

Investigation on Dietary Behavior Changes in 658 Pregnant Women Before and During Pregnancy in China

QingWen Wang

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

XiaoQI Cao

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

Miao Tian

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

ZhiHong Li

Department of Obstetrics and Gynecology, Taihang Hospital

CaiXia Guo

Department of Obstetrics and Gynecology, Taihang Hospital

XinYu Cao

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

YiChuan Zhang

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

WenLin Bai

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

Li Wang (✉ wangli_1@sxmu.edu.cn)

Department of Child and Adolescent Health, School of Public Health, Shanxi Medical University.

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Abstract

Background The extra dietary care women receive after pregnancy, coupled with the effect of their own physiological response during pregnancy, can cause some changes in their dietary habits compared with those before pregnancy. Current studies have mostly focused on detailed foods and specific dietary patterns; less attention has been given to changes in food flavor, cooking methods, and meal frequency before and after pregnancy. This study aimed to investigate these changes in pregnant women in TaiYuan City, China and analyze some possible related factors.

Methods A total of 658 pregnant women were asked about their frequency of daily meals, choice of eating at home or out, personal preference for different tastes (salty, spicy, and sweet), cooking methods (frying, braising, sautéing, steaming, and stewing), specific food choices, and other changes in dietary habits before and after pregnancy through a questionnaire. SPSS 24.0 was used for all data statistical analyses. $P < 0.05$ was considered statistically significant.

Results The choice of salty, spicy, and sweet tastes changed, and the proportion of women who chose lighter flavors after pregnancy increased ($P < 0.001$). A positive correlation was found between the choice of lighter salty taste and parity ($r = 0.142$, $P = 0.035$), that is, pregnant women with more parity were likely to choose a lighter salty taste after pregnancy. By contrast, a negative correlation was found between the choice of lighter spicy taste and age ($r = -0.115$, $P = 0.048$), implying that younger pregnant women were likely to choose a lighter spicy taste after pregnancy. In the traditional Chinese cooking methods, compared with pre-pregnancy, the number of pregnant women who chose frying, braising, and sautéing decreased, whereas that of steaming and stewing increased ($P < 0.001$). Compared with pre-pregnancy, the number of meals every day of pregnant women increased (from 2.85 to 3.09) ($P < 0.001$), and the frequency of eating at home every week increased (from 4.82 to 5.52) ($P < 0.001$).

Conclusion Overall differences were found in the eating habits of 658 pregnant women before and after pregnancy. Pregnant women with more parity were likely to choose a lighter salty taste, and younger pregnant women were likely to choose a lighter spicy taste.

Background

Since the full implementation of China's Two-Child Policy in 2016, many one-child families have joined the queue to prepare for the birth of a child once again^[1]. With the improvement of people's economic income and living standard in recent years, Chinese women generally have higher requirements on their diet during pregnancy. We often focus on the changes in women's eating habits after pregnancy, including the frequency of daily meals, the choice of eating at home or out, preferences for various flavors, cooking methods, and the choice of specific foods. Traditional Chinese families often attach great importance to the diet of pregnant women. The extra dietary care women receive after pregnancy, coupled with the effect of their own physiological response during pregnancy, can cause some changes in eating habits compared with those before pregnancy^[2,3]. Studies have shown that many pregnancy

complications and adverse birth outcomes are related to poor dietary habits, including gestational diabetes and gestational hypertension [4,5].

We have been keen to obtain more basis for nutrition education during pregnancy and some supporting information about the causes of pregnancy complications from the aforementioned changes in women during pregnancy. Recent studies in many western countries have focused on the relationship between dietary patterns during pregnancy and birth outcomes [6]. However, few studies have been conducted on the relationship between dietary patterns during pregnancy and the incidence of adverse outcomes in Asia, particularly in China [7,8]. Moreover, most of these studies have focused on detailed foods and specific dietary patterns; less attention has been given to changes in food flavor, cooking methods, and meal frequency before and after pregnancy.

Studies have shown that the source of nutrients present in the amniotic fluid is from the diet of the mother; early taste stimulation in utero may influence food taste choices for a period of time after birth [9]. Emergence of some cardiovascular disease and obesity problems in adulthood are associated with daily food taste preferences [10-11]. Ensuring that the fetal taste stimulation is positive and healthy through the reasonable selection of taste during pregnancy, to a certain extent, can promote the normal and healthy development of dietary taste. Chinese traditional cooking methods, including sautéing, frying, braising, steaming, and stewing, are relatively varied. Different cooking methods have diverse degrees of retention and utilization of nutrients in food. Steaming can ensure retention of proteins and minerals, but easily cause vitamin loss. Stewing is more likely to lose vitamins and minerals, but slow stewing can keep the protein inside the food. Quick sautéing preserves the nutritional value of most nutrients [12-15]. Meanwhile, the long-term health risks of eating fried foods should not be underestimated [16], particularly for pregnant women. Thus, while paying close attention to food preferences of pregnant women, we also need to observe their cooking choices. Research on meal frequency is limited [17]. However, irregular dietary frequency appears to be associated with a number of cardiovascular disease risk factors (including insulin resistance and higher fasting lipids) [18]. Recently, researchers have added eating frequency during pregnancy to studies of dietary patterns and found that regular eating may be one of the most effective approaches to avoid preterm birth [6]. In this study, we observe the changes in the average daily meal frequency of pregnant women compared with before pregnancy, too.

To sum up, the study of pregnant women's changes during pregnancy and related influencing factors can help us to understand the current nutritional situation during pregnancy more comprehensively and provide scientific basis for formulating individualized nutrition advice during pregnancy. The aim of this study was to investigate diet habit changes, including food flavor, cooking methods, and meal frequency, in pregnant women in TaiYuan, a north city in China, and analyze some possible influencing factors.

Methods

1. Study design and population

Under the principle of informed and voluntary consent, we selected 658 single tier pregnant women who came to TaiHang Hospital for the first time to obtain their health care pregnancy manual and antenatal care. This study used the same inclusion and exclusion criteria as the study we previously published [19]. Pregnant women who met the inclusion criteria had a gestational age of less than 28 weeks and normal expression and comprehension abilities. The exclusion criteria were mental disorder, chronic hypertension during pre-pregnancy, chronic diabetes during pre-pregnancy, gestational hypertension, and gestational diabetes. This study was approved by the ethics committee of Shanxi Medical University (2019LL118), and all participants provided written consent.

The age of the subjects ranged from 18 to 39 years, with an average age of 28.44 years and a mean body mass index (BMI) of 21.45 kg/m² (Table 1).

1.2 Survey methods and contents

While the pregnant women were waiting at the outpatient clinic, a questionnaire survey (supplementary file 1) was given to them by uniformly trained investigators. The questionnaire was mainly composed of the following:

1. General information (age, pre-pregnancy BMI, parity and abortion history, educational experience, etc.). The BMI of the pregnant women was divided into three groups according to the World Health Organization standards, namely, underweight, BMI < 18.5 kg/m²; normal range, BMI between 18.5 and 24.9 kg/m²; and overweight and obese, BMI > 25 kg/m².
2. Pre-pregnancy and during pregnancy diet habits (frequency of meals per day, number of days eating at home per week, preference for food, cooking methods, and degree of acceptance for salty, spicy, and sweet flavors). The preference degree of each taste was divided into four grades: "very strong", "strong", "medium" and "light" with values of 4, 3, 2, and 1, respectively. Pregnant women chose according to their daily subjective preferences when filling in the questionnaire. The pre-pregnancy taste selection score was subtracted from the pregnancy score. The resulting value > 0 was denoted by 1, indicating that the change in taste tended to the stronger degree in pregnancy. The value < 0 was denoted by -1, indicating that the change in taste tended to the light degree. When the value obtained was 0, the taste preference had not changed. The more the absolute value of the difference, the more the degree of taste change.

1.3 Statistical analysis

All questionnaire information was input using Epidata 3.1. Statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS), version 24.0 (SPSS, Inc., Chicago, IL, USA). Quantitative variables are expressed as $\pm s$. Mann-Whitney U rank test was used to analyze the differences in daily meals and cooking methods before and after pregnancy. Furthermore, associations between each indicator of the characteristics were analyzed using Spearman's correlation analysis. A *P*-value < 0.05 was considered statistically significant.

Table 1 General demographic characteristics of pregnant women

Variable name	n(%)	Variable name	n(%)
Age*/year		Parity*	
<25	68(10.3)	0	434(66.9)
25~29	355(54.0)	1	201(31.0)
30~34	184(28.0)	≥2	14(2.1)
≥35	38(5.8)		
BMI of Pre-pregnancy/kg/m ² *		Times of abortion*	
<18.5	88(13.5)	0	492(77.0)
18.5≤BMI<24.9	490(75.2)	1	103(16.1)
BMI≥25	74(11.3)	2	37(5.8)
Degree of education*		≥3	7(1.1)
Junior high school degree or below	38(6.4)		
Senior high and technical secondary	93(15.6)		
Junior college	221(37.0)		
Bachelor degree or above	245(41.0)		

Note: There are missing values under the “*” variable

Results

2.1 Brief description of dietary changes during pregnancy

About 51.0% pregnant women (321) indicated some changes in dietary habit, and 290 pregnant women specifically described changes in eating behavior. Among them, 31.7% (101) indicated some changes in the daily preference of certain foods after pregnancy, 74 (23.2%) indicated a decrease in appetite (or food intake) after pregnancy compared with before pregnancy, and 22 (6.9%) indicated an increase in appetite (or food intake) after pregnancy. Fifty-four women (16.9%) preferred a lighter diet after pregnancy. Thirty-nine women (12.2%) reported a change in their preference for sour or spicy flavor since pregnancy. In addition, 29 women (9.1%) described other changes, including descriptions of other inconvenient categories such as certain food restrictions.

2.2 Changes in taste preference pre-pregnancy and during pregnancy

In general, the proportion of people who chose “medium” degree of taste before and after pregnancy was the highest, accounting nearly or more than 50%. After pregnancy, 41.0%, 54.8%, and 34.0% of the women changed their preference for salty, spicy, and sweet tastes, respectively. Among them, the salty, spicy, and sweet tastes tended to be stronger, accounting for 7.5%, 8.7%, and 9.9%, respectively, and lighter, accounting for 33.4%, 46.1%, and 24.2%, respectively.

Mann-Whitney U rank test showed a statistically significant difference in the overall distribution of the intake preference of salty, spicy, and sweet flavors after pregnancy ($P < 0.001$) (Table 2). The percentage of women who chose lighter salty, lighter sweet, and lighter spicy tastes after pregnancy was higher than that before pregnancy.

Table 2 Comparison of food taste preferences pre-pregnancy and during pregnancy

Flavor	Stage	Degree of taste preference				Z	P
		Very strong	Strong	Medium	Light		
Salty	pre-pregnancy	7(1.1)	165(25.3)	376(57.7)	104(16.0)	-7.875	0.001
	pregnancy	5(0.8)	88(13.5)	344(52.8)	215(33.0)		
Spicy	pre-pregnancy	24(3.7)	224(34.4)	303(46.5)	100(15.4)	-11.361	0.001
	pregnancy	6(0.9)	91(14.0)	308(47.2)	247(37.9)		
Sweet	pre-pregnancy	7(1.1)	101(15.5)	343(52.8)	199(30.6)	-4.118	0.001
	pregnancy	5(0.8)	72(11.1)	307(47.2)	267(41.0)		

Spearman correlation analysis was also used to analyze the maternal characteristics that may be related to taste changes after pregnancy. We found a positive correlation between the choice of salty taste to lighter and parity ($r = 0.142$, $P = 0.035$), that is, pregnant women with more parity were likely to choose a lighter salty taste after pregnancy. By contrast, a negative correlation was found between the choice of spicy taste to lighter and age ($r = -0.115$, $P = 0.048$). This finding implies that younger pregnant women were likely to choose a lighter spicy taste after pregnancy (Table 3).

Table 3 R value of Spearman correlation analysis between maternal characteristics and selection of cooking methods during pregnancy

	Frying	Braising	Sautéing	Steaming	Stewing
Maternal age	-0.139 ^a	-0.064	0.049	0.008	0.052
Degree of education	-0.044	-0.006	0.047	0.042	0.116 ^a
Parity	-0.080 ^a	-0.012	-0.001	-0.043	0.001
BMI	-0.012	0.038	-0.001	-0.041	-0.023

Note: a: There are statistically significant ($P < 0.05$).

2.3 Choices of cooking methods pre-pregnancy and during pregnancy

According to the results of Mann-Whitney U rank test, on the whole, pregnant women's choices of five cooking methods were different between pre-pregnancy and during pregnancy. The top three cooking methods before pregnancy were sautéing, stewing, and braising; however, after pregnancy, the top methods were mainly sautéing, stewing, and steaming. Since pregnancy, the number of people who chose frying, braising, and sautéing was less than before pregnancy, whereas the number of those who chose steaming and stewing was more than before pregnancy. All the differences were statistically significant ($P < 0.001$) (Table 4).

Table 4 Comparison of cooking methods pre-pregnancy and during pregnancy n(%)

Cooking methods Items	Frying	Braising	Sautéing	Steaming	Stewing
pre-pregnancy	81(12.4)	90(13.8)	581(89.2)	91(14.0)	359(55.2)
pregnancy	18(2.8)	34(5.2)	488(74.9)	185(28.5)	441(68.0)
Z	-6.577	-5.276	-6.734	-6.386	-4.711
P	∞0.001	∞0.001	∞0.001	∞0.001	∞0.001

Spearman correlation analysis was performed to assess the relationship between the choice of cooking methods after pregnancy with age, educational level, parity, and abortion times (Table 5). A negative correlation was found between age and parity and the choice of frying method after pregnancy ($r = -0.139$, $P < 0.001$; $r = -0.080$, $P = 0.044$). This indicates that younger and pregnant women with less parity were more likely to choose the frying method after pregnancy. A positive correlation was noted between maternal education level and the choice of stewing method after pregnancy ($r = 0.116$, $P = 0.005$). This indicates that pregnant women with higher education level were more likely to choose the stewing method than those with lower education level.

Table 5 R value of Spearman correlation analysis between maternal characteristics and selection of cooking methods during pregnancy

	Frying	Braising	Sautéing	Steaming	Stewing
Maternal age	-0.139 ^a	-0.064	0.049	0.008	0.052
Degree of education	-0.044	-0.006	0.047	0.042	0.116 ^a
Parity	-0.080 ^a	-0.012	-0.001	-0.043	0.001
BMI	-0.012	0.038	-0.001	-0.041	-0.023

Note: a: There are statistically significant ($P < 0.05$).

2.4 Changes in the number of meals per day and the dining location

Results of Mann-Whitney U rank test showed that the average number of daily meals after pregnancy was more than that before pregnancy ($Z = -9.151, P < 0.001$). Similarly, the average number of days eating at home per week also increased after pregnancy compared with that pre-pregnancy ($Z = -4.896, P < 0.001$) (Table 6).

Table 6 Comparison of average daily meals and days of eating at home pre-pregnancy and during pregnancy

		n	± s	Z	P
Number of meals per day	pre-pregnancy	639	2.85±0.46	-9.151	0.001
	pregnancy	636	3.09±0.72		
Days eating at home per week	pre-pregnancy	633	4.82±2.50	-4.896	0.001
	pregnancy	634	5.52±2.16		

Discussion

We found that the number of meals per day and days eating at home per week had increased since pregnancy. Combined with the written description of the pregnant women, some women had taken the initiative to add meals daily since pregnancy. This makes sense to increase the energy intake during pregnancy to meet essential vitamin and mineral requirements. In addition, the dietary principle of small and multiple meals is recommended by the Chinese Nutrition Society to supplement the necessary food intake and carbohydrates for early pregnancy population^[25], which is necessary for early morning sickness and weight control throughout the pregnancy.

Eating out too often also contributes to irrational weight gain during pregnancy [26]. Depending on the environment, cooking style, ingredients, and other factors, eating out can lead to different amounts of certain nutrients than eating at home. A study found that people eat far less fresh fruit and vegetables when eating out than eating at home, but much more fish, meat, desserts, beverages, coffee, and alcohol [27]. Our results also suggest that home diners usually tend to use light condiments. These may be the main cause of obesity in people who prefer to eat out for a long time. Overall, the number of days pregnant women eating at home were more than they did before pregnancy, but there were still 20.8% who ate at home less than 4 days a week. In addition to job needs, the phenomenon of eating out may also be related to personal taste and lifestyle habits. Therefore, our future research will focus on the comparison between the types and intakes of food eaten at home and out during pregnancy, and provide more reasonable suggestions for better planning for weight gain during pregnancy.

In the survey of cooking methods, we found that the number of women who chose sautéing after pregnancy decreased, but this remained the preferred method of cooking for most mothers-to-be. Notably, the percentage of women who chose steaming and stewing had increased since pregnancy. Mainly choosing steaming and braising methods for light dietary requirements may cause a partial nutrient deficiency. To ensure that the value of each nutrient can be used to a greater extent, while choosing the appropriate cooking method, we also need to pay attention to scientific cooking methods. In addition, the choice of frying method changed from 12.4% before pregnancy to 2.8% after pregnancy. We also found that the younger the age, the more likely pregnant women chose such food. Fried food contains acrylamide and other toxic substances [16]. This suggests that we should pay special attention to the younger age groups when conducting nutrition survey and education for pregnant women.

The demands of a variety of nutrients in the body of pregnant women have changed compared with those pre-pregnancy. The changes in dietary habits during pregnancy are not only related to the intake and level of their own nutrients, but also to the nutrition and health status of the fetus in utero. We found that the changes in eating habits after pregnancy were common. Half of the pregnant women reported some changes in their eating habits, including food preference, appetite, meal frequency, taste selection, and so on. Analyzing these changes and possible influencing factors can aid in understanding the dietary nutritional status, as well as pregnancy complications and adverse birth outcomes of development mechanism.

This study has some limitations. First, it is a cross-sectional study. We systematically investigated and analyzed the dietary habits, tastes, and cooking methods of pregnant women who visited to a hospital in TaiYuan for examination. However, we did not analyze the association between the above changes after pregnancy and pregnancy complications and birth outcomes in the process of improving the follow-up work; we will conduct a correlation analysis in the future. Second, we collected pregnant women's information from only one hospital in TaiYuan. However, as it is a specialized hospital dominated by the department of obstetrics and gynecology, the pregnant women population covers each district of TaiYuan City. With the continuous follow-up work and increase in sample size, we will perform a more in-depth analysis of the influencing factors and related outcomes of dietary changes during pregnancy.

This study has also several strengths. We found the relationship between the parity of pregnant women and salt taste preference, which provides a new idea for the causes of some complications during pregnancy, also, provides a new theoretical basis for targeted pregnancy propaganda and education. This study describes the changes in dietary habits before and after pregnancy and includes multiple variables. To our knowledge, this study is the first to consider several traditional Chinese eating habits. It also provides the basis for developing and improving health and nutrition education for different pregnant women.

Conclusions

Overall differences were found in the eating habits of 658 pregnant women before and after pregnancy. Moreover, an overall shift to lighter tastes and cooking methods and an increase in the number of women who chose to eat at home were observed. Pregnant women with more parity were likely to choose a lighter salty taste, whereas younger pregnant women were likely to choose a lighter spicy taste. More effective nutrition education during pregnancy can be conducted according to the above dietary habits and age characteristics.

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of Shanxi Medical University (2019LL118), and all participants provided written consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon request.

Competing interests

All the authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest (such as personal or professional relationships, affiliations, knowledge, or beliefs) in the

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Authors' contributions

QW-W wrote the first draft, and LW helped to improve the manuscript; QW-W and LW participated in the design of the questionnaire. QW-W, XQ-C, MT, XY-C, YC-Z and WL-B completed data acquisition; ZH-L and CX-G provide a platform for the inclusion of sample population and supervise the collection of data. QW-W, XQ-C and MT collated the data. QW-W analyzed the data; All co-authors participated in data interpretation and paper writing; All co-authors provide feedback and approve the final version.

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