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Comprehensive effect assessment of medical nutrition guidance during pregnancy towards the health of mothers and children

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Summary

Objective: This study evaluates the effects of medical nutrition guidance provided to pregnant women to reduce pregnancy complications and occurrence of low birth-weight children and macrosomia. This guideline aims to provide the basis for improving birth delivery outcomes. *Materials and Methods:* A randomized controlled method was used. A total of 261 parturient women who enrolled in regular pregnancy testing were sampled and selected. The subjects were randomly divided into experimental group (EG, $n = 124$) and control group (CG, $n = 132$). The differences in maternal health, pregnancy outcomes, and newborn health between the two groups were compared. *Results:* Hypertensive disorders in pregnancy and gestational diabetes risks in EG were significantly lower than those in CG ($p < 0.05$). The cesarean section rate decreased (EG 36.29%, CG 51.50%), and the vaginal delivery rate increased (EG 63.71%, CG 51.50%). The incidence of macrosomia in EG was significantly lower than that in CG ($p < 0.05$). *Conclusion:* Medical nutrition guidance during pregnancy improves the perinatal outcomes of mothers and children.

Key words: Medical nutrition guidance during pregnancy; Pregnancy nutrition; Maternal health; Newborn health.

Introduction

Excessive intake of nutrients and nutritional imbalance during pregnancy can affect the perinatal outcomes of mothers and children. Given the increasing improvement of social living standards, nutrients during pregnancy have been excessively consumed in recent years. This excessive consumption has led to excessive weights of pregnant women. Maternal obesity significantly increases incidences of preeclampsia, gestational diabetes, and low birth weight. Macrosomia (high birth weight), shoulder dystocia, and abnormal labor progress increase incidences of cesarean delivery and postpartum hemorrhage [1-4]. A large number of studies have shown that nutrition guidance and weight management during pregnancy can effectively control weight increase, with high probability of preventing complications in mothers and children. Therefore, this guidance is conducive to the outcomes of mothers and children. Weight gain during pregnancy and nutritional status directly affect the process and outcome of pregnancy, fetal posterior development, and postnatal physical condition of women. Therefore, performing an individualized nutrition supply and weight management to pregnant women from early pregnancy stage is necessary. This individualized guidance reduces pregnancy complications and incidence of abnormal delivery and improves maternal and newborn health levels [5, 6], providing significance to perinatal work. This study provided medical nutritional guidance to pregnant women in the first trimester of pregnancy to achieve improved perinatal outcomes.

Materials and Methods

Data were obtained from 261 primiparous parturient women aged from 18 to 40 years. The subjects enrolled in regular pregnancy testing in the Department of Obstetrics, Tongzhou Maternal and Child Health Hospital from January 2011 to December 2011. This study was conducted in accordance with the Declaration of Helsinki and with approval from the Ethics Committee of Tongzhou Maternal and Child Health Hospital. Written informed consent was also obtained from all participants.

Inclusion criteria included subjects who were healthy before pregnancy, had at least 12 weeks of live births pregnancy, and had live-birth newborns. Exclusion criterion was incomplete clinical data [including one case of non-specific birth weight, two cases of abortion because of prenatal-diagnosed fetal malformations, one case of miscarriage during pregnancy (fetus was < 28 week gestation), and one case of non-gestational week). Exactly 256 cases had complete data.

The grouping design used the comparison research method. Based on the principles of voluntariness and informed consent, 124 pregnant women were randomly selected for the nutritional guidance. A total of 132 pregnant women whose conditions of age, economic status, and place of residence were roughly similar to those of the experimental group (EG) were selected and set as the control group (CG). The outcome indicators mainly included general demographic data, incidence of complications during pregnancy, birth weight, and newborn health.

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A researcher was assigned to investigate and record the maternal age, pre-pregnancy weight, pre-pregnancy lifestyle, and eating habits of the subjects. The pre-pregnancy body mass index (BMI) was calculated based on height. The Abbott pregnancy nutrition software was used to develop a dietary regimen, which was modified according to different dietary habits, to perform individualized target nutrition guidance. The following data were obtained: basic situations of pregnant women, total weight gain during pregnancy, daily nutrient caloric intake per kilogram body weight during pregnancy, gestational weeks, pregnancy complications (including pre-eclampsia, anemia, and gestational diabetes), and delivery mode.

The main focuses of nutrition education were significance of reasonable diet during pregnancy, risk factors of nutrition imbalance, and daily nutrient intake during pregnancy. Stratified explanation was performed according to the pregnancy dietary pagoda recommended by the Chinese Nutrition Society. Pregnancy nutrition tips and precautions, such as health education matters, were completed by nurses. For parturient women detected with gestational diabetes during pregnancy, secondary maternal health education included the following: gestational diabetes effects on mother and child, using the food exchange chart to determine how to eat according to weight, cognition of food model, blood sugar control standards during pregnancy, and proper exercise. The education period was circa one hour per session and was completed by an obstetrician. Nutrition brochures were provided, and each parturient woman with gestational diabetes was required to record in detail her diet, daily weight, blood glucose, and movement.

The Abbott pregnancy nutrition software was used to develop a reasonable dietary regimen. The dietary calories and nutrient distribution were adjusted at any time in the middle and late stages of gestation.

Results

In this study, the minimum age of pregnant women in CG was 18 years and the mean age was 27.70 ± 3.73 years. The minimum age of pregnant women in EG was 20 years and the mean age was 27.84 ± 3.60 years. No statistically significant difference was observed between the age compositions of the two groups ($p > 0.05$); the age composition of each age segment was similar in both groups. BMI analysis showed that no statistically significant difference was observed between EG and CG groups ($p < 0.05$; Table 1).

The result showed that the pre-eclampsia complication rate in EG was 2.41%, which was significantly lower than that of CG (10.59%) with statistically significant difference ($p < 0.05$). Further stratified analysis indicated that the statistically significant difference mainly existed between subgroups of emaciated and normal ($p < 0.05$), but no statistical significance was achieved between the subgroups of overweight and obese ($p > 0.05$; Table 2).

The results showed that pregnancy nutrition guidance had a significant function in reducing the incidence of gestational diabetes, as shown in Table 3. The diabetes detection rate of EG was 17.88% lower than that of CG. The diabetes detection rates of EG, especially in the overweight and obese subgroups, were 30.77% and 25.00%, lower than those of CG (45.45% and 28.57%). The difference was statistically significant ($p < 0.05$; Table 3).

Whether in the emaciated, normal, or overweight subgroups, the cesarean section rate was significantly lower than that of CG ($p < 0.05$) throughout the study once nutritional guidance during pregnancy was established. However, the cesarean rate in EG (20.00%) was significantly lower than that in CG (71.43%) in the two obese subgroups ($p = 0.215$). This result may be attributed to the relatively small sample size of the pregnant women enrolled in these subgroups (Table 4).

In EG, only one case of macrosomia and no occurrence of low birth weight was observed, whereas 27 cases of macrosomia and seven cases of low birth weight were observed in CG. A statistically significant difference existed between the two groups ($p < 0.05$). The neonatal hyperbilirubinemia rates were 80.30% and 7.32% in CG and EG, respectively; the difference was statistically significant ($p < 0.05$). The hypoglycemic rate in CG was 83.21%, but not a single case occurred in EG. The comparison between the two groups showed a statistically significant difference ($p < 0.05$). Table 5 presents the detailed information of grouping, birth weight, and occurrences of hyperbilirubinemia and hypoglycemia.

According to results of univariate analysis, combined with relevant expertise analyses, newborn birth weight was set as a dependent variable. Whether or not to perform nutritional guidance, whether pregnancy complications would occur, and intrauterine growth were set as independent variables to establish logistic regression analysis for the main factors affecting newborn birth weight. The model was set at 0.05 and 0.10 as inclusion and exclusion criteria, respectively. The final analysis results showed that without the nutrition guidance, higher levels of gestational diabetes and pregnancy BMI were the risk factors of abnormal newborn birth weight. Among the risk factors, nutrition exhibited the greatest risk (OR = 42.327). Table 6 shows the main factors and the degrees of risks.

Discussion

This study showed that the incidence of pre-eclampsia (2.41%) in EG was significantly lower than that in CG (10.59%). No significant difference was observed between the emaciated subgroups of the two groups. The risk of pre-eclampsia in obese pregnant women (28.61%) was significantly higher than in peak, normal, and overweight women of the same group (9.09%, 8.89%, and 16.71%). This finding suggests that obesity is one of the adverse factors that cause gestational hypertension [7-9].

Diabetes obesity is an independent risk factor of gestational diabetes [10]. In this study, the risk of developing gestational diabetes by obesity in EG was significantly reduced when pregnancy nutrition guidance was performed (25%). The incidence rate in CG was 28.57%. This result indicates that reasonable dietary guidance is a protective factor in obese pregnant women. The diabetes incidence

Table 1. — *Comparison of general information between EG and CG.*

Grouping		CG		EG		χ^2	*p*
		n.	%	n.	%		
Age	≤ 25	35	26.51	36	29.32	1.32	0.856
	26-30	72	53.49	63	51.18		
	31-35	22	16.68	21	17.13		
	36-40	3	2.32	3	2.37		
BMI	Emaciation	11	8.33	23	18.55	8.300	0.040
	Normal	92	69.69	83	66.94		
	Over-weight	22	16.67	13	10.48		
	Obesity	7	5.31	5	4.03		

Table 2. — *Comparison of pre-eclampsia situation in EG and CG.*

Grouping	CG		EG		χ^2	*p*
	Normal	Pre-eclampsia (%)	Normal	Pre-eclampsia (%)		
Emaciation	10 (90.91)	1 (9.09)	22 (95.65)	1 (4.35)	3.423	0.058
Normal	84 (91.11)	8 (8.89)	80 (96.41)	3 (3.59)	5.170	0.023
Over-weight	18 (83.33)	4 (16.71)	13 (100.00)	0 (0.00)	0.557	0.456
Obesity	5 (71.4)	2 (28.61)	5 (100.00)	0 (0.00)	0.569	0.428
Summary	117 (89.41)	15 (10.59)	120 (97.59)	4 (2.41)	6.825	0.009

Table 3. — *Comparison of GDM situations in EG and CG.*

Grouping	CG		EG		χ^2	*p*
	Normal	GDM	Normal	GDM		
Emaciation	8 (72.73)	3 (27.27)	20 (86.96)	3 (13.04)	1.037	0.031
Normal	71 (76.67)	21 (23.33)	69 (83.13)	14 (16.87)	1.119	0.029
Over-weight	12 (54.55)	10 (45.45)	9 (69.23)	4 (30.77)	0.462	0.514
Obesity	5 (71.43)	2 (28.57)	4 (75.00)	1 (25.00)	0.016	0.789
Summary	96 (72.72)	36 (28.28)	102 (82.12)	22 (17.88)	3.293	0.044

Table 4. — *Comparison of the delivery mode in EG and CG.*

Grouping	CG		EG		χ^2	*p*
	Natural delivery (%)	Cesarean (%)	Normal	Pre-eclampsia (%)		
Emaciation	5 (45.45)	6 (54.55)	13 (56.62)	10 (43.48)	15.242	0.001
Normal	50 (55.56)	40 (44.44)	56 (67.47)	27 (32.53)	79.514	0.001
Over-weight	7 (29.17)	17 (70.83)	6 (46.15)	7 (53.85)	17.541	0.001
Obesity	2 (28.57)	5 (71.43)	4 (80.00)	1 (20.00)	3.077	0.215
Summary	64 (48.50)	68 (51.50)	79 (63.71)	45 (36.29)	10.498	0.001

Table 5. — *Comparison of newborn health in EG and CG.*

Grouping		CG		EG		χ^2	*p*
		n.	%	n.	%		
Body weight	Low birth-weight	7	5.30	0	0.00	33.485	0.000
	Normal	98	74.24	123	99.19		
	Macrosomia	27	20.45	1	0.81		
Hyperbilirubinemia	Yes	26	80.30	9	7.32	8.241	0.004
	No	106	19.70	115	92.68		
Hypoglycemia	Yes	22	83.21	0	0.00	22.615	0.000
	No	109	16.79	124	100.00		

Table 6. — *Multivariate logistic analysis results of newborn body weight.*

Factors	β	S.E.	χ^2	*p*	OR	95% C.I.	
						Lower	Upper
Nutrition guidance	3.745	1.024	13.388	0.001	42.327	25.692	54.721
GDM	1.127	0.382	8.729	0.003	1.324	1.153	2.684
Pre-eclampsia	1.984	1.068	5.849	0.035	2.674	1.330	11.675
BMI			4.987	0.017			
Normal	0.051	1.097	3.002	0.046	0.952	0.123	0.934
Obesity	1.907	1.145	4.628	0.042	2.478	1.263	10.363

rate of pregnant women with normal BMI in CG was 23.33%, which was higher than that of EG (16.87%). This rate suggests that diabetes medical nutrition guidance [11-13] could also be applied to normal pregnant women.

Research data worldwide have shown that the weight gain of pregnant women influences the mode of delivery [14]. The dystocia rate of pregnant women who had rapid, excessive weight gain or significant weight gain during pregnancy and who needed assistance in the birth process was significantly higher than that of pregnant women whose body weight increased at a reasonable speed. The natural birth rate of EG was 63.71%, which was significantly higher than that of CG (48.5%). The cesarean section rate of EG was 36.29%, which was lower than that of CG (51.50%). The occurrence of labor abnormalities of EG in natural childbirth was 1.27%, which was significantly lower than that of CG (50%). A difference was observed between the two groups ($p < 0.05$). Thus, proper nutrition guidance and intervention during pregnancy could significantly improve pregnancy outcomes, improve natural birth rate, and reduce cesarean section rate [15]. This finding is consistent with the health policy advocated by the Ministry of Health, namely, "to promote natural childbirth and reduce cesarean section rate", which could also improve the quality of perinatal medicine.

The medical nutritional guidance provided during pregnancy improved maternal intrauterine nutrition, thus preventing fetal-borne diseases. The theory states that balanced nutrition within the first 1,000 days of life can reduce the risk of offspring suffering from chronic non-infectious diseases, such as hypertension, diabetes, and heart disease [12]. Pregnancy nutrition guidance can significantly reduce the incidence of fetal-restricted growth and low birth weight [16]. In this study, the fetal-restricted growth occurred in CG, and the incidence rate in EG was 6.06%, indicating a significant difference between the two groups ($p < 0.05$). Good/adverse effects of pregnancy nutrition guidance mainly manifest in birth weight. In this study, the incidence of macrosomia in EG was 0.81%, which was significantly lower than that of CG (20.50%). Some studies have confirmed that incidence of childhood overweight is correlated with excessive increase of mother's weight during pregnancy and macrosomia [17]. Reports have indicated that appropriate and reasonable pregnancy nutrition guidance is significant in reducing the rate of fetal macrosomia. Table 6 shows the logistic regression analysis which set newborn body weight as a dependent variable. Whether or not to perform nutrition guidance, whether pregnancy complications occurred, and intrauterine growth were set as independent variables. The result showed that gestational diabetes and high level of pregnancy BMI were risk factors of fetal abnormal birth weight. Among these factors, the effects of nutrition guidance showed the greatest risk (OR = 42.327). This regression model also showed that the incidence rate of abnormal neonatal weight in pregnant women with diabetes was 1.324 times that in pregnant women without diabetes [18]. Developing appropriate calorie intake, adjusting eating habits, and monitoring weight growth of pregnant women could improve the health conditions of newborns. This finding indicates that effective and reasonable nutrition guidance and intervention during pregnancy reduced the incidence of macrosomia and low birth weight. Based on these research results, a significant increase in maternal and perinatal outcomes were observed through nutritional guidance during pregnancy.

The problem of excessive nutrition intake during pregnancy is serious, as observed in recent years, and forms a contradiction with the lack of nutrition knowledge during pregnancy. Given these reasons, this study contrasted and evaluated the nutrition guidance during pregnancy toward the health of mothers and children. The study summarized the findings as follows.

Pregnancy nutrition guidance could significantly reduce the incidence of maternal complications. This study showed that medical nutrition therapy towards overweight and pre-pregnancy obesity could significantly reduce the incidence of pre-eclampsia [19]. The comparison between EG and CG showed that the pregnancy nutrition guidance had a significant function in reducing the occurrence of gestational diabetes [20]. This guidance is especially important to overweight and obese pregnant women who had accompanying high-risk factors of diabetes.

After the pregnancy nutrition guidance, the mothers who exhibited reasonable weight gain and natural delivery had reduced risk of abnormal labor; the rate of cesarean section also significantly reduced [14, 21].

Nutritional guidance during pregnancy resulted in rare incidence of macrosomia and low-birth weight children, regardless of the previous body weight of the pregnant women. To maintain a stable intrauterine environment and reduce nutrient absorption and utilization, a stable blood sugar should be maintained, especially for pregnant women with gestational diabetes. A stable blood sugar would result in rare incidence of macrosomia.

Pregnancy nutrition guidance could significantly improve the health of mothers and children. Proper nutrient intake during pregnancy and fetal growth monitoring showed great significance in reducing maternal complications. Therefore, prenatal nutrition education should be carried out, especially in rural populations. Dietary survey and individualized nutrition therapy should be performed if necessary, and an obstetric nutrition department should be established. Pregnant women with gestational diabetes mellitus diagnosed using the International Association of Diabetes and Pregnancy Study Groups (IADPSG) standard should undergo positive nutrition intervention to control newborn weight, reduce incidence of macrosomia and low birth weight, as well as reduce the risk of fetal-borne diseases [22].

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