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Effects of dietary approaches to stop hypertension diet versus usual dietary advice on glycemic indices in women at risk for cardiovascular disease; a randomized controlled clinical trial

Mohammad Hasan Entezari, Amir Hadi, Marzieh Kafeshani*

Food Security Research Center and School of Nutrition & Food Science, Isfahan University of Medical Sciences, Isfahan, Iran

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ABSTRACT

Introduction: Diabetes is a global health problem. Dietary factors are important and potentially modifiable risk factors, to prevent and control of diabetes. One of these diets is the dietary approaches to stop hypertension (DASH) diet which may be influenced by risk factors for type 2 diabetes.
Objectives: The main aim of this study was to investigate the effects of DASH diet versus usual dietary advice (UDA) on glycemic indices.
Patients and Methods: In this randomized controlled clinical trial 44 healthy obese and overweight women were randomly assigned to the DASH diet or the UDA for 12 weeks. The fasting blood sugar (FBS), serum fasting insulin (FINS) level, and homeostasis model of insulin resistance (HOMA-IR) were measured at the first and end of the study.
Results: There were no significant differences in any glycemic indices between two groups, however, FBS reduced in both DASH and UDA groups. Additionally, HOMA-IR and fasting concentration of insulin increased in UDA group.
Conclusion: There was not the difference between recommendations to follow DASH dietary pattern or UDA in glycemic control.

Implication for health policy/practice/research/medical education:
Dietary factors are important and potentially modifiable risk factors to prevent and control of diabetes. As regard to a special component of dietary approaches to stop hypertension (DASH) diet, this diet may be influenced on type 2 diabetes, so this study was conducted to compare the effect of the DASH diet versus usual dietary advice (UDA) on fasting blood sugar (FBS), serum fasting insulin level (FINS), andhomeostasis model of insulin resistance (HOMA-IR). The result of this study suggested that DASH diet cannot improve glycemic markers compared to UDA.

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Introduction

Obesity has affected an approximated 300 million people in the worldwide (1). Its prevalence is expanding in both developed and developing countries. Type 2 diabetes may be the most destructive result that related to obesity (1). The risk of type 2 diabetes increases as body mass index (BMI) increases (2). The prevalence of type 2 diabetes is 3-7 times more in obese adults (3). The World Health Organization (WHO) has reported 44% of the diabetes is due to be overweight and obesity (4). Both obesity and type 2 diabetes are related to insulin resistance, although in normal conditions, some obese, insulin-resistant individuals do not become hyperglycemia, because of increasing insulin release to overcome the reduced efficiency of insulin action by the pancreatic islet β-cells, thus glucose tolerance remains normal (5).
Dietary factors are important and potentially modifiable risk factors to prevent and control of diabetes (6). One of this diet which may be influenced on type 2 diabetes is the dietary approaches to stop hypertension (DASH)

***Corresponding author**: Marzieh Kafeshani, Ph.D, Email: MarziehKafeshani@hlth.mui.ac.ir

diet. DASH diet contains the high intake of whole grain, fruits, vegetables, and low-fat dairy products combined with sodium restriction, was initially suggested to prevent hypertension. As regard to the profile of the DASH dietary pattern which is high in calcium, magnesium, antioxidant constituents, and fibers was suggested that it should improve insulin action in humans independent of weight loss or physical activity (7). However, the effect of the DASH diet on the risk of type 2 diabetes and insulin sensitivity is controversial.

Objectives

The main purpose of this study was to evaluate the effects of DASH diet versus usual dietary advice (UDA) on fasting blood sugar (FBS), fasting insulin (FINS), and insulin resistance.

Patients and Methods

Participants

In this randomized clinical trial study, on a group of healthy overweight or obese female aged 20-50 years that were referred by the general health center. BMI more than 25 kg/m^2 and low physical activity were defined as at risk for cardiovascular disease. Subjects were not included in the study if they had each chronic diseases such as cardiovascular, renal, gastrointestinal, diabetes, hepatic, thyroid, rheumatoid arthritis, any infection and trauma or presence of allergy. Additionally, patients who taking multi-vitamins, and mineral or omega-3 fatty acids supplements, and anti-acid drugs containing magnesium and calcium were also excluded from the study. They were excluded if had weight loss (more than 1 kg) duration the study or they had poor adherence to the study protocol.

Study procedures

Participants were randomly assigned to the DASH diet or UDA based on random sequencing created in SPSS for 12 weeks. A questionnaire which validated for use in Iranian was applied to evaluate the socio-economic status. The anthropometric markers were controlled every 2 weeks and biochemical measurements were taken at the beginning and at the end of the study. During the study period, participants were requested to not change their typical physical activity level. They were demanded to make a recording of their physical activity for three days every month that was assessed by using 2011 compendium physical activity (8).

The diets

The macronutrient composition of the DASH diet was as follows; carbohydrates, 53%–58%, proteins, 15%–18%; total fats, 26–30% of total energy and the diet was rich in low-fat dairy products, fruits, vegetables, whole grains, and low in refined grains, sweets, saturated fat, total fat, cholesterol, with a total of 2400 mg/d sodium. We insisted on removing table salt and prescribed adding minimal salt [only one teaspoon/d (4.6 g/d)] while cooking. The UDA group was given oral and written information about healthy food selection as described before (9). To calculate the energy requirement for each participant, we used Mifflin-St equation and diets were designed to maintain the current weight. The participants were visited every 2 weeks. They were in contact with the nutritionist by phone every day. The diets were individually prescribed and an exchange list was offered to each patient for replacing food items. Every participant had to bring her 3 days diet records every month, and nutritionist reviewed the diaries and analyzed them by the Nutritionist IV software (version 7.0; N-Squared Computing, Salem, OR, USA) which was changed for Iranian food items.

Anthropometric measurements

Subjects were weight dressing minimal clothing and without shoes by digital scales and recorded to the nearest 0.1 kg (SECA, Hamburg, Germany). Height was measured in a standing position without shoes using a tape while the shoulders were in a normal state. Waist circumference was assessed where the waist was narrowest over light clothes and that of the hip at the maximum level over light clothing, by an unstretched tape, without any pressure to body surface and measurements were recorded to the nearest 0.1 cm.

Biochemical measurements

Blood samples after 12 hours of overnight fasting, were collected in the tubes of blood with sodium citrate buffers and centrifuged at 48°C and 500 × g for 10 minutes. Photometric procedures with commercially available kits (Pars Azmoon kits; Tehran, Iran) was used to measure FBS and Insulin-R Monobid (ELISA) kit was used to measure FINS, and insulin resistance was calculated from homeostasis model of insulin resistance (HOMA-IR) which was expressed as FINS (U/L) × fasting glucose (mg/dl)/405 by Matthews et al (10).

Ethical issues

The research adhered to the principles of the Declaration of Helsinki. The purpose of the study was explained to the subjects, and they delivered written informed consent. The study was certified by the ethical committee of the Isfahan University of Medical Sciences and registration ID of this study in Iranian registry of clinical trials (http://www.irct.ir/) was IRCT2014090719072N1.

Statistical analysis

One-sample Kolmogorov-Smirnov test and normal probability plots were used to assess the normality of continuous variables. The dependent t test and χ^2 tests were used to determine the significance of any baseline differences between groups. Energy-adjusted dietary intakes of nutrients were computed using the residual method and compared using analysis of covariance. General linear models (paired Student t tests) was used for assessing glycemic control differences between the UDA and the DASH diet after 12 weeks. Statistical analysis was performed by using the SPSS 16.0 (SPSS Inc, Chicago, IL) and $P<0.05$ was considered statistically significant.

Result

Characteristics

Of the 51 participants, 44 persons finished the study. During the study, one patient with the ovary polycystic syndrome and another with high weight change excluded from the analysis. Five patients departed from the study protocol and their data were not available. Differences in distribution of several characteristics among 22 individuals in DASH group and 22 subjects in UDA group are presented in Table 1. The mean patient age was 38 ± 8 years in the control group and 37 ± 9 years in the intervention group. There was no difference between groups regarding age, weight, physical activity, socioeconomic status, blood pressure, fasting serum insulin, FBS, and HOMA-IR at baseline.

Nutrient intake

Calorie intake of two groups regard to the analysis of the 3 days diet self-report indicated that was not significantly different 1688 ± 799 vs. 1633 ± 391 kcal/d in the control and DASH diets, respectively. The actual protein intake (15% vs. 16%) was the same. However, these two diets were different in the percentage of the carbohydrate intake (50% vs. 59%) as well as total fat and fat composition intake (37% vs. 25%) in the control and DASH diet groups, respectively. Sodium content was different (1544 vs. 1613) mg/d in the control and DASH diets, respectively. The amount of calcium (875 vs. 674 mg/d), potassium (2796 vs. 2362 mg/d) and fiber (14 vs. 11 g/d) were higher in DASH diet ($P<0.05$; Table 2).

Table 1. Baseline characteristics of the study participants (mean values and standard deviations)

Variable	UDA group n = 22	DASH group n = 22	P
Age (y)	38.9 (7.7)	37.3 (9.0)	0.53
Socioeconomic status			
Low	6 (26.1%)	9 (37.5%)	
Medium	11 (47.8%)	6 (25%)	0.27
High	6 (26.1%)	9 (37.5%)	
Weight (kg)			
Baseline	82 (8.45)	84.5 (9.3)	0.35
End of trial	82.3 (7.4)	83.8 (9.3)	0.39
Difference (95% CI)	-0.32 (-1.68-1.03)	-0.73 (-1.49-0.03)	
Waist circumference (cm)			
Baseline	99.8 (6.7)	102.3 (10.9)	0.02
End of trial	100.0 (6.7)	99.9 (8.7)	0.90
Difference (95% CI)	0.11 (-1.64-1.43)	-2.4 (0.09-4.6)	
Physical activity (MET min)			
Baseline	42.0 (5.9)	40.0 (4.2)	0.20
End of trial	41.9 (6.3)	38.9 (3.5)	0.07
Difference (95% CI)	0.17 (-0.8-1.14)	1.04 (-0.62-2.7)	

Biochemical parameters

Plasma glucose, insulin, and HOMA-IR of 44 subjects were measured at baseline and 12 weeks after the trial. No significant differences were observed in any glycemic indices between two groups (Table 1). However, in control group HOMA-IR and fasting concentration of insulin increased and the reducing in FBS was also significant in both groups ($P<0.05$; Table 3).

Discussion

The finding of the current study showed no difference in any glycemic markers between two groups. However,

Table 2. Daily energy and nutrient intakes in DASH group and UDA group at baseline and at end of the study

Intake	UDA group n = 22	DASH group n = 22	P[a]
Energy (kcal)	1688.3 (799.7)	1633.4 (391.8)	0.77
Protein (g/d)	63.0 (34.5)	66.9 (24.0)	0.27
Total fat (g/d)	69.0 (35.0)	48.0 (21.0)	0.00
Carbohydrate (g/d)	211.0 (108.0)	239.0 (50.0)	0.00
Saturated fat (g/d)			
Crude[b]	15.2 (3.3)	13.4 (3.7)	0.2
Model 1[c]	15.2 (4.9)	13.3 (5.0)	0.06
PUFA (g/d)			
Crude	26.5 (12.0)	16.3 (9.0)	0.00
Model 1	26.0 (6.8)	16.7 (6.8)	0.00
MUFA (g/d)			
Crude	13.0 (6)	15.8 (6)	0.14
Model 1	13.3 (4.4)	15.6 (2.9)	0.04
PUFA/SFA ratio			
Crude	1.75 (0.6)	1.23 (0.8)	0.00
Model 1	2.4 (2.1)	0.92 (3.5)	0.09
Fiber (g)			
Crude	14.6 (6.7)	14.8 (5.23)	0.94
Model 1	11.2 (4.5)	14.3 (5.8)	0.05
Potassium (mg)			
Crude	2362.2 (1039.7)	2796.5 (1086.6)	0.19
Model 1	2325.0 (542.0)	2831.0 (769.0)	0.01
Calcium (mg)			
Crude	674.1 (318.9)	875.1 (378.9)	0.06
Model 1	664.5 (260.0)	884.0 (287.0)	0.01
Magnesium (mg)			
Crude	249.3 (207.0)	255.3 (15.1)	0.91
Model 1	246.0 (185.0)	259.0 (93.0)	0.80
Sodium (mg)			
Crude	1544.3 (151.2)	1613.7 (1625.4)	0.87
Model 1	1682 (1242.0)	1645.0 (849.0)	0.70
Vitamin C (mg)			
Crude	104.6 (73.9)	138.2 (94.73)	0.20
Model 1	102.9 (64.0)	140.0 (87.0)	0.12

Abbreviations: DASH, dietary approaches to stop hypertension; PUFA, polyunsaturated fat acid; SFA, saturated fatty acid; UDA, usual dietary advice; MUFA, monounsaturated fatty acid.

[a] Obtained from independent *t* test.

[b] Data are means ± SD.

[c] Model 1 adjusted for energy intake (data are means ± SD).

HOMA-IR and fasting concentration of insulin increased in UAD group. They did not change significantly in DASH group. This finding is consistent with the outcome of past study that obtained no significant relationship between DASH diet and HOMA-IR and fasting concentration of insulin (11,12). The result of this study also reveals FBS reduced in both DASH and UDA groups that are in a good agreement with the result of studies showed DASH diet can decrease FBS (13). It is different with studies which did not observe the significant relation between DASH diet and FBS. We expected regard to special dietary compounds in DASH diet that prevent diabetes complications (14,15). The same data from insulin resistance atherosclerosis study (IRAS) indicated that the DASH diet may inhibit the development of diabetes (4).

One explanation for our result is the difference in fat and carbohydrate ratio that fat intake in DASH group is significantly fewer and carbohydrate higher than UDA and fat components, different between two groups such as polyunsaturated fat acid (PUFA): saturated fatty acid (SFA) ratio. While, regard insulin receptor substrate (IRS1) function is membrane-dependent because it is a membrane-bound protein, it is logical to theorize that changes in membrane lipid induced by dietary fat may influence the function of the plasma membrane insulin receptor and FINS (16).

Table 3. Effects of recommendations to follow the DASH diet versus UDA on glycemic markers

Variable	Control group n = 22	DASH group n=22	P value
FBS (mg/dL)			
Baseline	89.3 (9.3)	88.9 (12.5)	0.87
End of trial	83.0 (10.7)	83.8 (9.5)	0.83
Difference (95% CI)	-6.2 (-10.9,-1.4)	-6.1 (-10.8,-1.35)	
FINS (pmol/L)			
Baseline	6.7 (5.6)	10.0 (10.0)	0.18
End of trial	11.5 (8.6)	11.2 (9.3)	0.90
Difference (95% CI)	4.8 (1.2-8.3)	1.1 (-3.6-5.8)	
HOMA-IR			
Baseline	1.5 (1.4)	2.2 (2.2)	0.23
End of trial	2.4 (1.9)	2.2 (1.8)	0.75
Difference (95% CI)	0.9 (0.03-1.7)	0.02 (-0.9-1.0)	

Abbreviations: DASH, dietary approaches to stop hypertension; UDA, usual dietary advice; FBS; fasting blood sugar; FINS, fasting insulin; HOMA-IR, homeostasis model of insulin resistance.
All values are mean± SD.

Conclusion

This study was conducted to compare the effect of the DASH diet and UDA on FBS, FINS, and HOMA-IR. The results of this study suggested that DASH diet cannot improve glycemic markers compared to UDA.

Limitations of the study

The limitations of this study were as follow; the first, participant was suggested to follow a particular diet rather than receiving prepared foods and second we used food record to assess dietary compliance rather than biochemical markers.

Authors' contribution

All authors participated in the design of the study.MK, AH, and MHE managed the study. MK analyzed the data and prepared the manuscript. All authors read, revised and approved the manuscript.

Conflicts of interest

None of the authors had any personal or financial conflict of interest

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References

1. Rathmann W, Giani G. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care. 2004;27:2568-9. doi: 10.2337/diacare.27.5.1047.
2. Leon-Munoz LM, Martinez-Gomez D, Balboa-Castillo T, Lopez-Garcia E, Guallar-Castillon P, Rodriguez-Artalejo F. Continued sedentariness, change in sitting time, and mortality in older adults. Med Sci Sports Exerc. 2013;45(8):1501-7. doi: 10.1249/MSS.0b013e3182897e87.
3. Booth FW, Lees SJ. Fundamental questions about genes, inactivity, and chronic diseases. Physiol Genomics. 2007;28:146-57. doi: 10.1152/physiolgenomics.00174.2006.
4. Hinderliter AL, Babyak MA, Sherwood A, Blumenthal JA. The DASH diet and insulin sensitivity. Curr Hypertens Rep. 2011;13:67-73. doi: 10.1007/s11906-010-0168-5.
5. Juhl CB, Gjedsted J, Nielsen MF, Schmitz O. Increased action of pulsatile compared to non-pulsatile insulin delivery during a meal-like glucose exposure simulated by computerized infusion in healthy humans. Metabolism. 2012;61:1177-81. doi: 10.1016/j.metabol.2011.12.014.
6. Nasri H, Behradmanesh S, Maghsoudi AR, Ahmadi A, Nasri P, Rafieian-Kopaei M. Efficacy of supplementary vitamin D on the improvement of glycemic parameters in patients with type 2 diabetes mellitus; a randomized double blind clinical trial. J Renal Inj Prev. 2014;3:31. doi: 10.12860/jnp.2014.07.
7. Ard JD, Grambow SC, Liu D, Slentz CA, Kraus WE, Svetkey LP. The effect of the PREMIER interventions on insulin sensitivity. Diabetes Care. 2004;27:340-7. doi: 10.2337/diacare.27.2.340.
8. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, et al. Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc. 2000;32:S498-504.
9. Kafeshani M, Janghorbani M, Salehi R, Kazemi M, Entezari MH. Dietary approaches to stop hypertension influence on insulin receptor substrate-1gene expression: A randomized controlled clinical trial. J Res Med Sci. 2015;20:832. doi: 10.4103/1735-1995.170596.
10. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher

DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia. 1985;28:412-9.

11. Blumenthal JA, Babyak MA, Sherwood A, Craighead L, Lin PH, Johnson J, et al. Effects of the dietary approaches to stop hypertension diet alone and in combination with exercise and caloric restriction on insulin sensitivity and lipids. Hypertension. 2010;55:1199-205. doi: 10.1161/Hypertension.109.149153.
12. Hodson L, Harnden KE, Roberts R, Dennis AL, Frayn KN. Does the DASH diet lower blood pressure by altering peripheral vascular function? J Hum Hypertens. 2010;24:312-9. doi: 10.1038/jhh.2009.65.
13. Azadbakht L, Fard NR, Karimi M, Baghaei MH, Surkan PJ, Rahimi M, et al. Effects of the Dietary Approaches to Stop Hypertension (DASH) eating plan on cardiovascular risks among type 2 diabetic patients: a randomized crossover clinical trial. Diabetes Care. 2011;34:55-7. doi: 10.2337/dc10-0676.
14. Rideout TC, Marinangeli C, Martin H, Browne RW, Rempel CB. Consumption of low-fat dairy foods for 6 months improves insulin resistance without adversely affecting lipids or body weight in healthy adults: a randomized free-living cross-over study. Nutr J. 2013;12:1-9. doi: 10.1186/1475-2891-12-56.
15. da Silva Ferreira T, Torres MRSG, Sanjuliani AF. Dietary calcium intake is associated with adiposity, metabolic profile, inflammatory state and blood pressure, but not with erythrocyte intracellular calcium and endothelial function in healthy pre-menopausal women. Br J Nutr. 2013;110:1079-88. doi: 10.1017/S0007114513000111.
16. Kahle M, Schäfer A, Seelig A, Schultheiß J, Wu M, Aichler M, et al. High-fat diet-induced modifications in membrane lipid and mitochondrial membrane protein signatures precede the development of hepatic insulin resistance in mice. Mol Metab. 2015;4:39-50. doi: 10.1016/j.molmet.2014.11.004.