/Measurable	13 (46.42%)
Easy to follow	15 (53.57%)
Total	**28**

Table 13: Extent of following diet

Fig 10: Extent of following diet

The 21 dietitians whose patients found sustaining DASH diet difficult cited the following reasons as highlighted in Table 14.

According to dietitians, challenges faced by patients in following DASH diet	**# of dietitian selections**
Cooking separate diet meal is a challenge	10
DASH menu included many food items which are not part of our cuisine	11
Healthier food choices are expensive	8
Poor availability and quality of fresh fruits and vegetables nearby	5
Limited options to eat healthier food in restaurants	10

Table 14: Reasons cited for difficulty in following the diet

Note: The total is 44 selections by dietitians and not 21 dietitians, as the dietitians could select multiple challenges.

To determine whether the frequency distribution of the dietitians' selections differ significantly from what we would expect if all challenges were equally likely, we employed the Chi-square goodness-of-fit test. We found significant evidence that all challenges were equally experienced ($\chi^2 = 2.591$; p= 0.6284).

The dietitians were then surveyed about the use and effectiveness of diet trackers/smart apps. Of the 49 dietitians, 37 (75.51%) felt that use of diet tracker/ smart app helped patients in adhering to the diet and managing it better.

Finally, all the 50 dietitians were asked the question if the use of smart app/trackers have helped patients keep track of what they eat thereby adhering better to a dietary modification plan? This question was asked to all the dietitians enrolled in the study irrespective of whether they were aware of DASH diet, in order to understand if the patients visiting the dietitians were using technology for monitoring their food intake which could be a source for future research. The responses we received from the dietitians is detailed in table 15.

Extent to which trackers / smart apps help	# of dieticians	Percentage
Never	2	4%
Rarely	14	28%
Sometimes	22	44%
Often	10	20%
Almost Always	2	4%
Total	**50**	**100%**

Table 15: Extent to which trackers helped

To determine whether the frequency distribution of the dietitians' responses differ significantly from what we would expect if all challenges were equally likely, we employed the Chi-square goodness-of-fit test and the standard residual method for post-hoc analysis. As per the calculations of the standard residual, "Sometimes" was the response that occurred significantly more (and "Never" and "Almost Always" were the responses that occurred significantly lesser) number of times ($\chi^2 = 28.8$; p= 8.584 x 10-6).

Discussion

This study analysed the effect and impact of DASH diet in hypertensive patients who visited the dietitians. The survey was answered by the dietitians who had a good influx of hypertensive patients in their clinic. The responses from the Dietitians obtained in this survey study clearly shows that there was a significant reduction in BP readings in their hypertensive patients who were following DASH diet in general which is similar to the findings observed in many previous clinical studies[7,8,9]. When the five independent approaches of DASH diet was analysed separately, dietitians said there was reduction in BP reading in their patients who "increased

fruits, vegetables, nuts and whole grains", or "increased intake of potassium rich food "only. However, they did not significantly see reduction in BP readings in their patients who "reduced their salt intake", "reduced sugar intake", or "reduced saturated fatty foods and red meat". Although the earlier studies[10,17] showed significant reduction in BP readings at lower sodium intake our survey study didn't show significant reduction in BP readings with respect to reduced salt intake. However, with respect to fruits, vegetables, nuts and whole grains our findings were similar to the findings in earlier study were in an inverse relationship between risk of mortality and increase in fruit and vegetable intake was seen[18].

A moderate reduction (3-7mm /Hg) in systolic BP was observed by the dietitians in their patients who followed DASH diet in general, and also in patients who adhered to independent approaches of "increased fruits, vegetables, nuts, whole grains", or "increased intake of potassium rich food". This finding was similar to the findings reported in previous studies[7].

Dietitians also observed a slight reduction (1-3mm /Hg) in diastolic BP in their patients who followed DASH diet in general, as well as when each of the independent approaches were followed independently. These findings clearly shows that DASH diet was effective in controlling and management of hypertension which was similar to the findings reported in earlier clinical studies[10,11,23].

Majority of the dietitians (98%) who were recruited in this study were aware of DASH diet. However, the awareness amongst the patients who visited these dietitians was of varying nature. This finding was similar to that observed in previous studies where the awareness of the diet was varied based on location, education and gender[12,13]. Majority of dietitians (57%) always recommended their hypertensive patients to follow DASH diet and 43% recommended the diet only sometimes. The reason why it was recommended only sometimes was not captured in this study.

While all the dietitians (100%) enrolled in his study agreed that DASH diet contributes in controlling hypertension, they believed that DASH diet alone was not effective in controlling hypertension, and they had mixed opinion on its effectiveness when followed along with taking anti-hypertensive medications. If any other factors in combination with DASH diet was perceived by the dietitians to be effective in controlling hypertension, then those factors were not captured in the study.

This study observed a strong association between dietitians who found following DASH diet sustainable, and their patients who found DASH diet easy to follow. According to the dietitians, there was no significant difference in the challenges that the patients faced in sustaining DASH diet. Although the perceived barriers are similar to that found in earlier studies24 our study showed that most of the patients who visited the dietitians found the diet easy to follow and there were no significant differences in the challenges faced which was similar to the finding in a study conducted on Black Americans[25].

In today's growing world of technology, dietitians felt that use of trackers / smart apps sometimes helps patients in adhering to DASH diet and managing it indicating the need to have more efficient tracking apps. This finding was similar to that observed in earlier studies[26,27]. This study however did not collect reasons why the dietitians did not trust the apps completely.

Limitations

Since this was a survey based observational study, the data collected is as reported by the dietitians who had hypertensive patients consulting them. Since the sample size of the dietitians selected for this study is small the opinion cited by these dietitians regarding DASH diet cannot be generalised across the dietitian community. The responses given by the dietitians about the patient experiences (extent of reduction in BP after following DASH diet) is based on the dietitians' perceptions which may deviate from patients' actual experiences. This study found that DASH diet was effective in reducing the SBP and DBP readings. If this effect was purely due to diet alone or in combination with other confounding factors (like medication, supplements, exercise or other lifestyle modifications) could not be ascertained.

Conclusions

This study showed that DASH diet is effective in reducing and managing high blood pressure. The effectiveness of DASH diet as reported by dietitians was captured indicating that for successful implementation of DASH diet there must be a collaboration between different stakeholders like patients, clinicians etc. Results of this study clearly showed that although most of the dietitians were aware of the DASH diet benefits there is still lack of awareness among the general patient population regarding this dietary intervention method. Hence there is a need for implementing awareness campaigns as a public health initiative so that people can get frequent checkups done and if diagnosed with hypertension can follow measures to control and manage high blood pressure, use of social media to create awareness about the benefit of good nutrition and diet on overall health. This study also showed how including different nutrient groups in the diet can have an overall impact on blood pressure readings. One can consider this knowledge by increasing the intake of certain micronutrients and decreasing the intake of some macronutrients in order to improve their overall well-being.

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