Original Article | JOGCR. 2023; 8(5): 438-445

Journal of Obstetrics, Gynecology and Cancer Research | ISSN: 2476-5848

Investigating Dietary Approaches to Stop Hypertension (DASH) on Pregnancy Outcomes of Pregnant Women with Chronic and Gestational Hypertension

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Article Info

10.30699/jogcr.8.5.438

Received: 2022/07/21;
Accepted: 2022/12/28;
Published Online: 09 Sep 2023;

Use your device to scan and read the article online

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ABSTRACT

Background & Objective: Hypertension during pregnancy is associated with significant negative outcomes. In this study, we evaluated the effectiveness of dietary approaches to stop hypertension (DASH) on pregnancy outcomes of pregnant women with gestational and chronic hypertension.

Materials & Methods: This randomized controlled clinical trial study was conducted on 60 pregnant women with a diagnosis of gestational hypertension and chronic hypertension. Women were randomly divided into the control (n=30) and the DASH diet (n=30) groups for 2 months and were followed until delivery. The outcomes of maternal pregnancy including the incidence of preeclampsia, placental abruption and preterm delivery (<37 weeks) were assessed during follow-up examinations. Birth weight and minute 1 and minute 5 Apgar score of the infant were also assessed.

Results: After 1 and 2 months of intervention, systolic and diastolic blood pressure in the DASH diet group was significantly lower than the control group (P<0.05). The incidence of preeclampsia (P=0.035), preterm delivery (P=0.020) and placental abruption (P=0.007) in the DASH diet group was significantly lower than the control group. The mean gestational age at the time of termination of pregnancy was not significantly different between the two groups (P = 0.467). There was no significant difference between minute 1 and minute 5 Apgar scores of the infants and the mean birth weight of the infants was not significantly different between the DASH and control groups (P = 0.756, P = 0.115 and P = 0.101, respectively).

Conclusion: The DASH diet could be used as an effective strategy to improve the clinical outcomes of pregnant women with gestational and chronic hypertension.

Keywords: DASH, Pregnancy Outcomes, Hypertension, Pregnancy, Diet

Introduction

Hypertensive disorders during pregnancy are one of the most common dangerous complications of pregnancy (1, 2). Hypertension can be categorized into chronic or pre-gestational hypertension, gestational hypertension, preeclampsia, and eclampsia (3, 4). They affect more than 10% of pregnancies and are one of the major causes of maternal and perinatal morbidity and mortality (5). Gestational hypertension is systolic blood pressure higher than or equal to 140 mmHg and /or diastolic blood pressure higher than or equal to 90 mmHg, which is confirmed at least twice by measuring blood pressure with time interval of 4 to 6 hours (5-7). If the hypertension occurs after the fifth month of pregnancy, this disorder is called gestational hypertension, and if the hypertension occurs before pregnancy and / or before the 20th week of pregnancy, this disorder is called chronic hypertension (6). Based on the existing reports, about 12-14% of maternal deaths worldwide are due to hypertensive disorders in pregnancy (8, 9). Hypertensive disorders in pregnancy are associated with an increased risk of cardiovascular disease, renal dysfunction and other metabolic diseases (10). Other negative gestational hypertension related outcomes include seizures (eclampsia), increased cesarean delivery, and preterm delivery. Hypertension in pregnancy can also cause fetal complications such as intrauterine growth restriction, respiratory problems, and intrauterine fetal death (8, 11, 12). Studies have shown that nutritional factors are directly associated with inflammatory response, oxidative stress, vascular endothelial damage and abnormal lipid metabolism and are involved in the pathogenesis of gestational hypertension disorders and it has been reported that gestational hypertension is associated with dietary patterns and nutritional factors (13, 14). Nutritional interventions in non-pregnant women have been identified as an important strategy for lowering blood pressure (15, 16). Dietary Approaches to Stop Hypertension (DASH) is one of the most important issues in this area. The DASH diet emphasizes high intake of fruits and vegetables, whole grains and lean proteins, moderate intake of unsaturated fats, and consumption of small amounts of red meat, saturated fats, trans fats, and sugar and sodium (17). Several studies have shown that the DASH diet in non-pregnant people improves cardiovascular outcomes, lowers blood pressure, improves lipid profile, and fasting blood sugar (18-20). Moreover, the DASH diet in pregnant women with gestational diabetes mellitus (GDM) and other cardio-metabolic disorders has improved metabolism and pregnancy outcome (21-23). It has also been reported that the DASH diet reduced blood pressure in healthy pregnant women without hypertensive disorders (24). A recent study on pregnant women with hypertensive disorders showed that the DASH diet in the second trimester of pregnancy could be used to improve clinical outcomes such as preeclampsia, preterm birth, and low birth weight (25). It has also been reported that adherence to the DASH diet before pregnancy significantly reduces the risk of preeclampsia (26). Thus, the DASH diet can be effective in improving pregnancy outcomes in women with hypertensive disorders in pregnancy. However, there is very little information on the effect of DASH diet on the health of pregnant women with hypertensive disorders in pregnancy of and no study has been conducted to investigate the effect of this dietary approach in late pregnancy in women with hypertensive disorders in pregnancy. Hence, the aim of the present study was to evaluate the effect of DASH diet in the third trimester of pregnancy-on-pregnancy outcomes of pregnant women with gestational and chronic hypertension.

Methods

Analysis method

The present study is a double-blind randomized controlled clinical trial conducted on pregnant women with hypertension referred to Imam Khomeini Hospital in Ahvaz in 2020. The present study was conducted after being approved by the Ethics Committee in the Research Deputy of Ahwaz Jundishapur University of Medical Sciences (Code: IR.AJUMS.HGOLESTAN.REC.1399.141). This study was also registered in the Iranian Clinical Trial Registration Center with the code of IRCT20210222050458N1. Informed and written consent was obtained from all patients before starting treatment. Also, in all stages of this study, the provisions of the ethics statement in the Helsinki study and the principles of patient information confidentiality were observed. Sample size in each group was calculated to be 30 people by considering the first type error of 5% (α = 0.05), test power of 80% and the results of similar studies (23), in which the prevalence of pregnancy outcomes was 81.3% in the control group and 47.1% in the DASH group. Pregnant women with gestational hypertension or chronic hypertension in the last trimester of pregnancy were included the study. Women with underlying diseases such as diabetes mellitus and cardiovascular disease were excluded from the study.

The baseline characteristics of all participants were collected at the beginning of the study, including age, weight, body mass index (BMI) and gravidity.

Intervention

In the present study, patients were divided into two groups by a convenience random sampling method after diets physician approved the hypertension of pregnant mothers. Patients were allocated to study groups based on a table of random numbers and the use of a computer. Random allocation sequences were performed without knowing which treatment diets the patients would receive. The control group followed a normal diet with standard blood pressure control drugs and the experimental group (case group) in addition to receiving blood pressure control drug followed the DASH diet. The control group received a normal diet containing 45 to 55% carbohydrates, 15 to 20% protein and 25 to 30% fat. The DASH diet was rich in fruits, vegetables, whole grains, low-fat dairy products and contained small amounts of saturated fats, cholesterol, refined grains and sweeteners. Also, the amount of sodium intake in the DASH diet was limited to less than 2400 mg per day. It should be noted that in the control group, a diet containing essential nutrients for pregnancy was provided and all participants in both groups received ferrous sulfate supplementation once a day. A physician who was unaware of the patient grouping performed the intervention (receiving a blood pressure control diet or normal diet) and evaluation of patients. Also, patients and statistical analyzer of the results were unaware about patient grouping. Individuals in both groups were asked not to change their normal physical activity and to monitor the level of adherence to diets once a week via telephone.

Evaluation of outcomes

After two months of using the diet (DASH or normal diet) and delivery, the demographic and disease characteristics of pregnant women were completed according to their medical records. Pregnancy outcomes including preeclampsia, preterm pregnancy, placental abruption as well as gestational age at termination of pregnancy were recorded in the data collection checklist. Infant information such as birth weight and minute 1 and minute 5 Apgar score were also examined and recorded.

Statistical Analysis

SPSS-22 software (SPSS Inc., Chicago, IL, U.S.A.) was used for statistical analysis. Mean and standard deviation were used to describe the data in quantitative variables and frequency and percentage were used in qualitative variables. Independent t-test and Chi-square test were used to examine the differences between the two groups and compare quantitative and qualitative variables, respectively. The significance level in the tests was considered at 0.05.

Results

In the present study, 60 pregnant women with a mean age of 33.65 ± 3.27 years (age range 25 to 38 years) participated. The baseline characteristics of the participants in two groups of DASH diet and control are presented in Table 1. There was no significant difference between women's ages (P=0.420), weight (P=0.179), BMI (P=0.328) and Gravidity (P=0.467) in the DASH diet and control groups.

Comparison of mean blood pressure before the intervention and one and two months after the intervention in the two groups of the DASH diet and control is presented in Table 2. As seen, systolic and diastolic blood pressure at the beginning of the intervention was not significantly different between the DASH and control groups (P=0.368 and P=0.193, respectively). Systolic and diastolic blood pressure in one and two months after intervention in DASH diet group was significantly lower than the control group. In the DASH group, 1 month and 2 months after intervention, systolic and diastolic blood pressure decreased significantly compared to the beginning of the study.

Table 1. **Baseline Characteristics of Participants in Two Groups**

Variable	Control diet (n=30)	DASH diet (n=30)	P-value*
Women age (years)	34.27 ± 2.94	33.67 ± 2.77	0.420
Weight (kg)	76.18± 6.83	74.28 ± 5.71	0.179
BMI (kg/m^2)	30.17 ± 4.34	29.23 ± 3.20	0.328
Gravidity	3.21 ± 0.79	3.53 ± 0.85	0.467

Abbreviations: BMI: body mass index; DASH: Dietary Approaches to Stop Hypertension.
Numbers are presented as means ±SD.
*P <0.05 is significant

Table 2. **Comparison of blood pressure before and after the intervention in women with hypertension in the two groups**

Variable	Control diet (n=30)	DASH diet (n=30)	P-value*
Systolic blood pressure (mmHg)			
SBP- before intervention	135.50 ± 9.40	133.50 ± 7.56	0.368
SBP- after 1 month	130.67 ± 9.53	125.67 ± 8.17	0.033
SBP- after 2 months	130.33 ± 9.64	123.50 ± 6.45	0.002
Diastolic blood pressure (mmHg)			
DBP- before intervention	80.00 ± 7.42	77.67 ± 6.26	0.193
DBP- after 1 month	80.67 ± 7.73	75.08 ± 6.29	0.003
DBP- after 2 months	80.33 ± 8.80	74.00 ± 4.98	0.001

Numbers are presented as frequency (percentage) or mean ± standard deviation
*P <0.05 is significant

The maternal and neonatal outcomes in the two groups of DASH diet and control diet are presented in Table 3. The prevalence of preeclampsia (P=0.035), preterm birth (P=0.020) and placental abruption (P=0.007) in the DASH diet group was significantly lower than control group. Also, a reduction in blood pressure was observed in 12 patients (40%) in the control group and 20 patients (66.7%) in the case group (P=0.038).

One-minute and 5-minute Apgar scores of the infants were not significantly different between the two groups of DASH diet and control (P=0.756 and P=0.115, respectively). Furthermore, there was no significant difference in neonate birth weight between two groups of DASH diet and control (P=0.101).

Table 3. Comparison of maternal and neonatal outcomes in women with hypertension in two DASH and control groups

Variable	Control diet (n=30)	DASH diet (n=30)	P-value*
decrease in blood pressure	12 (40.0)	20 (66.7)	0.038
Preeclampsia	16 (53.3)	8 (26.7)	0.035
Preterm birth	21 (70.0)	12 (40.0)	0.020
Placental abruption	12 (40.0)	3 (10.0)	0.007
Minute 1 Apgar	7.10 ± 0.84	7.03 ± 0.80	0.756
Minute 5 Apgar	8.33 ± 0.84	7.97 ± 0.96	0.115
Neonate Birth weight (g)	2687.54 ± 392.69	2836.86 ± 240.68	0.101

Numbers are presented as frequency (percentage) or mean ± standard deviation
*P <0.05 is significant

Discussion

The results of the present study showed that the mean blood pressure after intervention in the DASH diet group was significantly lower than control group. Moreover, at the end of study frequency of patients with decreasing blood pressure in DASH group was significantly higher than control group (66.7% vs. 40%). These results suggest that the DASH diet can lower blood pressure in women with hypertensive disorders during pregnancy compared to control. This result can be explained by the beneficial effects of this diet on the physiological processes that regulate blood pressure during pregnancy, especially the renin–angiotensin system, as well as fluctuations in progesterone and estradiol **(15)**. The DASH diet in pregnant women has been shown to be a useful tool for controlling blood pressure **(24, 25)**. A recent study conducted on 511 healthy pregnant women without hypertension in Ireland showed that the DASH diet significantly reduced blood pressure during pregnancy. It was shown that the DASH diet could be used to promote cardiovascular health in pregnancy **(24)**. It has also been reported that dietary approaches reduce blood pressure further in people with clinical hypertension than in people with normal blood pressure **(27)**. Therefore, adherence to the DASH diet can potentially reduce the need for antihypertensive drugs. These results suggest that the DASH diet can be used to treat and prevent hypertension.

The results of the present study showed that the DASH diet significantly reduced the incidence of preeclampsia, preterm delivery and placental abruption in comparison with the control group. In general, these results suggest that the DASH diet improves the clinical outcomes of women with hypertensive disorders in pregnancy.

Despite much evidence about the benefits and positive effects of the DASH diet on blood pressure in non-pregnant people **(19, 28-30)**, there are few studies on the effects of the DASH diet on hypertensive disorders in pregnancy. In a recent interventional study conducted in China on 85 pregnant women diagnosed with previous hypertension or gestational hypertension (hypertension before 20 weeks of gestation), results showed that the DASH diet group had a lower incidence of preeclampsia and preterm delivery than the control group **(25)**. In this regard, the results of a study conducted by Arvizu et al. in the United States showed that adherence to DASH diet before pregnancy significantly reduced the risk of preeclampsia **(26)**.

The DASH diet in women with hypertensive and metabolic disorders in pregnancy can play an important role in glycemic control **(22)** and can improve pregnancy outcomes **(22, 31-33)**. In a meta-analysis on 6 randomized trials, it was reported that the DASH diet significantly reduced fasting blood sugar and reduced the incidence of preeclampsia compared with standard control diets in pregnant women with cardio-metabolic disorders in pregnancy. However, the DASH diet had no effect on gestational age at delivery, and the risk of cesarean section delivery and preterm birth **(21)**. It has also been reported that the DASH diet in pregnant women with diabetes mellitus has a positive effect on blood pressure **(34)**.

However, in an observational study of 1760 American women, Fulay et al. **(35)** found no significant association between the DASH diet in the first trimester of pregnancy and hypertensive disorders during the third trimester of pregnancy. The results of another observational study conducted on 66651 Danish women indicated that adherence to the DASH diet was not associated with a reduced risk of gestational hypertension or preeclampsia **(36)**. In a recent population-based cohort study in the Netherlands, results showed that adherence to the DASH diet had no effect on the incidence of gestational hypertension **(15)**. These studies were conducted as a population-based cohort, while the present study was conducted as a clinical trial on women with hypertensive disorders in pregnancy. Thus, the difference in the results might be attributed to differences in the study methods and the characteristics of the study populations.

Hence, due to the lack of sufficient information about the effect of DASH diet on reducing the incidence of hypertensive disorders in pregnancy in women with gestational hypertension, it is not possible to compare the results of this study with those of other studies accurately. A possible explanation for differences in results of the studies could be that the DASH diet is affected by other physiological processes during pregnancy that regulate blood pressure, such as progesterone fluctuations, estradiol, and the renin-angiotensin system, and hypertension might happen regardless of the nutritional pattern. Moreover, the role of intervening effects of eating out of the DASH diet should be considered in this regard **(25, 37)**.

The results of the present study showed that adherence to DASH diet in pregnant women with chronic hypertension or gestational hypertension leads to improved pregnancy outcomes including preeclampsia, preterm delivery, placental abruption, and reduced blood pressure. In a previous study it was reported that improvement in pregnancy outcomes in women with hypertensive disorder in the DASH diet, might be due to its high protein and low fat (less pre-inflammatory fatty acids) **(38)**.

The results of the present study showed that the DASH diet had no significant effect on neonatal outcome compared to control. The minute 1 and minute 5 Apgar score of the infants was not significantly different between the DASH and control groups. There was also no significant difference between the DASH and control groups in terms of neonatal weight at birth. In line with these results, a study conducted by Jiang et al. on the effect of DASH diet in pregnant women with hypertensive disorders, the mean neonatal birth at weight and Apgar score were not significantly different between the two groups of DASH diet and control **(25)**.

In a meta-analysis conducted by Li et al., DASH diet during pregnancy in pregnant women with cardio-metabolic disorders in pregnancy, including gestational diabetes, obesity and hypertension, compared with the control diet had no effect on infant weight and Apgar score **(21)**. Although these results showed that adherence to DASH diet in pregnant women had no effect on the weight and Apgar score of the infant, identifying the effect of this diet on other neonatal outcomes requires further studies. Some strengths of this study include random nature of the study, collection of data on prospective pregnancy outcomes, and investigating neonatal outcomes such as Apgar score and weight birth. One of the limitations is the small sample size and relatively short duration of the intervention (late pregnancy). Also, in this study, only short-term outcomes of pregnancy were studied and long-term outcomes such as post-pregnancy blood pressure were not examined. This study also did not investigate the effects of the DASH diet on biochemical parameters such as proteinuria, creatinine, and transaminases. Finally, by conducting more studies with a larger sample size and multicenter studies, better results can be achieved.

Conclusion

The results of present study revealed that the prevalence of preeclampsia, preterm delivery and placental abruption in the DASH diet group was significantly lower than the control group. Thus, the DASH diet can be used as a safe, easy, and successful strategy to improve the clinical outcome of pregnant women with gestational hypertension or chronic hypertension. Better recognizing of the effects of the DASH diet on pregnancy outcomes can have significant effects on the health of this group of women. Thus, more studies are needed to confirm the association between dietary patterns and hypertensive disorders in pregnancy.

Acknowledgments

The present article was derived from a student thesis with the research project code of FIRC-9924 in the medical school of Ahvaz Jundishapur University of Medical Sciences.

Conflict of Interest

The authors declared no conflict of interest.

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How to Cite This Article:

Najafian, M., Shariati, M., Nikbakht, R., Masihi, S. Investigating Dietary Approaches to Stop Hypertension (DASH) on Pregnancy Outcomes of Pregnant Women with Chronic and Gestational Hypertension. J Obstet Gynecol Cancer Res. 2023; 8(5):438-45.