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Research Article

Diet Counselling in Pregnancy Induced Hypertension: Effect on the Status of Serum Trace Elements, Electrolytes and Neonatal Health

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Abstract

Keeping in view that pregnancies are complicated by hypertension, the present study was planned to create awareness and knowledge about pregnancy induced hypertension through diet counseling among low-income group women who were visiting government hospital and community health centers. A total of 60 pregnancy induced hypertensive subjects were selected. They were divided into two groups i.e., Control and Experimental with 30 subjects each. The experimental group was provided with diet counseling based on the principle of DASH diet at a regular interval of fifteen days for consecutive three months. Ethical clearance was obtained from the institutional ethical committee and written informed consent was obtained from the subjects before data collection. The information pertaining to general and socio-economic profile, food and nutrient intake, serum trace elements and electrolytes concentrations and neonatal outcome and anthropometry was recorded. The counseling resulted in a significantly ($p < 0.05$) higher intake of fruits, vegetables, milk and milk products in experimental group as compared to control. The diet counseling had a significant ($p < 0.05$) impact on the serum trace elements and electrolytes concentrations of experimental group in comparison to control. The birth weight and gestational age at the time of delivery for the experimental group was found to be significantly high as compared to the control group (2.53 ± 0.48 Vs 2.16 ± 0.80 kg). Hence, the nutrition and diet counseling should be provided to all the women of reproductive age group and assessment of serum trace elements and electrolytes should be done during pregnancy to manage the pregnancy related complications and for better neonatal health.

Keywords: Pregnancy Induced Hypertension; Trace Elements; Electrolytes; Diet Counseling; Antenatal; Neonatal

Abbreviations

PIH: Pregnancy Induced Hypertension; DASH: Dietary Approaches to Stop Hypertension

Introduction

Pregnancy is a dynamic and demanding state of human physiology, during which, a woman undergoes a pattern of anatomical and physiological changes to cope with physical and metabolic demands [1]. Hypertension is a common health problem that when hits during pregnancy, becomes the most important factor that may lead to maternal morbidity and mortality and poor neonatal health [2]. Pregnancy induced hypertension (PIH) is characterized by persistently increased blood pressure i.e., more than or equal to 140/90 mmHg which may or may not include proteinuria, but edema [3]. It includes a group of disorders that develops after 20th week of gestation. It involves gestational hypertension (Blood pressure ≥ 140/90 mmHg), preeclampsia (gestational hypertension+ proteinuria) and eclampsia (preeclampsia + convulsions). The prevalence of pregnancy induced hypertension is 4.6-13 percent globally [4]. The appropriate concentrations of serum trace elements and electrolytes play an important role during pregnancy. For preventing the complications related to pregnancy induced hypertension, it is important to maintain the maternal serum concentrations of trace elements and electrolytes. Otherwise, the complications in pregnancy can lead to pre-term delivery, low birth weight babies and poor neonatal health [6]. The impaired levels of serum trace elements like magnesium, calcium and zinc can cause

oxidative stress, reduced vasodilation and increased vasospasm. Several dietary factors are suggested to play a role in the prevention of pregnancy induced hypertension. In a study, high total energy and low intake of calcium and magnesium were found to be related to the incidence of pregnancy induced hypertension [5]. A higher Body Mass Index is found to be a robust and self-regulating risk factor for the incidence of pregnancy induced hypertension [7]. Maintaining an appropriate and adequate diet and nutritional status during prenatal period is of utmost importance to prevent various complications. Behavioral interventions and counseling for regulating gestational weight gain are observed to be impactful in terms of preventing pregnancy induced hypertension [8]. An adequate intake of micronutrients such as iron, calcium, magnesium, copper, zinc and selenium were found to be helpful in preventing the incidence of pregnancy induced hypertension.

The poor pre-pregnancy nutrition and unawareness about it might be a reason for an increase in the prevalence of pregnancy induced hypertension worldwide. To manage it well in time, pregnant women and those who are in their reproductive age need to be aware about an adequate and nutrient-rich diet as the demands of nutrients in the body increase during pregnancy. Intake of Dietary Approaches to Stop Hypertension (DASH) diet during pregnancy induced hypertension can be helpful in managing the condition and taking it towards better maternal and fetal outcomes. This study was planned to evaluate the effectiveness of diet counseling based on the principle of DASH diet among pregnancy induced hypertensive subjects and to assess their neonatal outcome.

Materials and Methods

Patients and study design

The case-control study was carried out to evaluate the effect of diet counseling based on the principle of Dietary Approaches to Stop Hypertension (DASH) diet for the management of pregnancy induced hypertension. The study was carried out in Government Rajindra Hospital, Patiala. A total of 60 subjects with pregnancy induced hypertension were selected and they were divided into two groups of 30 subjects each i.e. Control (without diet counseling) and Experimental (with diet counseling).

Inclusion criteria

- Age between 20-40 years.
- Known pre-pregnancy weight.
- Diagnosed with pregnancy induced hypertension by the gynecologist.
- Blood Pressure ≥ 140/90 mmHg and proteinuria i.e., excretion of 300 mg of protein in urine/24 hours
- Clinical symptoms
- Willingness to participate.

Exclusion criteria

- Antenatal mothers who were not willing to participate.
- Diabetic or with any systemic disease.

Diet counseling

The experimental group was provided with diet counseling (face-to-face and group discussion sessions) at a regular interval of fifteen days for three months before the data collection. The subjects of the experimental group were provided with an educational module i.e., "Dietary Interventions to Manage Pregnancy Induced Hypertension" designed on the principle of Dietary Approaches to Stop Hypertension (DASH) diet i.e. low sodium, low fat, moderate protein and high fiber diet. The module included nutritious and low-cost recipes recommended for pregnancy induced hypertension.

Collection of data

Prior to the data collection, ethical approval to conduct the study was obtained from the institutional ethical committee (vide letter No. DR.III.AU.2019/19589-98 dated 11.10.19). Afterwards, written consent was obtained from subjects for their willingness to participate in the study. The data were collected by using a pretested and validated interview schedule. The information about general and socio-economic profile, dietary intake, serum trace elements and electrolytes levels neonatal health was recorded. A 24-hour recall method was used to record dietary intake of subjects for consecutively three days.

The effectiveness of diet counseling was evaluated in terms of comparison between food and nutrient intake, percent adequacy and serum trace elements and electrolytes levels and neonatal outcome and anthropometry in both groups.

Blood samples collection

The blood samples for the analysis of serum trace elements and electrolytes were collected by the laboratory technician and the analysis was done in the laboratory by the professional following standard procedures. The neonatal outcome of both groups was observed in terms of vitality, birth weight, gestational age and anthropometric measurements taken within 24 hours of birth.

Statistical analysis

To analyze the data, mean, standard deviation and percentages were calculated using standard methods. For comparing data, t-test was applied and correlation coefficient was calculated to evaluate the association between various factors.

Results and Discussion

Demographic and socioeconomic profile

The mean age of the subjects in the control and experimental group was found to be 30.3 ± 4 and 28.9 ± 3.32 years**.** Pregnancy induced hypertension is generally observed in mothers with advanced maternal age. Similar study reported that the risk of pregnancy induced hypertension increased with maternal age ≥ 30 years (OR = 2.87; 1.03-7.99) [9]. The maternal education level impacts her health during crucial conditions including pregnancy. An educated mother knows the importance of nutrition before and

during pregnancy. The majority of the subjects (23.4%) in control group had their education up to the elementary level, while, in the experimental group, more than one-fourth (26.6%) of the subjects had their education up to the primary level. A study reported that low maternal education level had significantly increased the risk of preeclampsia as compared to higher education level [10]. The mean monthly family income of control and experimental groups was Rs. 16.166 ± 6.346 and Rs. 17.215 ± 6.545.

Effectiveness of diet counseling on food and nutrient intake of selected subjects

The data regarding food and nutrient intake for both the groups was collected at the same time, but, the experimental group was provided with diet counseling for three months before data collection. The data is presented in Table 2 and 3. The results revealed a significantly higher ($p < 0.05$) percent adequacy among the experimental group as compared to control i.e. cereals (94.3 Vs 89.2), green leafy vegetables (77 Vs 66.2), other vegetables (89.3 Vs 81.5), fruits (78.3 Vs 45) and milk and milk products (81.7 Vs 69). Whereas, intake of fat was significantly lower in control group as compared to experimental group in terms of percent adequacy (114.7 Vs 133.2). The significant difference in the intake of all the food groups in experimental group may be due to the effect of diet counseling provided to the subjects for three months at a regular interval of fifteen days. A similar study reported that the regular intake of fruits and vegetables including green leafy vegetables and other vegetables significantly reduced the risk of developing pregnancy induced hypertension (OR = 3.51 and $p < 0.001$) [11]. Another study revealed that the antenatal women who received nutrition/ diet counseling as a part of antenatal care, had an improved intake of fruits and vegetables that helped them to have a protective effect against preeclampsia [12]. The nutrition/diet counseling had an impact in terms of improvement in the intake of various food groups including cereals, pulses, fruits and vegetables etc. [13]. The reason of lower percent adequacy of various food groups among the subjects of control group may be the inadequate intake due to lack of awareness about nutrition and increased requirements. In Table 3, the results showed a significantly ($p < 0.05$) higher intake of macro-nutrients in the experimental group as compared to control i.e., protein (47.93 ± 4.74 Vs 33.7 ± 2.58g), fat (34.9 ± 3.9 Vs 39.8 ± 2.5g) and carbohydrates (340 ± 13.05 Vs 310 ± 10.6g). Further, the intake of calcium, magnesium, zinc and ascorbic acid was found to be significantly higher in the experimental group as compared to the control group i.e. (757.2 ± 45.3 Vs 653.7 ± 65.8 mg), (319.9 ± 12.5 Vs 276.8 ± 15.7 mg), (8.87 ± 1.01 Vs 7.1 ± 1.2 mg) and (68 ± 5.3 Vs 57.6 ± 8.7 mg) respectively. This increase may be due to improvement in food intake after diet coun-

Particulars	Control (n = 30)	Experimental (n = 30)
Age (years)		
20-25	3 (10)	7 (23.4)
25-30	10 (33.3)	13 (43.3)
30-35	10 (33.3)	9 (30)
35-40	7 (23.4)	1 (3.3)
Mean Age	30.3 ± 4.0	28.9 ± 3.32
Educational Qualification		
Primary	5 (16.6)	8 (26.6)
Elementary	7 (23.4)	7 (23.4)
Matric	5 (16.6)	6 (20)
Graduate	4 (13.4)	3 (10)
Post-graduate	4 (13.4)	2 (6.6)
Illiterate	5 (16.6)	4 (13.4)
Family Income per month (Rs)		
< 10,000	-	-
10,000-20,000	16 (53.4)	13 (43.4)
20,000-30,000	8 (26.6)	9 (30)
>30,000	6 (20)	8 (26.6)
Mean Family Income	16,166 ± 6,346	17,215 ± 6,545

Table 1: General and socio-economic profile of selected pregnancy induced hypertensive subjects (N = 60).

Control Group - Pregnancy Induced Hypertensive group without Diet Counseling.

Experimental Group - Pregnancy Induced Hypertensive group with Diet Counseling.

Figures in parenthesis indicate percentages.

		Control Group (n = 30)		Experimental Group (n = 30)		
Food Groups	Suggested Dietary Intake (g)	Actual Intake	Percent Adequacy	Actual Intake	Percent Adequacy	t-value
Cereals	325	290	89.2	306.5	94.3	0.838*
Pulses	90	61.9	68.6	67.8	75.3	0.197^{NS}
Green leafy vegetables	100	66.2	66.2	76.7	77	3.989*
Other vegetables	200	163.1	81.5	183.7	89.3	2.013*
Roots and Tubers	100	106.7	107	112.5	112.5	0.528^{NS}
Fruits	150	67.6	45	117.7	78.3	10.677*
Milk and milk products	400	276	69	327	81.7	2.517*
Fat	25	26.7	114.7	33.3	133.2	4.476*
Sugars	20	20.1	101	19.2	96	0.697^{NS}

Table 2: Effect of diet counseling on food intake of selected pregnancy induced hypertensive subjects (N = 60).

Control Group - Pregnancy Induced Hypertensive group without Diet Counseling.

Experimental Group - Pregnancy Induced Hypertensive group with Diet Counseling.

*Significant at 5%, level NS- Non-significant.

		Control Group (n = 30)		Experimental Group (n = 30)		
Nutrients	**Estimated Average Requirements**	**Actual Intake**	**Percent Adequacy**	**Actual Intake**	**Percent Adequacy**	**t-value**
Protein (g)	43.6	33.7 ± 2.58	77.2	47.93 ± 4.74	110	2.010*
Fat (g)	30	76.5 ± 6.72	255	34.97 ± 3.94	132	2.014*
Energy (Kcal)	2010	2092.7 ± 147	104	1902.97 ± 78.9	94.6	2.039*
Calcium (mg)	800	653.7 ± 65.8	81.7	757.23 ± 45.39	94.6	7.085*
Iron (mg)	32	15.03 ± 2.32	43	15.98 ± 1.62	50	1.823^{NS}
Magnesium (mg)	320	276.8 ± 15.77	86.5	319.93 ± 12.56	99.9	11.709*
Zinc (mg)	12	7.10 ± 1.21	59	8.87 ± 1.01	73.9	6.104*
Ascorbic Acid (mg)	80	57.66 ± 8.75	71	68 ± 5.32	85	5.522*

Table 3: Effect of diet counseling on nutrient intake of selected pregnancy induced hypertensive subjects (N = 60).

Control Group - Pregnancy Induced Hypertensive group without Diet Counseling.

Experimental Group - Pregnancy Induced Hypertensive group with Diet Counseling.

*Significant at 5%, level NS- Non-significant

seling. A similar study reported that the inclusion of recommended allowances of trace elements such as iron, zinc, selenium, ascorbic acid, thiamine, riboflavin, niacin and folate in diet of pregnancy induced hypertensive subjects help in reduction in oxidative stress and inflammation and prevent the development of pregnancy induced hypertension [14]. While, a study revealed that hypertensive pregnant women on dietary advice to follow Dietary Approaches to Stop Hypertension (DASH) based diet had lesser amounts of sodium and more of calcium, magnesium and zinc due to the increased consumption of cereals, pulses, fruits, vegetables and low-fat dairy products [15].

Effectiveness of diet counseling on Serum trace elements and electrolytes concentration

The data revealing the effectiveness of diet counseling is shown in Table 4. The results revealed the significantly ($p < 0.05$) higher serum concentrations of trace elements and electrolytes in experimental group as compared to control group i.e., calcium (8.23 ± 0.4 Vs 7.78 ± 0.65 mg/ dl), magnesium (1.55 ± 0.22 Vs 1.44 ± 0.19 mg/ dl), zinc (68.29 ± 4.25 Vs 64.72 ± 2.31 **µg/dl), selenium (79.03** ± 6.5 Vs 74.8 ± 6.3 µg/dL). Further, the serum sodium concentration was significantly ($p < 0.05$) low in experimental group as compared to control group (137.67 ± 2.22 Vs 145.9 ± 8.92 mEq/L). A study reported that the low dietary intake of calcium is associated with low serum calcium concentration. The serum calcium level can be improved by including calcium sources or supplementation of calcium in diet [16]. Another study reported that the inclusion of vegetarian sources in diet increases the concentration of magnesium in serum, acting as calcium channel blocker and increases nitric oxide level that prevents endothelial dysfunction [17]. A study on randomized control trial reported that the inclusion of zinc sources in diet and zinc supplementation helped in improving serum concentrations of zinc and showed a protective effect against preeclampsia [18].

Effectiveness of diet counseling on neonatal outcome and anthropometry

Trace elements	Reference Value	Control (n = 30)	Experimental (n = 30)	t-value
Calcium	8.2- 9	7.78 ± 0.65	8.23 ± 0.4	3.18*
Magnesium	1.5 -2.2	1.44 ± 0.19	1.55 ± 0.22	2.05*
Iron	44- 178	85.01 ± 15.79	82.54 ± 5.6	0.64^{NS}
Zinc	51-80	64.72 ± 2.31	68.29 ± 4.25	4.03*
Copper	165-221	170.5 ± 1 2.83	178.2 ± 9.18	1.79^{NS}
Selenium	75-145	74.8 ± 6.3	79.03 ± 6.5	2.53*
Sodium	129-148	145.9 ± 8.92	137.67 ± 2.22	2.87*
Potassium	3.3- 5	3.90 ± 0.98	4.21 ± 0.98	1.20^{NS}
Chloride	97-109	117.3 ± 8.9	114.67 ± 12.16	0.96^{NS}

Table 4: Effect of diet counseling on serum trace elements and electrolytes of selected pregnancy induced hypertensive subjects (N = 60).

Control Group - Pregnancy Induced Hypertensive group without Diet Counseling.

Experimental Group - Pregnancy Induced Hypertensive group with Diet Counseling.

*Significant at 5% level, NS- Non-significant

The data regarding neonatal outcome and anthropometric measurements is presented in table 5. In terms of neonatal outcome, a total of 96.6 percent of the neonates were born live to experimental group as compared to control group with live-born neonates to be 93.3 percent. Further, a total of 100 percent of the neonates born to experimental group were term born, while about 7 percent of the neonates born to control group were pre-term. Further, the results showed that the neonates born to the experimental group had significantly ($p < 0.05$) prolonged mean gestational age i.e., 38.7 ± 1.03 weeks as compared to neonates born to control group i.e., 36.7 ± 1.37 weeks. A case-control study on diet counseling based on DASH diet principle reported a significant ($p < 0.05$) difference

in birth weight and gestational age at delivery in DASH-diet group as compared to control group [19]. Further, significantly higher mean birth weight was observed in neonates of experimental group as compared to control group (2.53 ± 0.48 Vs 2.16 ± 0.80 kg). A difference in various anthropometric measurements was observed with higher measures in neonates born to experimental group as compared to control group. But, the difference was non-significant. It may be due to poor maternal pre-pregnancy nutritional status as well as various genetic factors involved in the anthropometric measurements of neonates. Similar results reported in a study that there was non-significant difference between neonatal anthropometric measurements of normal and PIH mothers (birth length 46.95 ± 3.95 cm Vs 46.76 ± 4.09 cm), head circumference (34.15 ± 3.97 cm Vs 33.78 ± 3.69 cm), mid-arm circumference (9.78 ± 2.92 cm Vs 9.8 ± 2.02 cm), chest circumference (30.66 ± 6.3 cm Vs 29.7 ± 4.25 cm) and mid-thigh circumference (13.75 ± 3.045 cm Vs 13.71 ± 3.14 cm) [20].

Conclusion

Neonatal outcome	Neonatal outcome of Control Group (n = 28)	Neonatal outcome of Experimental Group (n = 29)	
Vitatlity			
Live	28 (93.3)	29 (96.7)	
Still-Born	2 (6.7)	1 (3.3)	
Birth status			
Pre-term	2 (7.2)	0	
Term	26 (92.8)	29 (100)	
Post-term	0	0	
Neonatal anthropometric measurements	Neonatal outcome of Control Group (n=28)	Neonatal outcome of Experimental Group (n=29)	t-value
Gestational Age	36.7 ± 1.37	38.7 ± 1.03	6.3*
Mean Birth weight (Kg)	2.16 ± 0.80	2.53 ± 0.48	2.08*
Crown Heel Length (cm)	46.4 ± 12.7	47.7 ± 9.06	0.42 NS
Head Circumference (cm)	30.9 ± 8.4	32.9 ± 6.2	1.02 NS
Chest Circumference (cm)	29.14 ± 7.9	30.4 ± 5.7	0.74 NS
Mid -Arm Circumference (cm)	8.39 ± 2.29	8.83 ± 1.67	0.84 NS
Abdominal Girth (cm)	25.07 ± 7.3	25.19 ± 5.02	0.07 NS
Mid-Thigh Circumference (cm)	5.86 ± 1.59	6.09 ± 1.15	0.62 NS
Ponderal Index (Kg/m^3)	1.76 ± 0.63	1.88 ± 0.45	0.77 NS

Table 5: Effect of diet counseling on neonatal outcome and anthropometric measurements (N = 57).

Control Group - Pregnancy Induced Hypertensive group without Diet Counseling.

Experimental Group - Pregnancy Induced Hypertensive group with Diet Counseling.

*Significant at 5% level, NS- Non-significant

Pregnant women are already a vulnerable group, but the lack of awareness and knowledge about nutritional needs of body during pregnancy raise may complications including pregnancy induced hypertension. In order to reduce the incidence of pregnancy induced hypertension among low income group, diet counseling was provided in order to create awareness about their nutritional needs for better maternal and foetal outcome. The diet counseling based on the principle of DASH diet helped the experimental group in improving their nutritional status significantly and significant improvements in serum trace elements and electrolytes helped in managing PIH and improved the neonatal outcome of the experimental group. Thus, the study recommends the provision of diet counseling at community centers and government hospitals to create awareness about the importance of nutrition among pregnant and all women in reproductive age. The status of serum trace elements is directly related to maternal blood pressure and can be helpful in preventing PIH, so it should be assessed and monitored well in time.

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Conflict of Interest

We declare no conflicts of interest in this work.

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