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Effect of DASH Diet Versus Healthy Dietary Advice on the Estimated Atherosclerotic Cardiovascular Disease Risk

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Abstract

Introduction: Cardiovascular disease (CVD) is the most leading cause of mortality worldwide. Changes in diet can reduce subclinical cardiac injury and inflammation in parallel with reductions of other CVD risk factors. **Aim:** The study aimed to evaluate the beneficial effect of the DASH diet versus usual healthy dietary advice (HDA) on the estimated risk of atherosclerotic cardiovascular disease (ASCVD). **Methods:** It was a prospective interventional nonrandomized controlled study, conducted on 92 participants attending Family Medicine Outpatient Clinics, Cairo University. The participants were assigned to 2 dietary groups, the DASH and HDA groups, for 12 weeks. All subjects were subjected to anthropometric measurement, assessment of lipid profile, and the estimated cardiovascular risk pre-and post-intervention. **Results:** The estimated cardiovascular risk was reduced significantly in both the DASH and HDA groups, with no statistically significant difference between the 2 groups regarding the risk reduction. By comparing the percent change between pre and post-intervention in both DASH and HDA groups, the following are the results: BMI dropped by 6.5% versus 2.5%, systolic blood pressure decreased by 6.9% and 4.1%, fasting blood sugar dropped by 5.5% and 3.1%, total cholesterol dropped by 5.2% and 3.1%, LDL dropped by 8.2%, and 3.1%, and HDL increased by 8.2% and 2.4%, in DASH and HDA groups, respectively. **Conclusion:** Both the DASH diet and HDA are associated with improvement in CVD risk factors. Although better risk factors decline with the DASH diet, there was no statistically significant difference between the 2 groups.

Keywords

CVD, DASH diet, healthy dietary advice

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Introduction

Cardiovascular disease (CVD) is the most leading cause of mortality worldwide. The Global Burden of Disease, 2010, reported that CVD is responsible for about 15.6 million deaths globally, which represents 29.6% of all deaths.[1] Institute for Health Metrics and Evaluation has shown that, in Egypt, coronary heart disease (CHD) is responsible for 31.8% of fatality and 14.6% of disability-adjusted life years (DALY) lost.[2] Sedentary life, high fat diet, high blood pressure, smoking, diabetes, obesity, and dyslipidemia are the main risks that lead to an increased prevalence of CHD.[3] Other contributing factors of CVDs include poverty, stress, and hereditary factors. The main features of traditional Egyptian food depend on cereals, legumes, and vegetables, which guarantee a balanced diet; however, in the last decades, there was an introduction of new foods and eating habits. Sociocultural and economic changes contributed to these changes. These new trends represent a potential risk to health.[4]

Clinical CVD is the climax result of years of subclinical cardiovascular injury. Although an unhealthy lifestyle—even if it is short term—leads to a small incremental impact,

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however, these effects accumulate to result in clinically evident ischemic events.[5] Given that the diet is contributing to CVD pathways, changes in diet can reduce subclinical cardiac injury and inflammation in parallel with reductions of other CVD risk factors. So the role of dietary interventions is undeniable in CVD prevention among adults.[6]

The dietary approach to stop hypertension (DASH) diet is one of such healthy dietary patterns; it is rich in many nutrients as high calcium, magnesium, and fiber and low saturated with a reasonable amount of protein. Furthermore, it is reported that it can improve and manage different risk factors for CVD such as hypertension, dyslipidemia, and glucose intolerance.[7]

Despite its several health benefits, the majority of individuals could not confirm adherence to it. The reasons behind this non-adherence to the DASH diet include limited availability and quality of healthier food in stores in some regions, lack of time for preparing DASH meals, and the potential cost of DASH food ingredients being high.[8] The acceptability of these diets is very low, whereas, at the interpersonal level, adults have to adapt to foods that should be accepted by all family.[9] DASH diet provides daily and weekly nutritional goals that should be reached to achieve the diet's benefit.

On the other side, healthy dietary advice empowers the individual to adopt these instructions, incorporate them in their very own diets, and enrich and diversify the nutrient in their usual daily intake.

As CVD is rising in our region, it is crucial to focus on lifestyle measures to prevent these illnesses and reduce the associated morbidity and mortality morbidity; however, such lifestyle measures should be adopted by and tailored according to the individuals' preferences and requirements of all socioeconomic strata of the population, to ensure the long-term compliance.

Although there is evidence of the DASH diet reduce the risk of cardiovascular diseases, yet, little is known about the effectiveness of healthy dietary advice in comparison to the DASH diet.

Therefore, our study aimed to address the beneficial effect of usual healthy dietary advice versus the DASH diet on the estimated ASCVD risk.

Methodology

Study Setting and Population

This was a prospective interventional nonrandomized controlled study. All adult patients ≥40 years old attending Family Medicine Outpatient Clinics, Cairo University Hospitals, between April and July 2016, were invited to participate in the study. The exclusion criteria were patients with decompensating cardiovascular disease, renal disease, or psychiatric problems, patients who participated in weight-reduction programs during the previous 6 months, pregnant and lactating women, or patients taking medication affecting blood lipids and blood pressure such as oral contraceptives pills, corticosteroids, hormonal replacement therapy, anti-depressive medications, routine use of nonsteroidal anti-inflammatory drugs, supplements, or antacids that contain magnesium or calcium. The sample size calculated was 92 participants, 46 subjects for each treatment arm (intervention and control). These calculations are based on a study power of 80%, a confidence interval of 80%, and a risk ratio of 7.4. The sample size was calculated using Epi 6 program.[10]

Data Collection Tools and Steps

After obtaining informed consent from the participants that met the inclusion criteria, they were assigned to 2 dietary groups, the DASH and healthy dietary advice groups for 12 weeks. Subjects were requested to keep their exercises as usual without any changes.

Regarding dietary intervention, the participants were allocated to follow the DASH diet or healthy dietary advice, according to their choices of which plan they prefer to follow, with the aid of printed material. All participants spent about 30 minutes with a researcher learning the basics of their diets. Besides, both groups attended the clinic for monthly sessions to assess their compliance and to explain the benefits of the diet.

- ***DASH Diet***

DASH dietary pattern is rich in fruit, vegetables, poultry, fish, nuts, and legumes instead of red meat and low-fat dairy products, containing more whole grains and fewer refined grains, and sweets. The DASH diet that was used in this study contained 2400 mg Na per day (1 teaspoon). The number of serving units needed for each participant was decided according to their caloric needs. The participants were advised about the number of servings from each food group according to the DASH Eating Plan.[11]

- ***Healthy Dietary Advice (HDA)***

This group was given general oral and written information about healthy food choices based on the Healthy Eating Plate.

The main advice of the Healthy Eating Plate is to focus on diet quality, which includes encouraging the use of complex healthy carbohydrates in the diet like whole grains, potatoes, and beans; avoiding low-nutrient dense food like processed food and sugary beverages; and encouraging consuming healthy oils.[12]

Patients were subjected to history taking, which included sociodemographic data[13] and medical history. A full clinical examination and anthropometric measurement were done upon enrolment in the study that included weight and height assessment and blood pressure measurement.

Height and weight were measured with subjects in light clothes and without shoes. To measure height, a measuring tape was fixed to the wall and the subject stood with heels, buttocks, shoulders, and occiput touching the vertical tape and was measured to the nearest 0.5 cm. Weight was measured to the nearest 0.1 kg on a calibrated beam scale. BMI was calculated as body weight in kilograms divided by the square of height in meters (kg/m^2). Blood pressure was measured with a standard mercury sphygmomanometer and a cuff of suitable size on the right arm after an adequate rest period of at least 15 minutes.

Blood samples of 4 mL were withdrawn after overnight fasting for biochemical assessment. Serum and plasma were separated and analyzed on the same day using the Beckman Coulter 680 to measure the fasting blood glucose (FBG), serum cholesterol, serum triglycerides (TG), serum high-density lipoprotein (HDL), and serum low-density lipoprotein (LDL).

Assessment of atherosclerotic cardiovascular disease risk (ASCVDR) was done using The American College of Cardiology (ACC)/American Heart Association (AHA) Risk Estimator of ASCVD.[14]

For all participants, BMI, BP, total cholesterol, TG, LDL, HDL, FBS, and ASCVD Risk Estimator were recorded at the time of enrolment and after 12 weeks of intervention.

Statistical Analysis

All data were collected, tabulated, and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA).

Quantitative data were expressed as the mean ± SD and median and interquartile range. Independent sample Student's *t*-test was used to compare the 2 groups of normally distributed measures, while the Mann–Whitney *U* test was used to compare the 2 groups of non-normally distributed measures. A paired *t*-test was used to compare pre- and post-treatment results of the same group of normally distributed measures, while the Wilcoxon test was used to compare pre-and post-treatment results of the same group of non-normally distributed measures.

Categorical data were expressed as absolute frequencies (number) and relative frequencies (percentage). Percent of categorical variables were compared using the Chi-square test.

All tests were 2-sided. *P* value <.05 was considered statistically significant, *P* value <.001** was highly significant, and *P* value >.05 was considered statistically insignificant (NS).

Ethical approval was obtained from the Family Medicine Research and Ethical Committee, Faculty of Medicine, Cairo University. The consent form was designed based on the international ethical guidelines for medical research involving human subjects. After ensuring confidentiality, full explanation of the nature of the study, benefits, and possible harm, an informed consent was granted from the patients who agreed to be involved; this procedure was based on the WHO Research Ethics Review Committee report on obtaining informed consent (WHO ERC, 2010). The study design and conduct complied with the principles embodied in the declaration of Helsinki.

Results

There were 92 participants of whom 46 completed the DASH diet, while 46 were on healthy dietary advice (HDA) following the food pyramid. The cardiovascular risk was reduced similarly in both the DASH and HDA groups with no statistical significance between them. The mean age of the DASH group was 48.21 ± 6.19, while that of the healthy dietary advice group was 46.7 ± 6.01. Around 80% of both groups were females. The majority of both groups were unskilled manual workers with low social class. So regarding the demographic data, both groups were matched regarding age, sex, education, occupation, and social class. There was no statistically significant difference between them as shown in Table 1.

Before the intervention, there was a statistically significant difference between the 2 groups regarding BMI and systolic blood pressure, as shown in Table 2, with higher mean BMI and systolic blood pressure in the DASH, while other laboratory results including fasting blood sugar and lipid profile showed no statistically significant difference.

Table 3 showed that, by comparing post-treatment results of BMI, blood pressure, and laboratory results between the 2 groups, there was a statistically significant difference between them regarding BMI only (*P*-value = .004* (*P* < .05*)), while there was no statistically significant difference between the studied groups regarding post-treatment results of systolic blood pressure, fasting blood sugar, and lipid profile.

As shown in Table 4, there was no statistically significant difference between the studied groups regarding pre-intervention or post-intervention cardiovascular risk score (*P*-values .098 and .609, respectively). *Z*-value was −1.65 in pretreatment groups and −0.512 in the post-treatment group.

Table 5 shows as expected that there was a highly statistically significant difference (*P* value <.001**) between pre-intervention and postintervention results of BMI, systolic blood pressure, FBS, and lipid profile in the DASH group with significant improvement of all the mentioned parameters (decrease in all parameters and increase in HDL).

In Table 6, we observed that there was a highly statistically significant difference (*P* value <.001**) between pre-intervention and postintervention with the HDA group. The

Table 1. Demographic Characteristics of the Studied Groups (n = 92).

Variables	DASH group (n = 46)		HDA group (n = 46)		*P* value
Age (years)					
Mean ± SD	48.21 ± 6.19		46.7 ± 6.01		.242*
Sex: No. (%)					
Male	10	21.7	9	19.6	.797**
Female	36	78.3	37	80.4	
Education					.86**
Illiterate	12	26.0	13	28.0	
Read and write	6	13.0	7	15.2	
Primary	7	15.2	6	`13.0	
Preparatory	10	21.7	8	17.3	
Secondary	4	8.6	6	13.0	
University graduate	5	10.8	5	10.8	
Postgraduate degree	2	4.3	1	2.1	
Occupation					.810**
Nonworking/housewife	4	8.6	5	10.8	
Unskilled manual worker	21	45.6	22	47.8	
Skilled manual (worker/farmer)	7	15.2	6	13.0	
Trades/business	6	13.0	5	10.8	
Semiprofessional/clerk	6	13.0	7	15.2	
Professional	2	4.3	1	2.1	
Social class					.561**
Very low	5	10.9	6	13.0	
Low	26	65.5	31	67.4	
Middle	13	28.3	8	17.4	
High	2	4.3	1	2.2	

*Independent sample *t* test.
**Chi-square test (χ^2).

Table 2. Comparing Pretreatment Results of BMI, Blood Pressure, and Laboratory Results Between the 2 Groups (n = 92).

	DASH group (n = 46)	HDA group (n = 46)	
Variables	Mean ± SD	Mean ± SD	*P* value*
BMI (kg/m2)	35.72 ± 5.37	31.5 ± 3.25	**<.001**
Systolic blood pressure (mmHg):	140.34 ± 9.65	134.56 ± 9.41	**.004**
FBS	109.76 ± 25.92	107.56 ± 23.92	.674
Total cholesterol	224.4 ± 57.94	218.84 ± 39.08	.584
LDL	148.06 ± 42.44	144.39 ± 38.15	.663
HDL	36.78 ± 31.25	37.1 ± 23.75	.797
TGs	172.93 ± 64.1	186.54 ± 55.44	.279

Bold is statistically significant.
*Independent sample *t* test.

results of BMI, systolic blood pressure, FBS, and lipid profile in the healthy dietary advice group showed significant improvement of all the mentioned parameters (decrease in all parameters and increase in HDL).

By calculating the percent change between pre-and postintervention, comparing DASH and HDA, the following are the results: BMI dropped by 6.5% with the DASH diet in contrast to 2.5% with HDA, systolic blood pressure decreased by 6.9% with DASH compared to 4.1% with HDA, fasting blood sugar dropped by 5.5% with DASH versus 3.1% with control, total cholesterol dropped by 5.2% with DASH versus 3.1% with HDA, LDL dropped by 7.5% with DASH and 3.1% with HDA, and HDL increased by 8.2% with DASH and only 2.4% with HDA. Finally,

Table 3. Comparing Post-Treatment Results of BMI, Blood Pressure, and Laboratory Results Between the 2 Groups (n = 92).

	DASH group (n = 46)	HDA group (n=46)	
Variables	Mean ± SD	Mean ± SD	*P* value*
BMI (kg/m²)	33.36 ± 5.18	30.69 ± 3.16	**.004**
Systolic blood pressure (mmHg)	130.54 ± 9.26	128.91 ± 8.36	.378
FBS	103.67 ± 22.51	104.19 ± 22.37	.911
Total cholesterol	212.52 ± 54.18	211.97 ± 34.63	.954
LDL	136.85 ± 36.95	139.82 ± 35.71	.670
HDL	39.82 ± 5.89	38.02 ± 5.8	.304
TGs	159.28 ± 61.42	181.28 ± 53.95	.065

Bold is statistically significant.
*Independent sample *t* test.

Table 4. Comparing Pre- and Post-Treatment Results of ASCVD Risk Between the Studied Groups.

	CVR			
	Before treatment		After treatment	
Items	DASH group	HDA group	DASH group	HDA group
Mean ± SD	4.98 ± 5.57	3.98 ± 5.57	3.48 ± 3.59	3.49 ± 5.17
Median (IQR)	3.4 (1.77-7)	3.1 (1.2-3.92)	2.55 (0.77-5.7)	2.5 (1.1-3.3)
z value	−1.65		−0.512	
P value*	.098 (NS)		.609 (NS)	

*Mann–Whitney test.

Table 5. Comparing Pre- and Post-Treatment Results of the DASH Group (n = 46).

	Before treatment	After treatment	
Variables	Mean ± SD	Mean ± SD	*P* value*
BMI (kg/m²)	35.72 ± 5.37	33.36 ± 5.18	**<.001**
Systolic blood pressure (mmHg)	140.34 ± 9.65	130.54 ± 9.26	**<.001**
FBS	109.76 ± 25.92	103.67 ± 22.51	**<.001**
Total cholesterol	224.4 ± 57.94	212.52 ± 54.18	**<.001**
LDL	148.06 ± 42.44	136.85 ± 36.95	**<.001**
HDL	36.78 ± 31.25	39.82 ± 5.89	**<.001**
TGs	172.93 ± 64.1	159.28 ± 61.42	**<.001**

Bold is statistically significant.
*Paired sample t test.

triglycerides dropped by 7.8% with DASH and 2.8% with the HDA group.

Table 7 shows that there was a highly statistically significant difference (*P* value <.001**) between pre-and postintervention results of each group (DASH and HDA group) regarding cardiovascular risk score as both improved cardiovascular risk factors and reduced CVD risk score. Percent of change in cardiovascular risk score was 25% with DASH versus 19.35% with healthy dietary advice group, and, as shown, *z* value was −5.911 with DASH diet and −5.38 with healthy dietary advice group.

Discussion

Diet plays a vital role in the prevention and development of CVD which is considered the leading cause of mortality worldwide.[15] A significant CVD risk reduction was a result of higher adherence to a healthy diet. The current study shows a statistically significant improvement between pre- and post-intervention results of both groups (DASH and HDA groups). Regarding the cardiovascular risk score, both diets have improved cardiovascular risk factors in hand with Casas et al,[16] who concluded that healthy diet consumption as DASH or Mediterranean is favored against an

Table 6. Comparing Pre- and Post-Treatment Results of the HDA Group (n = 46).

Variables	Before treatment Mean ± SD	After treatment Mean ± SD	*P* value*
BMI (kg/m^2)	31.5 ± 3.25	30.69 ± 3.16	**<.001**
Systolic blood pressure (mmHg)	134.56 ± 9.41	128.91 ± 8.36	**<.001**
FBS	107.56 ± 23.92	104.19 ± 22.37	**<.001**
Total cholesterol	218.84 ± 39.08	211.97 ± 34.63	**<.001**
LDL	144.39 ± 38.15	139.82 ± 35.71	**<.001**
HDL	37.1 ± 23.75	38.02 ± 5.8	**<.001**
TGs	186.54 ± 55.44	181.28 ± 53.95	**<.001**

Bold is statistically significant.
*Paired sample t test.

Table 7. Comparing Pre- and Post-Treatment Results of ASCVD Risk in Each Group.

	CVR			
	DASH group		HDA group	
Items	Before treatment	After treatment	Before treatment	After treatment
Mean ± SD	4.98 ± 5.57	3.48 ± 3.59	3.98 ± 5.57	3.49 ± 5.17
Median (IQR)	3.4 (1.77-7)	2.55 (0.77-5.7)	3.1 (1.2-3.92)	2.5 (1.1-3.3)
z value	−5.911		−5.38	
Percent of change	25%		19.35%	
P value	**<.001***		**<.001***	

Bold is statistically significant.
*Wilcoxon test.

unhealthy diet. Similarly, Pallazola et al, found that many healthy diets can help to prevent cardiovascular diseases and the most evidence was with Mediterranean, vegetarian, and DASH diets.[17]

Our results are showing a better CVD risk improvement with the DASH diet of 25% compared to 19.35% with HDA, similar to Mertens et al, who concluded that greater healthy diet adherence with the Alternative Healthy Eating Index 2010 (AHEI-2010) and the DASH score was associated with a lower risk of 20% to 40% of developing cardiovascular disease.[18]

Systolic blood pressure decreased by 6.9% with the DASH group compared to 4.1% with HDA, but this difference was of no statistical significance; this is in harmony with Barnes et al,[19] results which concluded that increase in DASH diet score was significantly associated with a decrease in systolic blood pressure. This could be explained by Hinderliter et al, who mentioned in his article that no specific nutrient is identified as the key element in blood pressure reduction; these diets are rich in potassium, magnesium, calcium, and fiber and have a low content of saturated fat.[20]

This greater reduction in systolic blood pressure with the DASH group may explain the postintervention disappearance of the statistically significant difference in SBP as the SBP mean was higher in the DASH group before the intervention.

In our study, the fasting blood sugar drop was 5.5% with the DASH group versus 3.1% with the HDA group, but this difference was of no statistical significance. This may be explained by the fact that the DASH diet encouraged the use of whole grains; Wursch and Pi-Sunyer, found that diabetic patients may get benefit from consuming cereals as some are high in β-glucan which increase the viscosity of the meal which delays the absorption. Reduction by 50% in glycemic peak can occur with 10% β-glucan in cereals also dropping LDL cholesterol.[21] This goes in harmony with Barnes et al, results which concluded that an increase in the DASH diet score was significantly associated with a decrease in HbA_{1c}.[19] Azadbakht et al, stated that the DASH reducing blood lipids also decrease fasting blood glucose levels (by 29%) and A1C (by 1.7% points).[22]

Our study total cholesterol dropped by 5.2% with DASH versus 3.1% with HDA group and LDL dropped by 7.5% with DASH versus 3.1% with HDA group, although this difference was of no statistical significance, in harmony with Folsom et al, who showed that the DASH diet positively reduced total and LDL cholesterol (−14 and −11 mg/dL, respectively).[23] As shown by many studies, a diet rich in fibers as a DASH diet reduces cardiovascular risk and suggests that high dietary fiber intake is encouraged to be a part of a healthy diet. This may be explained as the DASH diet encouraging some legumes and seeds which are a good source of soluble fibers reducing LDL.

Contrary to our study, Folsom et al, study showed lowered HDL cholesterol (−4 mg/dL),[23] while our current study results showed that HDL increased by 8.2% with DASH and only 2.4% with the healthy dietary advice group. HDL improvement could be explained by the use of nuts in the DASH diet and greater weight loss that was statistically insignificant, which has occurred in the DASH group; BMI dropped by 6.5% with the DASH diet in contrast to 2.5% with HDA, though there was no caloric deficit calculated in the diets used in this study.

Study Limitations

Due to the small sample size, our purpose to reach a definitive message regarding the DASH diet was limited. Also, the study included the Egyptian population; thus, results cannot be generalized but may reflect the situation in one of the developing countries.

The Implication for Practice and Research

The prospective design of the study strengthens the findings and highlights the importance of the quality of diet. Thus, dietary counseling is essential for reducing cardiovascular risk. Clinicians should be skilled in the integration of healthy dietary plans and be individualized for every patient taking into consideration their socioeconomic state, culture, and diet preference and find out the feasible dietary plan alternatives that suit their patient's needs. Further studies are needed to evaluate the effect of these dietary plans on different estimated cardiovascular risk strata.

Conclusion

An overall healthy diet will be valuable for cardiovascular disease risk reduction. Both the DASH diet and HDA are associated with improvement in CVD risk factors. Despite better risk factors decline with the DASH diet, there was no statistically significant difference between the 2 groups.

Authors' Note

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Declaration of Conflicting Interests

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