

# Analysis of Pregnancy Testing Index Results in Miyun District, Beijing from 2017 to 2021

**Keywords:** Early pregnancy; Pregnant women; Lipids; Blood glucose; Thyroid hormone levels

## Abstract

To understand the physical health of women during pregnancy in Beijing, the data of pregnant women who attended the obstetrics outpatient clinic of Miyun District Maternal and Child Health Hospital of Beijing from 2017 to 2020 were selected. The blood lipid indexes (the triglyceride (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C)), 75g oral glucose tolerance test (fasting plasma glucose, 1h plasma glucose, 2h plasma glucose) and thyroid hormones (thyroid stimulating hormone (TSH), free thyroxine (FT4), free triiodothyronine (FT3), total thyroxine (TT4), and total triiodothyronine (TT3)) of 11 parameters were analyzed. The levels of lipid and thyroid hormones in pregnant women, during 2017-2021, showed a general trend of decreasing and then reversing increase, and the difference was statistically significant ( $P < 0.0001$ ). Fasting blood glucose, 1h postprandial and 2h postprandial blood glucose showed a trend of chronological increase ( $P < 0.0001$ ). Except LDL-C, lipid index levels and fasting glucose, 1h postprandial and 2h postprandial glucose levels increased with age in pregnant women ( $P < 0.0001$ ). The opposite trend was observed for the indicators of thyroid function measurement. There were chronological differences in the abnormal rates of lipid index, OGTT, and thyroid hormones during pregnancy, but the trend was not significant. The abnormal rates of HDL-C, LDL-C were high. Lipid, blood glucose and thyroid hormone index in Miyun District of Beijing can better reflect the physical condition of pregnant women, and strengthening the indexes is of great value for eugenics and expected female health.

## Introduction

As the economic level in China continues to rise, the dietary habits of pregnant women have changed dramatically, leading to an increasing number of complications during pregnancy. In order to adapt to the needs of fetal growth and development during pregnancy, the hormones in pregnant women's bodies change accordingly, and all indicators of the body are prone to change. The level of progesterone and human placental prolactin increases with the prolongation of pregnancy, which leads to excessive lipolysis and reduced synthesis, resulting in physiological elevation of blood lipid level in pregnant women and a certain degree of elevated blood lipid level, but pathological elevation of blood lipid tends to induce a series of metabolic diseases [1]. After pregnancy, the thyroid gland is relatively active due to the dual regulation of hypothalamus-pituitary-thyroid axis and placenta-thyroid axis and its metabolism is enhanced accordingly, which may lead to hyperthyroidism and hypothyroidism [2]. At 24-28 weeks, the need for insulin of pregnant women reaches its peak. While the secreted insulin is not enough to maintain the normal level of glucose, it will cause metabolic disorders such as gestational hypertension, infection and ketoacidosis [3]. In order to understand the physical condition of pregnant women during pregnancy in Miyun District, this study collected data from pregnant women in obstetric clinics from 2017-2021, and the study is as follows.



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## Material & Methods

### Study Population

All pregnant women who attended the obstetrics department of Miyun District Maternal and Child Health Hospital in Beijing from January 2017 to December 2021 were selected. Exclusion criteria: pregnant women with diabetes mellitus or other severe metabolic diseases before pregnancy.

### Data collection

This study is a hospital-based multi-stage cross-sectional study. It collected the results of glucose tolerance test, lipid and thyroid function indexes from the investigated subjects through the hospital electronic information system. The study was reviewed and approved by the Ethics Committee of Miyun District Maternal and Child Health Hospital, Beijing, China.

### Research Methods

Based on the 9th edition of Obstetrics and Gynecology, the reference values of laboratory tests are used as the basis for judgment [4].

The reference ranges of OGTT: 24-28 weeks of pregnancy oral glucose tolerance test diagnostic criteria fasting blood glucose, 1h blood glucose, 2h blood glucose of 5.1, 10.0, 8.5 mmol/L, respectively.

The reference ranges of lipid indicators: TC, TG, HDL-C, LDL-C is 3.49-5.55mmol/L, 0.25-1.71mmol/L, 1.29-1.55mmol/L, and 2.07-3.10mmol/L, respectively.

The reference ranges of thyroid function indicators: TT3, TT4, FT3 measured by ECLIA method is 1.3-3.1nmol/L, 66-181nmol/L, 3.1-6.8pmol/L; TSH measured by Roche reagent is 0.05-5.17mIU/L, FT4 measured by Roche reagent is 12.91-22.35pmol/L from 2017 to 2019; afterwards it measured by Beckman reagent is 7.64-16.03pmol/L.

### Statistical Analysis

Continuous variables were expressed as mean  $\pm$  standard deviation, and categorical variables were expressed as rate ratio.

The Kruskal-Wallis test was used for comparison between years and age groups for each parameter, and the chi-square test was used to compare the differences in abnormal rates of maternal indicators between years. Statistical significance was defined as  $< 0.05$ . All statistical were performed using IBM SPSS Statistics for Windows version 26.0.

Results

Comparison of differences in parameters between year groups

Analysis of lipid indicators during pregnancy from 2017-2021 revealed that TC, TG, and LDL-C levels decreased year by year and began to reverse in 2019, while HDL-C levels showed an overall decreasing trend over time. Fasting blood glucose, 1h postprandial and 2h postprandial blood glucose was found to have the lowest levels in 2018, and then showed an increasing trend by years. FT4 and TSH levels showed an overall decreasing trend from 2017-2021, while TT3 and FT3 levels had chronological differences and had the highest in 2017, although the change trend was not obvious. The differences between year groups for all the above indicator values were statistically significant ( $P < 0.0001$ ), as shown in Table 1.

Comparison of differences in parameters between age groups

Table 2 revealed that TC, TG, and HDL-C values increased with age ( $P < 0.0001$ ). Blood glucose showed a continuous increasing trend ( $P < 0.0001$ ). Among the thyroid function indicators, TT4, FT3, and FT4 levels basically maintained a decreasing trend with age and were statistically different ( $P < 0.0001$ ). TT3 and TSH did not change significantly and remained the highest in 2017.

Comparison of parameter abnormality rates between year groups

HDL-C abnormality rate decreased year by year from 2017-2021, and the difference was statistically significant ( $P < 0.0001$ ). The trend of change in TC and TG abnormality rate was roughly the same, TC abnormality rate started to decrease in 2017, and the abnormality rate

reached the lowest value in 2018 then reversed. The TG abnormality rate climbed after the lowest in 2019. The trend of change in LDL-C abnormality rate was exactly the opposite of TG. The trend of fasting glucose, 1h glucose, and 2h glucose abnormality rate changes is roughly the same: it drops to the lowest in 2018, and then the abnormality rate climbs and exceeds the abnormality rate in 2017. TT3 and TT4 abnormality rates both decrease from 2017 to 2019, and show a small increase and then decrease in 2020, as shown in Table 3.

Discussion

The results of this study showed that the differences in lipid, glucose and thyroid hormone levels in early pregnancy were statistically significant ( $P < 0.0001$ ) in between 2017-2021. Except for LDL-C, other indicators were also statistically significant at different ages ( $P < 0.001$ ). Levels of TC, TG, HDL-C, LDL-C were lower than European pregnant women [5]. TC and TG levels were higher in early pregnancy than Zheng et al [6]. However, TC, TG, HDL-C, LDL-C were lower than the levels in Southern parts of China [7]. Thyroid hormones such as TSH, FT3 are higher than Chen Dan et al [8]; FT3, FT4 were higher than those in Xining [9]. TT3, TT4, FT3, FT4, TSH levels are higher than Guizhou [10]. This indicates that there are differences between the data from Beijing area and other areas, which may be related to the differences in economic culture, dietary habits, geographical location, and iodine nutrition status of the population.

According to age subgroups, serum lipid levels were found to be largely elevated in varying degrees. It may be due to the fact that aging hepatocytes reduce diet-induced apolipoprotein B synthesis with age, and some elderly women exhibit high cholesterol, triacylglycerol, high LDL levels, and clinical hyperlipidemia [11].

In this study, we found that blood glucose levels in Miyun District showed a trend of increasing with year and age. This trend may be due to over-nutrition in women during pregnancy due to excessive material intake and unreasonable diet structure.

Table 1: serum levels of lipid, glucose and thyroid hormones in pregnant women.

Year	Blood Lipid Index				Glucose Tolerance			ThyroidHormones				
	TC (mmol/L)	TG (mmol/L)	HDL-C (mmol/L)	LDL-C (mmol/L)	Fasting (mU/L)	1h (mU/L)	2h (mU/L)	TT3 (nmol/L)	TT4 (nmol/L)	FT3 (pmol/L)	FT4 (pmol/L)	TSH (mIU/L)
2017	4.89±0.93	1.76±1.00	1.84±0.33	2.25±0.72	4.72±0.48	7.81±1.77	6.63±1.41	2.49±0.56	146.64±28.37	5.14±0.90	16.00±2.71	2.12±2.07
2018	4.54±0.93	1.56±0.95	1.77±0.35	2.06±0.66	4.60±0.46	7.77±1.78	6.57±1.40	2.28±0.50	138.04±28.29	4.82±1.11	17.11±3.80	2.06±2.49
2019	4.43±0.87	1.49±0.91	1.75±0.36	2.00±0.62	4.66±0.49	7.67±1.84	6.61±1.41	2.25±0.45	132.16±25.55	4.95±0.72	16.48±3.12	1.89±2.63
2020	4.62±1.06	1.71±1.21	1.70±0.36	2.14±0.72	4.76±0.44	7.95±1.83	6.84±1.44	2.22±0.44	147.98±27.35	5.13±0.72	11.54±2.68	1.62±1.29
2021	4.63±1.05	1.81±1.53	1.60±0.33	2.23±0.69	4.73±0.44	7.96±1.91	6.86±1.51	2.30±0.48	146.15±27.52	5.04±0.92	10.74±2.90	1.58±1.28
H	106.20	68.59	214.76	111.92	139.25	24.33	37.44	233.18	316.22	238.16	2915.53	167.71
P	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 2: Serum levels of lipid, glucose and thyroid hormones of different age groups.

Age	Blood Lipid Index				Glucose Tolerance			ThyroidHormones				
	TC (mmol/L)	TG (mmol/L)	HDL-C (mmol/L)	LDL-C (mmol/L)	Fasting (mU/L)	1h (mU/L)	2h (mU/L)	TT3 (nmol/L)	TT4 (nmol/L)	FT3 (pmol/L)	FT4 (pmol/L)	TSH (mIU/L)
<25	4.45±0.99	1.45±0.89	1.68±0.35	2.10±0.68	4.55±0.43	7.00±1.68	6.10±1.25	2.36±0.54	142.07±28.40	5.05±0.89	15.72±3.37	2.17±2.95
25-30	4.49±0.95	1.48±0.95	1.72±0.35	2.09±0.65	4.62±0.45	7.60±1.68	6.46±1.31	2.32±0.50	142..01±28.11	5.04±0.94	15.86±4.00	1.97±2.36
30-35	4.63±0.96	1.72±1.20	1.74±0.35	2.10±0.68	4.72±0.48	8.01±1.84	6.83±1.44	2.33±0.51	141.13±28.46	4.98±0.96	15.21±3.91	1.88±1.89
35	4.75±0.98	1.92±1.28	1.78±0.36	2.11±0.75	4.83±0.52	8.41±1.91	7.20±1.61	2.29±0.50	137.22±26.81	4.87±0.71	15.03±3.29	1.99±1.72
H	77.37	164.72	26.20	1.77	213.16	308.28	317.91	8.16	15.64	32.76	84.08	31.03
P	<0.0001	<0.0001	<0.0001	0.621	<0.0001	<0.0001	<0.0001	0.043	<0.0001	<0.0001	<0.0001	<0.0001

**Table 3:** Analysis of abnormal rates of indicators in pregnancy from 2017-2021

Year	Abnormal Rate of Blood Lipid Index(n)				Abnormal Rate of Glucose Tolerance(n)			Abnormal Rate of Thyroid Hormones(n)				
	TC (mmol/L)	TG (mmol/L)	HDL-C (mmol/L)	LDL-C (mmol/L)	Fasting (mU/L)	1h (mU/L)	2h (mU/L)	TT3 (nmol/L)	TT4 (nmol/L)	FT3 (pmol/L)	FT4 (pmol/L)	TSH (mIU/L)
2017	25.3 % (118)	42.0% (196)	86.1% (402)	49.7% (232)	16.4% (333)	11.1% (225)	8.7% (176)	12.1% (202)	11.0% (186)	2.5% (42)	9.7% (258)	6.4% (170)
2018	20.9 % (398)	29.3% (558)	78.8% (1498)	59.5% (1131)	11.7% (204)	10.9% (190)	8.4% (147)	6.1% (96)	6.6% (105)	1.4% (22)	8.4% (192)	5.4% (123)
2019	21.4% (355)	25.8% (428)	77.3% (1283)	63.0% (1045)	13.3% (220)	11.2% (185)	10.3% (170)	3.9% (54)	3.1% (42)	1.4% (19)	9.7% (146)	4.7% (71)
2020	23.7% (290)	33.5% (409)	75.1% (918)	55.7% (681)	16.7% (176)	12.7% (134)	12.0% (126)	4.4% (25)	10.8% (62)	1.7% (10)	6.3% (39)	4.5% (28)
2021	25.2% (224)	36.4% (324)	67.0% (596)	51.7% (460)	17.0% (137)	14.6% (118)	12.4% (100)	4.1% (33)	9.2% (74)	1.7% (14)	8.5% (73)	6.0% (51)
χ <sup>2</sup>	10.65	65.20	75.44	48.63	25.49	10.00	18.73	106.83	81.14	7.78	3689.21	7.31
P	<0.05	<0.0001	<0.0001	<0.0001	<0.0001	<0.05	<0.0001	<0.0001	<0.0001	0.100	<0.0001	0.120

TG, TC, HDL-C, and LDL-C are commonly used clinically as indicators of lipid metabolism levels. Some studies have shown that the incidence of large babies with abnormal lipid levels during pregnancy is about 30% [12]. Subsequent studies have confirmed that dyslipidemia during pregnancy is an important predisposing factor for the occurrence of adverse pregnancy outcomes [13]. One study found that three or more meals a day and a preference for lighter tasting foods were independent risk factors for maternal dyslipidemia in the third trimester [1]. A light diet may reduce satiety, leading to more frequent meals and excessive carbohydrate intake, which can eventually lead to the development of maternal dyslipidemia.

In early pregnancy, human chorionic gonadotropin is at a high level, which binds to thyroid stimulating hormone receptors and increases thyroid hormone secretion, while pregnancy is a stressful stimulus to the thyroid gland, which increases the size of the thyroid gland and increases the demand for thyroxine [14]. Some studies have reported that the type of salt consumed, blood pressure, blood lipids, and blood glucose are factors influencing abnormal thyroid levels in pregnant women in early pregnancy [15]. These factors can lead to hyperthyroidism and hypothyroidism in early pregnancy. The body can compensate to maintain the consumption of thyroid hormones in mid and late pregnancy, but iodine deficiency is common in women in early pregnancy. Iodine demand increases in early pregnancy, and consumption of iodized salt is beneficial to the balance of iodine supply and demand, which can further strengthen the publicity and education of iodine supplementation for women in early pregnancy [16].

Coronavirus disease 2019 (COVID-19) epidemic, which has been ongoing since 2019, has widely affected social production and people's lives, bringing negative psychological reactions such as anxiety and depression to varying degrees. Pregnant women, who are in the special physiological process of pregnancy, They are more prone to anxiety and depression in the face of the risk of infection, medical problems, fetal health and other problems brought about by the epidemic [17]. Under the influence of negative emotions, pregnant women are also more likely to exhibit high blood lipid levels and impaired blood sugar control [18]. And due to the epidemic, obstetric outpatient clinics are restricted and lack individualized interventions for pregnant women, making it difficult to meet their medical needs. And pregnant women have decreased exercise due to reduced supervision by medical staff and the inability to go outside, resulting in significant weight gain [19].

It is thus clear that screening, monitoring and management of

pregnant women should be strengthened during special periods, and guidance on balanced diet during pregnancy and the deployment of nutrients, as well as supervision of exercise for women during pregnancy, early detection and elimination of adverse outcomes, are important measures to ensure the safety of mother and child.

In summary, this study identified the process of dynamic changes in blood lipid, glucose, and thyroid hormone levels in women during pregnancy, providing a basis for subsequent studies of factors affecting women during pregnancy. While this study collected obstetric outpatient results horizontally for 5 years, due to the large amount of data, there may be cases that were included in that exclusion due to the lack of perfect and comprehensive clinical information of the patients when excluding data according to the exclusion criteria, resulting in statistical bias. The present study only examined the indicators in their current state, and no association could be established between the data.

Conclusion

The rates of abnormalities in blood lipid, glucose, and thyroid indicators roughly have a trend of rising, which may be closely related to adverse pregnancy outcomes. The monitoring of lipid and glucose thyroid indicators during pregnancy should be strengthened, and maternal care should be emphasized to improve pregnancy outcomes.

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