



## Study on Effects of Dietary Structure on the Incidence of Gestational Diabetes Mellitus and Macrosomia

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### Abstract

**Objective:** To explore the relationship between dietary structure and the incidence of gestational diabetes mellitus and macrosomia.

**Methods:** We collected the pregnant women's diet of the sixth People's Hospital affiliated to Shanghai Jiaotong University from 2017-08 to 2018-08. With the approval of the Ethics Committee of the Sixth People's Hospital affiliated to Shanghai Jiaotong University. The corresponding medical history and production information of pregnant women were obtained through the history system, and the relationship between diet structure and the incidence of pregnancy with diabetes and macrosomia was analyzed, and the direction of association was further explored. Try to find out the cause of pregnancy with diabetes from diet.

**Results:** A total of 93 pregnant women with elevated blood sugar (including new gestational diabetes mellitus and diabetes mellitus with pregnancy) and 21 newborns were diagnosed as macrosomia to analyze the relationship between diet and pregnancy with diabetes and macrosomia.

**Conclusion:** There is a definite association between the occurrence of diabetes mellitus and macrosomia in pregnancy and the diet structure of pregnant women. For the main food, it is recommended to eat more potato and not fried noodles with edible oil; for the protein, it is recommended to eat more high-quality protein such as vegetable protein and lean pork.

**Keywords:** Diet; Diabetes; Macrosomia; Protein

### Introduction

Pregnancy with diabetes is a relatively common complication during pregnancy, including diabetes with Pregnancy (PGDM) and Gestational Diabetes (GDM), the incidence is about 6-9% among pregnant women. Among them, GDM% or more PGDM, per cent GDM most of the patients' glucose metabolism returned to normal after delivery, but the chance of type 2 diabetes will increase in the future [1]. Pregnancy and diabetes are harmful to both mothers and children, one of the most important complications is giant, Giant babies add to a range of pregnancy and childbirth risks and attention needs to be paid. During pregnancy due to estrogen, progesterone and placental lactogen, B cell proliferation, hypertrophy and hypersecretion of islets, Increased insulin secretion, Insulin in the blood circulation also increased, Causes the pregnant woman blood sugar to be slightly lower than the non-pregnant woman [2]. The increase of insulin content in blood was higher than that in non-pregnant women after intravenous glucose injection, and the decrease of blood glucose after insulin injection was not as effective as that in non-pregnant women, which indicated that the islet B cells were active and secreted. On the other hand, insulin requirement increased during pregnancy [3]. There are many hypotheses for the pathogenesis of gestational diabetes mellitus, including genetic factors, insulin resistance, abnormal fat factors and inflammatory factors. It is well known that improper eating habits can lead to obesity, and obesity is a high risk factor for diabetes. According to long-term clinical practice, diet control is an effective control method for pregnancy complicated with diabetes. We suspect that dietary structure also has a certain effect on the incidence of gestational diabetes mellitus (including diabetes mellitus complicated with pregnancy and gestational diabetes) [4]. The literature points out those foods such as red meat, eggs, sea fish and so on are the main sources of methylamine in the diet. Methylamine can produce trimethylamine oxide through a series of reactions, while circulating trimethylamine oxide can increase the risk of type 2 diabetes and cardiovascular disease [5]. In addition,

some studies have pointed out that diet can affect the occurrence of diabetes by changing intestinal flora in a study by Ilario Ferrocino, et al. [6]. 41 GDM pregnant women, under the guidance of dietitians, performed dietary structure regulation and intestinal flora assessment, and found that patients following dietary recommendations showed better metabolic and nutritional structure and the number of Simi bacterium associated with high-fat diet also significantly reduced [7]. In this study, we collected pregnant women's pregnancy recipes from 2017-08 to 2018-08 at the sixth people's Hospital affiliated to Shanghai Jiaotong University. Try to explore the diet of pregnancy with diabetes.

### Methods

With the approval of the Ethics Committee of the sixth people's Hospital affiliated to Shanghai Jiaotong University, the pregnancy recipes of pregnant women with obstetrical women's pregnancy recipes from 2017-08 to 2018-08 at the sixth people's Hospital affiliated to Shanghai Jiaotong University to analyze the relationship between diet structure and pregnancy with diabetes and macrosomia, and to explore the causes of pregnancy with diabetes.

Statistical methods: using SPSS software version 22.0 to analyze the data, using t test to analyze the difference between the two groups,

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rank test to analyze the difference between multiple groups, square table chi-square test to analyze the correlation between the distributions between the two groups.

## Results

A total of 397 cases were enrolled in the study between 2017-08 and 2018-08, and the subsequent delivery of pregnant women at the Sixth People's Hospital, There were 93 pregnant women diagnosed with gestational diabetes (including GDM and PGDM), 21 newborns diagnosed as macrosomia, There were 9 diabetes-related macrosomia, There were 12 macrosomia unrelated to diabetes. As can be seen from Table 1, There was no significant difference in the mode of delivery, neonatal score and postpartum hemorrhage in women with diabetes, Obesity is a high risk factor for pregnancy with diabetes and macrosomia, Low family income is a high risk factor for large children, And the less educated, The greater the risk of pregnancy with diabetes and macrosomia (no statistical difference).

The relationship between diet and gestational diabetes mellitus and macrosomia, as well as the level of blood glucose during pregnancy, was analyzed as follows: 1. Staple food: potato food can reduce blood sugar for 2 hours, fried pasta can significantly increase low density lipoprotein and cholesterol, edible oil fried noodles intake more than 42 per week, low density lipoprotein level increased 0.12 mmol/L, cholesterol increased 0.12 mmol/L; 2. Proteins: Fatty fish, other fish raise blood sugar in pregnant women, tofu can reduce triglycerides, negative correlation with the occurrence of macrosomia, consumption of pork is

negatively correlated with the level of blood sugar 2 hours after meal ; 3. Vegetables: the amount of vegetables consumed is positively correlated with the level of blood sugar 1 hour after meal, indicating that even vegetables need to be eaten properly; 4. drinks: Juice, yogurt can lower blood sugar, Other drinks raise LDL and cholesterol, Average absolute value of LDL increased by 0.21 mmol/L, in pregnant women who drank other beverages mmol/L.0.33 increase in cholesterol 5. oil: soybean oil, animal oil is a better choice, Eating soy oil can reduce the incidence of pregnancy and diabetes, Eating animal oil can reduce the incidence of macrosomia; 6. eggs are generally overfed, Can raise triglyceride and blood sugar levels, The amount of eggs eaten is more than 30 per month (1 per day), An increase of 0.33 mmol/L, in absolute value of triglyceride An increase of 0.13 mmol/L, in fasting blood glucose Blood glucose increased 0.38 mmol/L,1 hour Excessive consumption of eggs is the cause of pregnancy with diabetes and macrosomia diet; 7. Social factors: obesity is an important risk factor for pregnancy with diabetes, Old age is also a risk factor for pregnancy and diabetes, the low-income and low-educated population is the high-risk group of giant children.

## Discussion

There is a general consensus that obesity and old age are high risk factors for pregnancy with diabetes, both PGDM and GDM. In this study, a similar conclusion was drawn that obesity is an important risk factor for pregnancy with diabetes and macrosomia, and old age is also a risk factor for pregnancy with diabetes. Studies have shown that pregnant women with diabetes have an increased risk of later

Table 1: Baseline information of pregnant women.

Variables	Gestational Diabetes Mellitus			Fetal Macrosomia		
	Yes	No	P value	Yes	No	P value
Age			0.000			0.653
≥ 35 years old	16	12	-	2	26	-
<35 years old	77	291	-	19	349	-
BMI	27.70	26.49	0.002	28.22	26.69	0.041
Educational level			0.234	-	-	0.315
Primary school and below	1	0	-	0	1	-
Junior high school	4	30	-	2	32	-
Senior high school, technical secondary school	14	48	-	7	55	-
Junior college	19	67	-	4	82	-
Undergraduate	44	122	-	7	159	-
Master and above	11	36	-	1	46	-
Per capita household income	-	-	0.365	-	-	0.000
1K below	0	2	-	1	1	-
1 K-3 K	1	3	-	0	4	-
3 K-5 K	6	41	-	3	44	-
5 K-8 K	21	72	-	6	87	-
8 K-10 K	28	69	-	6	91	-
More than 10 K	35	99	-	5	129	-
Delivery mode	-	-	0.481	-	-	0.144
Eutocia	45	172	-	8	209	-
Forceps Delivery	3	10	-	1	12	-
Elective cesarean section	22	64	-	4	82	-
Emergency cesarean section	21	47	-	8	60	-
Neonatal weight	3257	3178	0.283	4126	3142	0.000
Neonatal score	-	-	0.311	-	-	1.000
10 points	88	272	-	20	340	-
<10 points	3	19	-	1	21	-
Postpartum blood loss	352	358	0.781	387	352	0.353

hypertension in addition to the risk of macrosomia [8]. Pregnancy with diabetes may also cause amniotic fluid excess, which may lead to premature delivery. In addition, pregnancy with diabetes may also be accompanied by fetal malformation, hyperbilirubinemia, hypocalcemia and neonatal respiratory distress. In recent years, the number of elderly and obese pregnant women has increased significantly with the opening of the second child.

From the results of this study, the pregnant women of staple food should add coarse grain reasonably. Although potato food is also starch food, it contains more cellulose and can increase satiety. Raising blood sugar speed is not as fast as refined grain, is one of the suitable staple foods to control blood sugar. And fried pasta because of high fat, can increase blood lipid level, can be reasonably explained, but also should be avoided during pregnancy [9]. For the protein class, the fat of the fat fish is relatively high, can raise the blood sugar level, increase the risk of diabetes, so the pregnancy fat fish is not a high quality protein choice, and lean red meat, bean products and so on can reduce blood sugar and blood lipids, it is a high quality protein source during pregnancy. For drinks, juice, yogurt can reduce blood sugar levels, but other drinks (such as cola) can increase blood lipid levels, do not recommend drinking [10].

For the choice of edible oil, studies show that soybean oil, animal oil is a better choice, soybean oil can reduce the incidence of pregnancy with diabetes, animal oil can reduce the incidence of macrosomia. The more controversial is the consumption of vegetables and eggs. This study shows that the consumption of vegetables is positively correlated with the level of blood sugar in 1 hour after meal, indicating that even vegetables, too much consumption will increase the value of blood sugar and need to be eaten in moderation. Excessive consumption of eggs (more than 1 per day) can significantly increase blood lipid levels, and hyperlipidemia can cause a series of complications, such as acute fatty liver during pregnancy, coagulation disorders, etc [11]. Moderate amount of the most important, diet attention to a small number of meals, according to the situation timely addition and subtraction.

As for the causes of dietary nutrition affecting diabetes, previous studies have pointed out that intestinal microecology may play a great role. Intestinal microecology during pregnancy is affected by many factors, such as age, heredity, dietary structure, BMI and so on. Oluf Pedersen team's studies have shown that the intestinal flora of pregnant women with gestational diabetes mellitus is abnormal at many levels, including phylum and genus, compared with pregnant women with normal blood sugar, actinomycetes and Collins. Roche and Vibrio delithi are abundant in pregnant women with gestational diabetes in the Wei Zheng et al. study. They evaluated the dynamic changes of intestinal microecology in 141 pregnant women from the first three months to the middle three months [12]. They found significant differences in intestinal microecology GDM pregnant women and normal control pregnant women as gestational weeks progressed, as evidenced by a continuous downward trend fecal coccus and streptococcus in pregnant women [13].

As for the mechanism of intestinal microecology affecting metabolism, there are several possible reasons: (1) changes in intestinal flora lead to changes in specific hormones such as insulin, gastric inhibitory peptides and adipokines, which lead to metabolic disorders; (2) disruption of the homeostasis between intestinal microbes and the immune system, which may lead to intestinal bacterial endotoxin entering the systemic circulation, leading to "metabolic endotoxemia", systemic inflammatory response and insulin resistance [14]; (3) Changes in short-chain fatty acids caused by intestinal dysbacteriosis, followed by a series of signal transduction pathways, lead to low-grade

intestinal inflammatory response, dyskinesia and increased intestinal mucosal permeability, which ultimately affect maternal and fetal energy metabolism [15].

There are some social factors in the occurrence of pregnancy with diabetes and macrosomia, and the low-income and low-educated population is the high-risk population of macrosomia. For a long time, it has been widely believed that nutrition should be strengthened during pregnancy, which reduces the intrauterine growth restriction caused by malnutrition, but as a result, many pregnant women overeat during pregnancy and gain significant weight, resulting in obesity, diabetes and so on. The risk of macrosomia also increases. The results of this study show that with the deepening of pregnancy education, some pregnant women with higher education level and better medical compliance have the concept of weight control, the weight of pregnancy is increased reasonably, and the size of fetus is controlled within a reasonable range. However, in the low-educated and low-income population, due to the neglect of pregnancy care and some relatively backward ideas, a considerable proportion of pregnant women still do not pay attention to the control of calorie intake during pregnancy, resulting in obesity, diabetes, macrosomia and other complications, which greatly increases the risk of mother and fetus. This shows that diabetes is no longer a "rich disease", it is necessary to further improve the coverage of pregnancy supervision, especially to increase the attention and education of low-income and low-educated people, to strive not to ignore any pregnant mother, not to miss any high-risk pregnancy, and to make women's health care, especially during pregnancy, as comprehensive and in-depth as possible.

## Conclusion

The occurrence of gestational diabetes mellitus and macrosomia has a definite relationship with the diet structure of pregnant women. For staple foods, it is recommended to eat more potato and not fried noodles for edible oil; for proteins, it is recommended to eat more high-quality proteins such as vegetable protein and lean red meat. Poly fat fish are rich in protein, easy to digest, but have a high fat content and a small amount of consumption; vegetables should be consumed moderately and excessive consumption will also increase blood sugar; beverages should be recommended to drink juice and yogurt, not other beverages; soybean oil, animal oil is a better choice of edible oil; eggs should be moderate, cannot be eaten from more than 1 per day. There are also important social factors in the occurrence of gestational diabetes mellitus and macrosomia. Obesity and old age are all high risk factors, while low-income and low-educated people are high-risk groups of macrosomia.

## Ethics Approval and Consent to Participate

The ethic approval was obtained from the Ethic Committee of Sixth People's Hospital Affiliated to Shanghai Jiaotong University.

## Consent to Publish

All of the authors have consented to publish this research.

## Availability of Data and Materials

The data are free access to available upon request.

## Competing Interests

All authors declare no conflict of interest.

## Funding

None.

## Authors' Contributions

Each author has made an important scientific contribution to the study and has assisted with the drafting or revising of the manuscript.

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