

Epidemiological Survey on Vitamin A, D, E Levels of Pregnant Women in Baoding

Bei Wang[†], Yakun Zhao[†], Hongli Wu, Ling Liang, Wenli Kang, Yan An, Jie Cui*

Department of Obstetrics, Affiliated Hospital of Hebei University, Baoding 073000, China

[†]These authors contributed equally to this work.

*Corresponding author: Jie Cui, 237201447@qq.com

Copyright: © 2023 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To understand the vitamin levels in pregnant women and its influencing factors and provide a basis for formulating scientific and reasonable vitamin supplement plans for pregnant women. *Methods:* Pregnant women with a pregnancy period of 12 weeks to 36 weeks in Baoding area were selected as the research subjects using the random sampling method. The sample size is estimated to be 5,000 people, and the diversity of the research subjects, such as age, education level, pregnancy, etc., were recorded through a survey. The content of the survey included the personal information of the research subjects, pregnancy conditions, eating habits, vitamin supplements taken, etc. At the same time, blood tests were carried out on the research subjects to detect indicators such as vitamin levels. *Results:* The results of serum measurement showed that the vitamin A level of pregnant women was 0.38 ± 0.12 mg/L, the vitamin E level was 13.51 ± 3.17 mg/L, and the vitamin D level was 17.82 ± 4.18 ng/L; the level of vitamin A of pregnant women in the first trimester was significantly lower than those in the second and third trimesters, and the level of vitamin E of pregnant women in second trimester was significantly higher than those in the first and third trimesters, with statistically significant differences ($P < 0.05$). The rate of vitamin A deficiency in the early stage was significantly higher than that in the middle and late stages of pregnancy, ($P < 0.05$); vitamin D deficiency existed in all pregnant women. *Conclusion:* Pregnant women should maintain a reasonable diet and eat more vitamin-rich foods, such as vegetables, fruits, etc.; besides, pregnant women should take vitamin supplements under the guidance of doctors or professionals according to their own conditions; moreover, the publicity and education for pregnant women should be improved with more emphasis on vitamin supplementation.

Keywords: Vitamins; Pregnant women; Epidemiology

Online publication: July 12, 2023

1. Introduction

Vitamin A, vitamin D, and vitamin E are three essential vitamins for the human body. Vitamin A is closely related to human growth and health, and is an important part of human cells and tissue. Vitamin D mainly regulates calcium and phosphorus metabolism and prevents osteoporosis. Vitamin E has important physiological functions for the human body, which is mainly on promoting the synthesis of sex hormones and maintaining fertility. Pregnant women are in a special physiological state that requires large amounts of various nutrients. The nutritional status of pregnant women not only affects the growth and intellectual development of the fetus, but also directly affects the health of mothers, infants, and young children ^[1]. The World Health Organization (WHO) stipulates that pregnant women should consume at least the following four vitamins and minerals: vitamin A, vitamin D, vitamin E and folic acid ^[2]. Based on China's national

conditions, we carried out a survey on pregnant women in the first trimester (13–27 weeks of pregnancy), second trimester (28–40 weeks of pregnancy), and third trimester of pregnancy (41–50 weeks of pregnancy) in Baoding and their lactation period. The serum vitamin A, vitamin D and vitamin E levels of pregnant women were monitored in order to understand the nutritional status and trends of the Chinese population during pregnancy, and provide a basis for formulating nutritional interventions for pregnant and lying in women.

2. Materials and methods

2.1. Research subject

5000 pregnant women in Baoding, aged 20–50, were selected as the research subjects by cluster random sampling method.

Inclusion criteria: (i) pregnant women admitted to the hospital during the investigation period, including pregnant women in the first, second, and third trimesters; (ii) no high-risk score; (iii) checked for accurate gestational weeks, no history of miscarriage in early pregnancy, and has normal glucose tolerance; (iv) those without medical or surgical complications, excluding cholestasis; (iv) able provide the basic information required for the study and are willing to be followed-up until they are discharged after delivery.

Exclusion criteria: (i) pregnant women who did not receive routine prenatal care during the follow-up period; (ii) lost to follow-up during the study; (iii) did not arrive at the delivery site for delivery; (iv) patients who were considered unsuitable for the trial by the researchers; (v) those with heart, liver, lung, kidney, and other important organ diseases and benign tumors (ovarian cysts, uterine fibroids) during pregnancy.

2.2. Methods

Cluster random sampling method was used to select pregnant women from 28 weeks of pregnancy to 3 months after delivery in Baoding area. The content of the survey included basic personal information, diet during pregnancy, weight gain during pregnancy, check-up during pregnancy, delivery method, and condition during delivery. All pregnant women underwent blood tests, including routine blood tests, a full set of biochemical tests, routine urine tests, and trace element test. Blood samples were tested for serum vitamin A, vitamin D, and vitamin E levels using an automatic biochemical analyzer. Serum vitamin A was detected by enzyme-linked immunoassay, and the concentration was determined by a microplate reader. The kit was provided by Brigham & Welch, USA; serum vitamin D was detected by chemiluminescence, and the concentration was determined by a chemiluminescence analyzer, and the kit was provided by Brigham & Welch, USA; serum vitamin E was determined by colorimetry.

2.3. Statistical analysis

The survey data was analyzed using SPSS software, including descriptive statistical analysis, *t*-test, chi-square test, and other methods were also used for data mining and variable correlation analysis.

3. Results

3.1. Analysis of serum vitamin A, vitamin E, and vitamin D in pregnant women

The blood test results showed that the average serum vitamin A of pregnant women was 0.38 ± 0.12 mg/L, the average serum vitamin E was 13.51 ± 3.17 mg/L, and the average serum vitamin D level was 17.82 ± 4.18 ng/L.

3.2. Comparison of serum vitamin A, vitamin E and vitamin D levels of pregnant women in different pregnancy periods

The serum vitamin A in early pregnancy was significantly lower than that in the second and third trimesters,

and the level of vitamin E in the second trimester was significantly higher than that in the first and third trimesters ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of serum vitamin A, vitamin E and vitamin D levels of pregnant women in different pregnancy periods (mean \pm SD)

Group	Number of cases	Vitamin A (mg/L)	Vitamin E (mg/L)	Vitamin D (ng/L)
First trimester (< 12 weeks)	1625	0.35 \pm 0.12	12.25 \pm 2.74	17.75 \pm 4.25
Mid-term (13–27 weeks)	1825	0.42 \pm 0.13	15.36 \pm 3.01	18.49 \pm 5.11
Third trimester (> 27 weeks)	1550	0.46 \pm 0.12	11.02 \pm 2.86	17.51 \pm 4.51

3.3. Comparison of serum vitamin A, vitamin E and vitamin D levels between pregnant women of different ages

There was no significant difference between the serum vitamin A, vitamin E, and serum vitamin D among pregnant women of different ages ($P > 0.05$), as shown in **Table 2**.

Table 2. Comparison of serum vitamin A, vitamin E, and vitamin D levels in pregnant women of different ages (mean \pm SD)

Group	Number of cases	Vitamin A (mg/L)	Vitamin E (mg /L)	Vitamin D (ng/L)
< 25 years old	475	0.38 \pm 0.11	11.20 \pm 0.56	17.46 \pm 3.15
25–30 years old	2175	0.39 \pm 0.12	11.56 \pm 0.94	17.96 \pm 3.26
31–35 years old	1300	0.37 \pm 0.15	11.06 \pm 0.6 8	17.55 \pm 3.73
> 35 years old	1050	0.38 \pm 0.12	11.18 \pm 0.6 5	18.76 \pm 3.58

Note: There was no statistical significance in any pairwise comparison within the group.

3.4. Comparison of abnormal rates of serum vitamin A, vitamin E and vitamin D in different pregnancy periods

The rate of serum vitamin A deficiency of pregnant women was 19.00%, and the rate of excess serum vitamin A accounted for 0.50%. Among them, the vitamin A deficiency rate in the first trimester was significantly higher than that in the second and third trimesters ($P < 0.05$); the overall rate of vitamin E abnormalities was 8.50%, with the rate of deficiency being 0.50%, and the rate of excess vitamin E was 8.00%; meanwhile, the overall rate of serum vitamin D abnormalities was 62.00%. There was no significant difference in the abnormalities of serum vitamin E and vitamin D between pregnant women in different pregnancy periods ($P > 0.05$), as shown in **Table 3**.

Table 3. Comparison of abnormal rates of serum vitamin A, vitamin E and vitamin D in different pregnancy periods (n [%])

Group	Number of cases	Vitamin A		Vitamin E		Vitamin D	
		Deficiency	Excessive	Deficiency	Excessive	Deficiency	Excessive
Early pregnancy	1625	475 (29.23)	0	0	150 (9.23)	975 (60.00)	0
Second trimester	1825	275 (15.07)	0	0	150 (8.22)	1075 (58.90)	0
Third trimester	1550	200 (12.90)	25 (1.61)	25 (1.61)	100 (6.45)	975 (62.90)	0
Total	5000	38 (19.00)	25 (0.50)	25 (0.50)	400 (8.00)	3100 (62.00)	0

Note: $P < 0.05$ compared to the first trimester.

3.5. Comparison of abnormal rates of serum vitamin A, vitamin E, and vitamin D between pregnant women of different ages

There was no significant difference in the abnormal levels of serum vitamin A, vitamin E and vitamin D among pregnant women of different ages ($P > 0.05$), as shown in **Table 4**.

Table 4. Comparison of abnormal rates of serum vitamin A, vitamin E and vitamin D between pregnant women of different ages (n [%])

Group	Number of cases	Vitamin A		Vitamin E		Vitamin D	
		Deficiency	Excessive	Deficiency	Excessive	Deficiency	Excessive
< 25 years old	475	75 (15.79)	0	0	25 (5.26)	300 (63.16)	0
25–30 years old	2175	400 (18.39)	25 (1.15)	25 (1.15)	125 (5.75)	1325 (60.92)	0
31–35 years old	1300	275 (21.15)	0	0	150 (11.54)	825 (62.26)	0
> 35 years old	1050	200 (19.05)	0	0	100 (9.52)	650 (61.90)	0
Total	5000	950 (19.00)	25 (0.50)	25 (0.50)	400 (8.00)	3100 (62.00)	0

Note: There is no statistical significance in the comparison within the group.

4. Discussion

Vitamins A, D, and E are important substances for human growth and reproduction. They have antioxidant properties and participate in processes such as hematopoiesis, bone growth, immunity, and anti-infection, and play an important role in maintaining normal physiological functions and structures of the human body. Vitamin A cannot be synthesized in the human body and is mainly taken in through diet; vitamin D can promote the absorption of calcium in the small intestine and promote bone growth and development; vitamin E has an important impact on immune function, cardiovascular, and cerebrovascular diseases, etc. Vitamins A, D, and E are all fat-soluble substances and are commonly found in animal foods. Pregnant women are a special population, and the content of vitamins A, D, and E in the body will change during pregnancy. Studies have shown that serum vitamin A levels in pregnant women fluctuate to a certain extent in the first and middle trimesters of pregnancy, but decrease in the second and third trimesters after delivery, and return to pre-pregnancy levels after delivery. Meanwhile, the serum vitamin D level of pregnant women will also change with the pregnancy cycle.

Studies have shown that due to changes in the endocrine system of pregnant women, the body's demand for vitamins increases and it is prone to deficiency. Maternal vitamin A, vitamin D, and vitamin E levels are closely related to fetal development^[3]. Currently, the issues of vitamin A, vitamin D, and vitamin E deficiencies still exist among pregnant women in our country. The results of this study show that the serum vitamin A and vitamin D levels of pregnant women in Baoding area are lower than the recommended intake in the "Reference Intakes of Dietary Nutrients for Chinese Residents" (2013 edition), and the level of vitamin E in pregnant women is related to diet, exercise, and living environment. Therefore, it is necessary to strengthen the publicity and education of nutritional knowledge for pregnant women, and eat more foods rich in vitamin E during pregnancy.

This study shows that the vitamin A, vitamin D and vitamin E levels of the population in Baoding area are generally low, and there are certain differences among different age groups. Besides, the level of vitamin E decreased with the progress of pregnancy, which was consistent with the results of other studies^[4-6]. Pregnant women with poor nutritional status is prone to gestational diabetes, hypertensive disorders of pregnancy, low birth weight, premature birth, and other related diseases^[7-10]. Therefore, pregnant women should eat more foods that are rich in vitamins A, D, and E, such as carrots, green leafy vegetables, and other vegetables rich in carotene; animal liver, egg yolk, fish and other foods rich in vitamin D; milk and

dairy products and other foods rich in vitamin E. However, pregnant women require a huge amount of folic acid, and it is recommended that they take folic acid tablets. There are some limitations to this study, such as small sample size and incomplete baseline data, which may affect the reliability and comparability of the results. Therefore, further studies with a larger sample size, multi-centered are needed, and prospective studies should also be carried out to comprehensively and objectively evaluate the vitamin A, vitamin D, and vitamin E levels of the population in Baoding.

Based on our results, the following recommendations are made:

- (i) The nutritional status should be evaluated before pregnancy. If the nutritional status is poor, dietary adjustment or vitamin A, vitamin D, and vitamin E supplementation can be prescribed to improve the nutritional status before pregnancy.
- (ii) Pregnant women should receive nutritional guidance in accordance with the WHO-recommended health care guidelines during pregnancy and receive nutritional consultation and assessment at least once before pregnancy. Besides, pregnant women should be encouraged to carry out outdoor activities and have balanced diet.
- (iii) For pregnant women with good nutritional status, in addition to paying attention to health care during pregnancy, outdoor activities should also be increased to increase vitamin D levels; for pregnant women with poor nutritional status, timely intervention should be performed to reduce anemia and gestational diabetes and other complications.

5. Conclusion

In conclusion, pregnant women should have a balanced diet and take in more vitamin-rich foods, such as vegetables and fruits. Besides, they should take vitamin supplements under the guidance of doctors or professionals. Lastly, the publicity and education for pregnant women should be strengthened to improve the awareness of vitamin supplementation.

Funding

Medical Science Research Project of Hebei Provincial Health and Health Commission, Epidemiological Investigation of Vitamin A, D, and E Levels of Pregnant Women in Baoding Area (Fund number: 20190947)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Hu Y, Wang D, Yang X, et al., 2023, Effects of 25-Hydroxyvitamin D on Anti-Inflammatory and Pro-Inflammatory Markers of Chronic Inflammation in Obese Pregnant Women. *Clinical Military Medical Journal*, 51(04): 394–396 + 400.
- [2] Sui S, Zhang Y, Huang Y, 2023, Correlation Analysis Between Vitamin D Nutritional Status During Pregnancy and Onset Time of Preeclampsia. *Chinese Medicine*, 18(04): 560–563.
- [3] Lu Y, Cai X, Zhu D, 2023, The Relationship Between Serum Vitamin A and E Levels and the Onset and Severity of Preeclampsia. *Journal of Bengbu Medical College*, 48(03): 364–367.
- [4] Niu L, Gao H, Wei L, et al., 2023, Meta-Analysis of the Effect of Prenatal Use of Vitamin K on Newborns by Pregnant Women. *Chinese Prescription Drugs*, 21(01): 52–56.

- [5] Du M, Yu Y, Huang J, et al., 2023, Correlation Analysis Between Serum Vitamin A and Vitamin E Levels in Pregnant Women and Preeclampsia. *Chinese Maternal and Child Health Care*, 38(02): 195–198.
- [6] Geng X, Yu H, 2023, Analysis of Influencing Factors of Vitamin D Levels in Pregnant Women [J]. *Nursing Research*, 37 (01): 34–39.
- [7] Guo C, Zhao J, Wang H, 2022, Correlation Between Serum Vitamin A and Vitamin E Levels and Anemia in Late Pregnancy. *Journal of Yan'an University (Medical Science Edition)*, 20(04): 87–92.
- [8] Yan Y, Zhang A, Li N, et al., 2022, Discussion on the Relationship Between Vitamin D Deficiency and Gestational Diabetes. *Modern Medicine*, 50(12): 1541–1545.
- [9] Su H, Li D, Liu S, et al., 2022, Study on the Correlation Between Serum Vitamin D Level of Obese Pregnant Women and Gestational Diabetes Mellitus. *Yunnan Medicine*, 43(05): 57–59.
- [10] Jia Y, Geng X, Liu N, et al., 2022, Effect of Vitamin A Level on Anemia and Subclinical Hypothyroidism in Pregnant Women. *Nursing Research*, 36(20): 3749–3751.
- [11] Wen J, Cheng D, Wang Y, et al., 2022, Effects of Amino Acid and Vitamin Levels of Pregnant Women on Birth Weight of Newborns. *Tianjin Science and Technology*, 49(10): 42–48.
- [12] Su R, Xie W, Wu X, 2022, Significance of Changes in leptin, Interleukin-6, and Vitamin B1 Levels Before and After Nasojejunal Tube Placement in Pregnant Women with Hyperemesis Gravidarum. *Practical Hospital Clinical Journal*, 19(05): 171–174.
- [13] Chen L, Guo H, Zhao J, 2022, Clinical Significance of Blood Lipids, Blood Sugar, Vitamin A and Vitamin E Levels in Pregnant Women with Preeclampsia. *Chinese Medical Journal*, 57(08): 877–880.
- [14] Tang Y, 2022, Relationship Between Changes in FA, Hcy , Vitamin B12 Levels of Pregnant Women and Pregnancy Outcomes. *Modern Diagnosis and Treatment*, 33(13): 1987–1989.
- [15] Lu B, Yan G, Dai S, 2021, Epidemiological Survey on Vitamin Levels of 5000 Pregnant Women in Hangzhou. *Chinese Maternal and Child Health Care*, 36(12): 2844–2847.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.