

ORIGINAL RESEARCH ARTICLE

Influence of nutritional guidance during pregnancy on nutritional status and pregnancy outcome of pregnant women

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Miaomiao Yu, Haiyan Chen and Na Li*

Department of Gynecology, Nanjing General Hospital of Nanjing Military Command, Jiangsu 210000, China

*For Correspondence: Email: nalipig@sina.com; Phone: +086 15050596859

Abstract

This study was an original article, mainly aimed to explore the influence of nutritional guidance during pregnancy on nutritional status and pregnancy outcome of pregnant women. Two hundred (200) pregnant women were admitted to the Nanjing General Hospital of Nanjing Military Command from May 2021 to May 2023. They were randomly sub-divided into a control group and an intervention group. Each group had 100 cases. The control group received routine guidance, while the intervention group received personalized nutrition guidance based on standards from the routine guidance protocol. The results showed that in comparison with the control group, the intervention group presented higher calcium, protein, folate, sodium, iron, vitamin and zinc levels, lower fat levels, lower incidence of adverse birth outcomes, lower incidence of adverse neonatal status, higher fetal body weight and Apgar score higher satisfaction rate, and lower incidence of complications during pregnancy. We conclude that reasonable intake of nutrition during pregnancy can meet the nutritional needs of pregnant women and fetuses, improve pregnancy safety, improve delivery and newborn conditions, reduce the occurrence of pregnancy complications, and improve the satisfaction of pregnant women. (*Afr J Reprod Health* 2024; 28 [12]: 29-37).

Keywords: Pregnant women; Nutritional guidance; Nutritional status; Pregnancy outcome

Résumé

Cette étude était un article original, visant principalement à explorer l'influence des conseils nutritionnels pendant la grossesse sur l'état nutritionnel et l'issue de la grossesse des femmes enceintes. Deux cents (200) femmes enceintes ont été admises Nanjing General Hospital of Nanjing Military Command de mai 2021 à mai 2023. Elles ont été réparties au hasard en un groupe témoin et un groupe d'intervention. Chaque groupe avait 100 cas. Le groupe témoin a reçu des conseils de routine, tandis que le groupe d'intervention a reçu des conseils nutritionnels personnalisés basés sur les normes du protocole de conseils de routine. Les résultats ont montré que par rapport au groupe témoin, le groupe d'intervention présentait des taux plus élevés de calcium, de protéines, d'acide folique, de sodium, de fer, de vitamines et de zinc, des taux de graisses plus faibles, une incidence plus faible d'issues défavorables à la naissance, une incidence plus faible d'état néonatal défavorable, une incidence plus faible le poids corporel fœtal et le score d'Apgar sont un taux de satisfaction plus élevé et une incidence plus faible de complications pendant la grossesse. Nous concluons qu'un apport nutritionnel raisonnable pendant la grossesse peut répondre aux besoins nutritionnels des femmes enceintes et des fœtus, améliorer la sécurité de la grossesse, améliorer les conditions de l'accouchement et du nouveau-né, réduire la survenue de complications de la grossesse et améliorer la satisfaction des femmes enceintes. (*Afr J Reprod Health* 2024; 28 [12]: 29-37).

Mots-clés: Femmes enceintes ; Conseils nutritionnels ; État nutritionnel ; Résultat de la grossesse

Introduction

Pregnant women need a lot of nutritional intake not only to supply their own nutritional requirements, but also need additional nutrients to meet the growth and development of the fetus. With the gradual increase in the living standards of Chinese residents, people attach great importance to nutrition during pregnancy. However, influenced

by traditional concepts, many pregnant women and their families do not have sufficient knowledge about nutrition during pregnancy and always think that eating more will enhance the nutrition of the body, resulting in excessive weight gain during pregnancy and excess nutrition¹. Such poor eating habits can cause complications during pregnancy. In addition, some women pay more attention to their own weight, too much pursuit of keeping fit

during pregnancy, with insufficient daily nutritional intake, which increases the possibility of anemia and the probability of low birth weight². The objective of this study was to investigate the impacts of nutritional guidance on maternal health and pregnancy outcomes of pregnant women.

Methods

A total of 200 pregnant women admitted to the obstetrics department of our hospital from May 2021 to May 2023 were selected as study participants, and were randomly selected into control group (CG) and intervention group (IG), with 100 cases in each group. The random allocation method was as follows: 200 numbers were selected successively from the random number table for numbering, and the numbers from 1 to 200 corresponded to 200 random numbers, which were put into sealed envelopes. The numbers in an envelope were randomly selected when the study participants were admitted to the hospital and grouped according to the parity of random numbers, with odd numbers as the control group and even numbers as the intervention group. Patients in the CG ranged in age from 22 to 38 years, with an average age of (30.1±1.2) years. Patients in the IG ranged in age from 21 to 40 years, with an average age of (29.3±1.3) years. No significant difference was seen in the basic data between the groups ($P>0.05$). Inclusion criteria were: 1) The gestational age less than 12 weeks at the time of enrollment, and single pregnancies; 2) women aged 20-40 years old; 3) pregnant women who had regular antenatal check-ups and 4) weight of the pregnant woman within the normal range when at the time of booking for antenatal care. Exclusion criteria were: 1) pregnant women with primary medical diseases; 2) those with malfunctioning organs; 3) those with no antenatal examination or care; and 4) women with special eating habits.

Clinical and nutritional methods

The CG was given routine guidance. Pregnant women underwent various clinical examinations in accordance with routine procedures, established pregnancy books, recorded the examination

contents, popularized the routine health contents of pregnant women such as childbirth knowledge, breastfeeding and dietary precautions, and answered questions for pregnant women.

The IG was given personalized nutrition guidance on the basis of routine guidance:

1. Establishing a lecture hall for pregnant women. A symposium on nutrition knowledge during pregnancy was held on 3 days a week, and the attending physicians and deputy chief physicians in the department took turns as lecturers. Nursing staff encouraged pregnant women as well as their families to participate actively. The content of the lecture was separated into three parts, and the content of the first day of the weekly lecture focused on the physiological content of pregnancy for pregnant women. Attention was paid to the diet ratio during pregnancy, so that the pregnant women can had a correct and basic understanding of the body changes during the whole pregnancy process³. On the second day of the weekly lecture, pregnant women were taught about childbirth and breastfeeding, including the advantages and skills of natural childbirth and breastfeeding. Simultaneously, pregnant women were educated about the fetus. On the third day of the weekly lecture, pregnant women were taught about the health care knowledge throughout the perinatal period. Each item was explained in sections to maintain continuity. The course used easy to understand language to explain various concepts, so that pregnant women could better understand⁴.
2. Nutritional assessment. The nursing staff learned about the eating habits and dietary intake of pregnant women in detail, conducted careful inquiries about the medical history and food allergy history of pregnant women, asked whether pregnant women have changes in eating habits after pregnancy, learned whether pregnant women had early pregnancy reaction and its severity, and assessed whether pregnancy weight gain was within the normal range⁵.
3. Nutritional guidance. Nutritional guidance was provided for different pregnant women at different gestational weeks, combining the daily eating habits and intake capacity of pregnant women, and integrating the results of prenatal examination at various stages of pregnant women, so that the

nutritional intake of pregnant women could be balanced. Meanwhile, nutrition was supplemented according to the growth and development stage of the fetus, but the amount of supplementation was strictly controlled to avoid blind supplementation, leading to an imbalance in nutrient intake. Pregnant women strictly abided by the dietary guidelines, supervised by family members, and the nutritional guidance plan could be adjusted at any time following the examination indicators of pregnant women and self-feedback.

4. Dietary care. Nursing staff carried out specific dietary preparation according to the actual situation of pregnant women. The specific dietary ratio was for pregnant women to consume 300 ~ 500 g/d of staple food, including rice, coarse grains, fine pasta and so on. The specific was as follows: eggs 1 to 2/d, soy milk or milk 200-400 g/d, other soy products 50-100 g/d, fresh vegetables and fruits 500-750 g/d⁶. 5 to 20 g of nuts could be added daily. Appropriate consumption of lean meat, shrimp, fish and other meats. Pregnant women with nutritional deficiencies were actively encouraged to eat more nutritious foods.

5. A pregnancy health consultation clinic was built in the department, in order to provide pregnant women who come to the hospital for examination with nutrition and other guidance during pregnancy, and carefully and patiently answer their questions. Health knowledge education manuals were distributed to pregnant women, so that pregnant women could read and learn in their leisure time to supplement their cognitive gaps. Attention was paid to the psychological guidance of pregnant women as some pregnant women were affected by hormone levels in the body during pregnancy, resulting in excessive psychological pressure and mental tension. For such pregnant women, nursing staff carried out corresponding psychological resolution and counseling to reduce the tension of pregnant women⁷.

Outcome indicators

1. Nutrition of pregnant women: calcium, protein, folate, sodium, iron, vitamins, zinc, fat. The nutritional guidance researchers during pregnancy measured the levels of the calcium, protein, folate,

sodium, iron, vitamin, zinc and fat in pregnant women at 24±6 weeks. 5 mL fasting venous blood was collected, and serum was collected after 3200 r/min centrifugation for 10 min. The levels of calcium, protein, folate, sodium, iron, vitamins, zinc and fat in pregnant women using BK-200 automatic biochemical analyzer (BIOBASE, Shandong, China).

2. Delivery situation: premature delivery, massive bleeding, cesarean section, dystocia. The final delivery was recorded by the nutrition guidance researchers during pregnancy.

3. Neonatal status: growth restriction, intrauterine distress, macrosomia, low birth weight, fetal asphyxia, fetal body mass, and Apgar score.

Diagnostic criteria for growth restriction: The fetal double parietal diameter, head circumference, abdominal circumference and femur length were measured by the last ultrasound examination before delivery. The fetal body mass was calculated using the Hadlock formula, and the fetal body mass or abdominal circumference was estimated to be less than the 10th percentile of infants of the same gestational age. Measurement of intrauterine distress: All pregnant women were examined using Mindray Medical's resona 8 Doppler ultrasound instrument, which included umbilical artery flow and fetal intracranial artery flow: The probe frequency was set to 1 ~ 1.5 MHz, and the fetal development and amniotic fluid conditions were routinely checked, and then the fetal double-diameter standard screen was scanned. The levels of middle cerebral artery resistance index (RI), pulse index (PI) and systolic to diastolic flow velocity ratio (S/D) were determined. When the newborn was quiet, the newborn was placed on the electronic scale to weigh the birth weight. The body length of the supine position was measured by a horizontal body length meter. The abdominal circumference of the newborn is measured with a soft tape measure parallel to the upper edge of the navel. The circumference of the head was measured with a soft tape measure around the two eyebrow arches and the occipital tubercles of the skull.

All data were measured three times and then averaged. All newborns were assessed immediately after birth by obstetricians, midwives and anesthesiologists using the neonatal Apgar score at

10 minutes after birth. The relevant evaluation indicators mainly included the skin color, heart rate, breathing status, muscle tension and external stimulation of the newborn. The Apgar score was full of 10 points, 8-10 points for non-asphyxia, 4-7 points for mild asphyxia, and 0-3 points for severe asphyxia. The higher the score, the more severe neonatal asphyxia was.

4. Satisfaction of pregnant women: dissatisfied, relatively satisfied, and very satisfied, satisfaction = relatively satisfied + very satisfied. Before discharge, the satisfaction of pregnant women was investigated by the nutrition guidance researchers during pregnancy. Pregnant women were evaluated based on their subjective feelings during the study, independently selected the satisfaction degree, and the satisfaction data were collected.

5. Complications during pregnancy: preeclampsia, anemia during pregnancy, gestational diabetes mellitus. The incidence of comorbidities during pregnancy was recorded by the gestational nutrition guidance researchers.

Statistical analysis

SPSS 24.0 statistical software was employed for data analysis. Measurement data were exhibited as

($x \pm s$), and t-test was employed for comparison. Count data were exhibited as (n, %), and χ^2 test was employed for comparison. $P < 0.05$ meant statistical significance.

Ethical considerations

Our study was approved by the Ethics Committee of Nanjing General Hospital of Nanjing Military Command.

Results

Nutritional status of pregnant women between 2 groups

In contrast to the CG, calcium, protein, folate, sodium, iron, vitamin and zinc in the IG presented higher ($P < 0.05$), and fat in the IG presented lower ($P < 0.05$, Figure 1).

Delivery situation in 2 groups

The total incidence of preterm birth, massive hemorrhage, cesarean section and dystocia in the IG was 4.00%, significantly lower than that in the CG (16.00%) ($P < 0.05$, Figure 2).

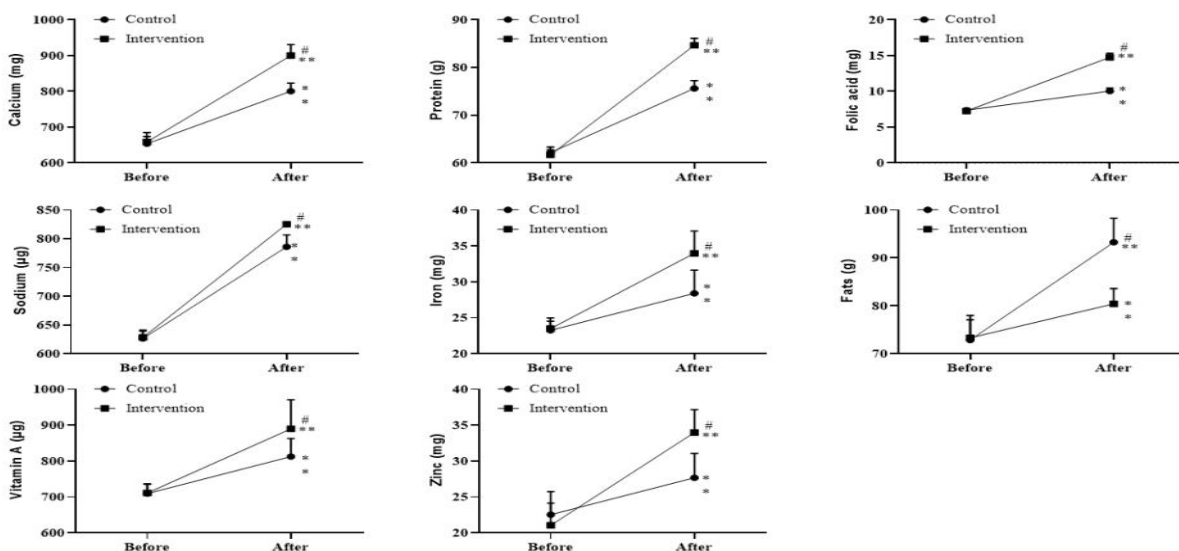


Figure 1: Nutritional status of pregnant women between 2 groups. Compared with before treatment, ** was $P < 0.01$; Compared with the control group, # was $P < 0.05$

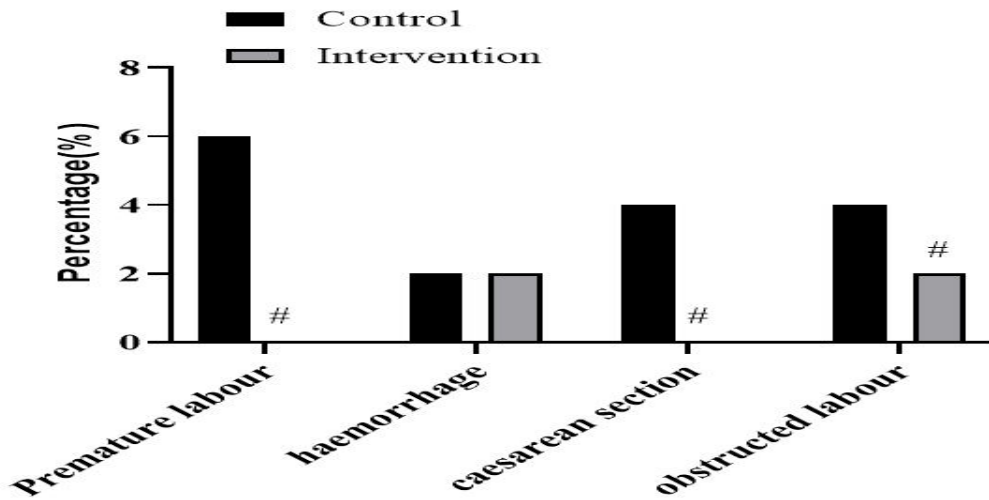


Figure 2: Delivery situation in 2 groups. Compared with the control group, # was P<0.05.

Table 1: Neonatal status in 2 groups

Groups	Cases	Growth restriction	Intrauterine distress	Macrosomia	Low birth weight	Fetal asphyxia	Total incidence rate
Control group	100	2 (2.00)	6 (6.00)	4 (4.00)	8 (8.00)	2 (2.00)	22 (22.00)
Intervention group	100	2 (2.00)	2 (2.00)	0 (0.00)	2 (2.00)	0 (0.00)	6 (6.00)
χ^2							5.3156
P							0.0211

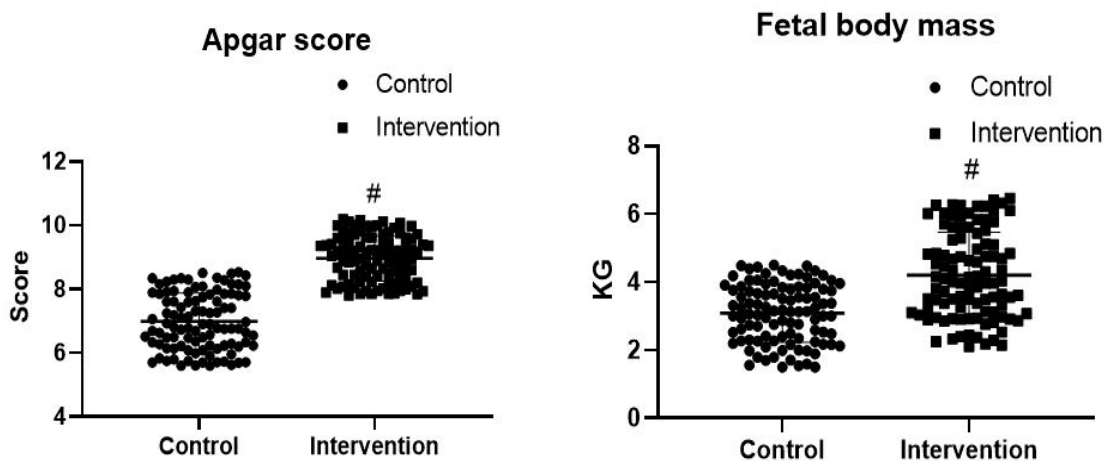


Figure 3: Fetal body weight and Apgar score in 2 groups. Compared with the control group, # was P<0.05

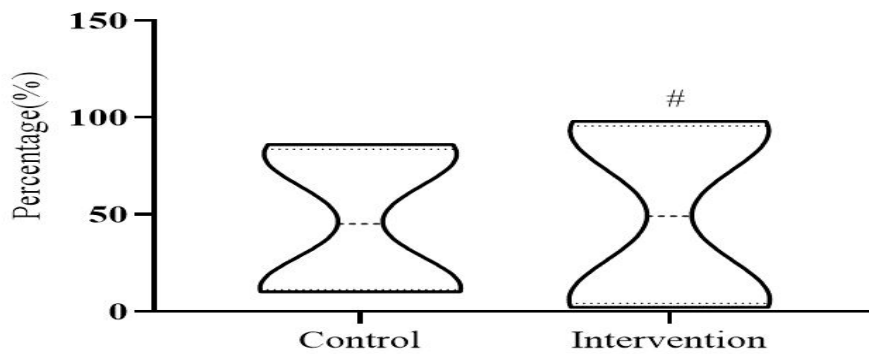


Figure 4: Satisfaction of pregnant women in 2 groups. Compared with the control group, # was P<0.05.

Table 2: Complications during pregnancy in 2 groups

Groups	Cases	Preeclampsia	Anemia during pregnancy	Gestational diabetes mellitus	Total incidence rate
Control group	100	4 (4.00)	6 (6.00)	4 (4.00)	14 (14.00)
Intervention group	100	0 (0.00)	2 (2.00)	0 (0.00)	2 (2.00)
χ^2					4.8913
P					0.0269

Neonatal status in 2 groups

The incidence of growth restriction, intrauterine distress, macrosomia, low birth weight and fetal asphyxia in the IG was 6.00%, lower than that in the CG (22.00%) (P<0.05, Table 1). The fetal body weight and Apgar score in the IG presented higher than the CG (P<0.05, Figure 3).

Satisfaction of pregnant women

The satisfaction rate of the IG was 98.00%, presented higher than that of the CG (86.00%) (P<0.05, Figure 4).

Complications during pregnancy in 2 groups

The incidence of complications during pregnancy in the IG was 2.00%, lower than that in the CG (14.00%) (P<0.05, Table 2). In recent years, many pregnant women and their families have misunderstandings and limitations in the cognition of nutrition during pregnancy, resulting in widespread problems such as unbalanced nutrition and unreasonable dietary structure during pregnancy, and the coexistence of “overnutrition”

and “malnutrition” among pregnant women. Overnutrition leads to excessive accumulation of fat during pregnancy, which eventually leads to the increase of the incidence of gestational diabetes, fetal malformation, and macrosomia⁸It is difficult to recover the body shape after delivery and easy to become obese. If the fetus is large during delivery, it may result in birth injury. Malnutrition increases the risk of perinatal death, premature birth, or neonatal death⁹. Both “overnutrition” and “malnutrition” are not conducive to maternal and child health, so the

nutritional health management during pregnancy poses more challenges.

Nutrition during pregnancy is linked to maternal health, and maternal health is closely linked to fetal health. The formation and development of fetal body tissues and organs completely depend on the nutrition and health of the mother, and the dietary nutrition of pregnant women is the key.

Studies have manifested that folic acid deficiency during pregnancy is closely related to fetal neural

tube defects¹⁰. The dietary nutrition intake of pregnant women is unbalanced, and the intake of nutrient elements also varies with age and education level¹¹. The Dietary Guidelines for Chinese Residents (2021) issued by the Chinese Nutrition Society pointed out that due to unreasonable nutritional intake, the incidence of anemia among pregnant women in China is as high as 13.6%¹². Anemia occurs during pregnancy, resulting in insufficient oxygen and nutrients supplied by the placenta to meet the needs of fetal growth, which is easy to cause fetal growth retardation, fetal distress, premature birth or stillbirth. When anemia is severe, pregnant women have low resistance, uterine contractions are weak during delivery, causing hemorrhagic shock.

The results of this study suggest that personalized nutrition intervention during pregnancy could effectively improve the pregnancy outcome of pregnant women, which was similar to the results of existing studies¹³⁻¹⁵. This study also indicate that relative to the CG, the incidence of maternal anemia was lower in the IG that had dietary nutritional guidance. The reason may be that gestational women with iron deficiency anemia during pregnancy in the IG received iron supplement and dietary nutrition intervention, while the CG only received iron supplement, and dietary nutrition intervention was superior to iron supplement alone in treating iron deficiency anemia during pregnancy. Therefore, dietary nutrition guidance and intervention have vital roles in treating iron deficiency anemia during pregnancy. Pregnant women should receive personalized dietary nutrition guidance due to individual differences. Special interventions are needed to supplement some nutrients that cannot be obtained from food, so as to keep the body in a balanced state of nutrition¹⁶, thus adjusting the dietary plan and habits of pregnant women, achieving the purpose of improving the levels of blood sugar and blood lipids of pregnant women, and the intake of various nutrients. Thus, the risk of adverse pregnancy outcomes such as gestational diabetes, gestational hypertension, and gestational anemia can be reduced. On this basis, the appropriate suitable dietary guidance and nutrition management program during pregnancy are put forward, and the

dietary guidance during pregnancy has the value of promotion and application in clinical work.

Nutrition during pregnancy is related to the health of the offspring. There is a complex intergenerational inheritance between newborn health and mother, and this genetic relationship will also influence the health of the next generation of newborns¹⁷. The outcomes of this study exhibited that the incidence of macrosomia and low birth weight in newborns delivered by pregnant women in the IG presented lower than that in the CG, which was similar to other related research results¹⁸. Most studies have validated that the early implementation of medical nutrition intervention in early pregnancy can reduce the risk of gestational diabetes mellitus (GDM) in high risk groups of GDM in the middle and late pregnancy¹⁹. Excessive nutrition intake during pregnancy as well as excessive weight gain during pregnancy will increase the risk of GDM and the possibility of delivering macrosomia²⁰. Pregnant women with GDM may experience slow weight gain, no weight gain or even decrease in the short term under diet control, and too little weight gain during pregnancy will increase the risk of small for gestational age²¹. Excessive weight gain in GDM pregnant women will increase the utilization of insulin²², and also easily lead to dystocia, fetal distress, neonatal asphyxia and other adverse pregnancy outcomes²³. The occurrence of macrosomia may cause postpartum hemorrhage caused by damage to the birth canal during childbirth, and elevate the risk of puerperal infection.

Personalized nutritional dietary guidance helps pregnant women to take a variety of nutrients, promote a balanced diet, control the weight of pregnant women, and ensure that their weight and blood sugar levels are within a reasonable range, which not only reduces the occurrence of macrosomia, but also provides sufficient nutrition for the fetus, and will not affect the growth and development of the fetus, and also reduces the occurrence of low birth weight infants. In this survey, no significant differences were seen in the rates of cesarean section, postpartum hemorrhage, premature delivery and neonatal asphyxia between the two groups of pregnant women, indicating that personalized nutrition guidance can not only reduce

pregnancy complications and improve pregnancy outcomes, but also ensure the development of the fetus through the scientific adjustment of pregnant women's dietary structure, reasonable dietary guidance management for pregnant women, and helping pregnant women eat reasonably, but comprehensive interventions are needed to improve maternal pregnancy outcomes as a whole. Because of the limited data in this survey, the relationship between them could not be clarified, and further research is needed.

Study strengths and limitations

The strength of the study is that it was a randomized controlled clinical trial that included multiple measures related to nutritional status and neonatal status. Due to difficulty in recruitment, we had a smaller control group than treatment, reducing our power to detect between-group differences. Our sample was primarily from one hospital, thus limiting generality. Our study may provide a valuable nutritional guidance for pregnant women.

Conclusion

Pregnant women accept nutrition guidance during pregnancy and reasonable intake of nutrition can meet the nutritional needs of pregnant women and fetuses, improve pregnancy safety, improve delivery and newborn conditions, reduce pregnancy complications, and improve pregnant women's satisfaction.

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Contribution of authors

Yu MM, Chen HY and Li N: conceived and designed the study, collected and analysed the data, and prepared the manuscript. All authors mentioned in the article approved the manuscript.

References

1. Crider K, Williams J, Qi YP, Gutman J, Yeung L, Mai C, Finkelstein J, Mehta S, Pons-Duran C, Menéndez C, Moraleda C, Rogers L, Daniels K and Green P. Folic acid supplementation and malaria susceptibility and severity among people taking antifolate antimalarial drugs in endemic areas. *Cochrane Database Syst Rev.* 2022; 2(2022)
2. da Silva Lopes K, Yamaji N, Rahman MO, Suto M, Takemoto Y, Garcia-Casal MN and Ota E. Nutrition-specific interventions for preventing and controlling anaemia throughout the life cycle: an overview of systematic reviews. *Cochrane Database Syst Rev.* 2021; 9(9):Cd013092.
3. Wikoff D, Welsh BT, Henderson R, Brorby GP, Britt J, Myers E, Goldberger J, Lieberman HR, O'Brien C, Peck J, Tenenbein M, Weaver C, Harvey S, Urban J and Doepker C. Systematic review of the potential adverse effects of caffeine consumption in healthy adults, pregnant women, adolescents, and children. *Food Chem Toxicol.* 2017; 109(Pt 1):585-648.
4. Nevins JEH, Donovan SM, Snetselaar L, Dewey KG, Novotny R, Stang J, Taveras EM, Kleinman RE, Bailey RL, Raghavan R, Scinto-Madonich SR, Venkatramanan S, Butera G, Terry N, Altman J, Adler M, Obbagy JE, Stoody EE and de Jesus J. Omega-3 Fatty Acid Dietary Supplements Consumed During Pregnancy and Lactation and Child Neurodevelopment: A Systematic Review. *J Nutr.* 2021; 151(11):3483-3494.
5. Faria APV, da Silva TPR, Duarte CK, Mendes LL, Santos FBO and Matozinhos FP. Tetanus vaccination in pregnant women: a systematic review and meta-analysis of the global literature. *Public Health.* 2021; 196:43-51.
6. Simon A, Pratt M, Hutton B, Skidmore B, Fakhraei R, Rybak N, Corsi DJ, Walker M, Velez MP, Smith GN and Gaudet LM. Guidelines for the management of pregnant women with obesity: A systematic review. *Obes Rev.* 2020; 21(3):e12972.
7. Motamed S, Nikooyeh B, Anari R, Motamed S, Mokhtari Z and Neyestani T. The effect of vitamin D supplementation on oxidative stress and inflammatory biomarkers in pregnant women: a systematic review and meta-analysis of clinical trials. *BMC Pregnancy Childbirth.* 2022; 22(1):816.
8. Martínez-Olcina M, Rubio-Arias JA, Reche-García C, Leyva-Vela B, Hernández-García M, Hernández-Morante JJ and Martínez-Rodríguez A. Eating Disorders in Pregnant and Breastfeeding Women: A Systematic Review. *Medicina (Kaunas).* 2020; 56(7)
9. Dingena CF, Arofikina D, Campbell MD, Holmes MJ, Scott EM and Zulyniak MA. Nutritional and Exercise-Focused Lifestyle Interventions and

- Glycemic Control in Women with Diabetes in Pregnancy: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. *Nutrients*. 2023; 15(2)
10. Peña-Rosas JP, Mithra P, Unnikrishnan B, Kumar N, De-Regil LM, Nair NS, Garcia-Casal MN and Solon JA. Fortification of rice with vitamins and minerals for addressing micronutrient malnutrition. *Cochrane Database Syst Rev*. 2019; 2019(10)
 11. East CE, Biro MA, Fredericks S and Lau R. Support during pregnancy for women at increased risk of low birthweight babies. *Cochrane Database Syst Rev*. 2019; 4(4):Cd000198.
 12. Campbell F, Booth A, Carroll C, Lee A and Relton C. Qualitative evidence syntheses of attitudes and preferences to inform guidelines on infant feeding in the context of Ebola Virus Disease (EVD) transmission risk. *PLoS Negl Trop Dis*. 2022; 16(3):e0010080.
 13. Raghavan R, Dreifelbis C, Kingshipp BL, Wong YP, Abrams B, Gernand AD, Rasmussen KM, Siega-Riz AM, Stang J, Casavale KO, Spahn JM and Stooey EE. Dietary patterns before and during pregnancy and maternal outcomes: a systematic review. *Am J Clin Nutr*. 2019; 109(Suppl_7):705s-728s.
 14. Harding KB, Peña-Rosas JP, Webster AC, Yap CM, Payne BA, Ota E and De-Regil LM. Iodine supplementation for women during the preconception, pregnancy and postpartum period. *Cochrane Database Syst Rev*. 2017; 3(3):Cd011761.
 15. Donovan S, Dewey K, Novotny R, Stang J, Taveras E, Kleinman R, Raghavan R, Nevins J, Scinto-Madonich S, Butera G, Terry N and Obbagy J. USDA Nutrition Evidence Systematic Reviews. *Maternal Diet during Pregnancy and Lactation and Risk of Child Food Allergies and Atopic Allergic Diseases: A Systematic Review*. USDA Nutrition Evidence Systematic Review; 2020.
 16. De-Regil LM, Palacios C, Ansary A, Kulier R and Peña-Rosas JP. Vitamin D supplementation for women during pregnancy. *Cochrane Database Syst Rev*. 2012; 2(2):Cd008873.
 17. Urgell-Lahuerta C, Carrillo-Álvarez E and Salinas-Roca B. Interventions on Food Security and Water Uses for Improving Nutritional Status of Pregnant Women and Children Younger Than Five Years in Low-Middle Income Countries: A Systematic Review. *Int J Environ Res Public Health*. 2021; 18(9)
 18. Dewidar O, John J, Baqar A, Madani MT, Saad A, Riddle A, Ota E, Kung'u JK, Arabi M, Raut MK, Klobodu SS, Rowe S, Hatchard J, Busch-Hallen J, Jalal C, Wuehler S and Welch V. Effectiveness of nutrition counseling for pregnant women in low- and middle-income countries to improve maternal and infant behavioral, nutritional, and health outcomes: A systematic review. *Campbell Syst Rev*. 2023; 19(4):e1361.
 19. Imanpour V, Khoshhali M, Goodarzi-Khoigani M and Kelishadi R. Systematic review and meta-analysis of nutritional interventions to prevent of gestational hypertension or/and preeclampsia among healthy pregnant women. *J Res Med Sci*. 2023; 28:25.
 20. Riggs E, Kilpatrick N, Slack-Smith L, Chadwick B, Yelland J, Muthu MS and Gomersall JC. Interventions with pregnant women, new mothers and other primary caregivers for preventing early childhood caries. *Cochrane Database Syst Rev*. 2019; 2019(11)
 21. Aoyama T, Li D and Bay JL. Weight Gain and Nutrition during Pregnancy: An Analysis of Clinical Practice Guidelines in the Asia-Pacific Region. *Nutrients*. 2022; 14(6)
 22. Demétrio F, Teles CAS, Santos DBD and Pereira M. Food insecurity in pregnant women is associated with social determinants and nutritional outcomes: a systematic review and meta-analysis. *Cien Saude Colet*. 2020; 25(7):2663-2676.
 23. Zhang J, Li Q, Song Y, Fang L, Huang L and Sun Y. Nutritional factors for anemia in pregnancy: A systematic review with meta-analysis. *Front Public Health*. 2022; 10:1041136.