

Research Article

Maternal Vitamin a Deficiency in Pregnancy and its Relationship with Maternal and Neonatal Haemoglobin Concentration

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ABSTRACT

Background: Vitamin A deficiency in pregnant women is a significant nutritional issue in developing countries, and could be a factor in maternal anemia and poor birth outcomes. Vitamin A deficiency is required for erythropoiesis, immune function and fetal growth. But little local information is available on the association of maternal vitamin A status with maternal and neonatal hemoglobin concentrations.

Objective: To determine the relationship between maternal vitamin A deficiency during pregnancy and maternal and neonatal hemoglobin concentration.

Methods: The study was an analytical cross sectional study conducted at Kabir Medical College and affiliated hospital from January 2025 to June 2025. The subjects were 72 pregnant women who were chosen by non-probability consecutive sampling, in the third trimester. Structured proforma was used to collect maternal demographic, obstetric, nutritional and clinical data. Vitamin A and hemoglobin levels of mothers were obtained prior to delivery and the hemoglobin level of the newborns was obtained after birth. Data were analyzed with the IBM SPSS Statistics version 26. The definition for vitamin A deficiency was serum retinol < 0.70 μmol/L. Independent sample t-test, Chi-square test and correlation analysis were performed. A p-value ≤ 0.05 was considered statistically significant.

Results: Among 72 pregnant women, 33 (45.8%) had vitamin A deficiency and 44 (61.1%) were anemic. Mean maternal hemoglobin concentration was significantly lower in vitamin A-deficient women compared with women having normal vitamin A levels (9.84 ± 1.08 g/dL vs 10.93 ± 1.12 g/dL, $p < 0.001$). Neonatal hemoglobin concentration was also lower among neonates born to vitamin A-deficient mothers (13.55 ± 1.31 g/dL vs 14.77 ± 1.28 g/dL, $p < 0.001$). Maternal vitamin A level showed a positive correlation with maternal hemoglobin ($r = 0.46$, $p < 0.001$) and neonatal hemoglobin concentration ($r = 0.39$, $p = 0.001$).

Conclusion: Maternal vitamin A deficiency was significantly associated with lower maternal and neonatal hemoglobin concentration. Early nutritional screening and improvement of maternal micronutrient status during pregnancy may help reduce maternal and neonatal anemia.

Keywords: Vitamin A deficiency, Pregnancy, Maternal hemoglobin, Neonatal hemoglobin, Maternal anemia, Neonatal anemia

INTRODUCTION

The period of gestation is physiologically stressful with a higher demand for nutrients to support the mother and her baby. Sufficient consumption of micronutrients before and during pregnancy is crucial for normal haematological, metabolic and immunologic functions. Of these micronutrients,

vitamin A has received special attention due to its role in cellular differentiation, regulation of the immune system, iron metabolism, and erythropoiesis. Vitamin A deficiency during pregnancy is still a significant nutritional problem in many LMIC countries where maternal

malnutrition and anemia are widespread public health issues (1-3)

Maternal anemia is one of the most common pregnancy complications, and it has been linked to women's health problems, fetal growth problems, low birth weight, preterm delivery and complications in newborns. Iron deficiency is believed to be the most common cause of maternal anemia, however other micronutrient deficiencies can also cause poor hemoglobin production. The deficiency of vitamin A can also cause changes in the iron mobilization from the body stores, decrease erythropoietin response and affect the production of red blood cells. Consequently, low levels of vitamin A in pregnant women could exacerbate anaemia even in those who are already taking iron supplements (4-6).

Vitamin A deficiency could also affect the neonatal health as a lot of nutrients is provided to the fetus through the mother. In the fetus, low vitamin A levels in the mother can impact the transfer of nutrients to the fetus, the neonatal iron reserves and thereby the level of hemoglobin in the neonate, which may increase the risk of neonatal anemia during pregnancy. Anemia in the neonatal period has been linked to poor neurodevelopmental outcomes, susceptibility to infection in early infancy, and poor growth. Thus, micronutrient deficiencies in mothers can have effects beyond childbirth and breastfeeding (7-9).

Dietary intake, lack of antenatal nutritional counseling, recurrent infections and low socioeconomic status are all risk factors for vitamin A deficiency in pregnant women in developing countries. Although vitamin A is known to play an important role in the regulation of haematology, iron deficiency is often the norm for routine antenatal screening and other micronutrient deficiencies are frequently not diagnosed. There are few studies that have specifically measured the association between maternal vitamin A status and neonatal hemoglobin concentration (10, 11).

The present study was conducted to determine the frequency of maternal vitamin A deficiency during pregnancy and to assess its relationship with maternal and neonatal hemoglobin concentration among pregnant women presenting to Kabir Medical College and its affiliated hospital.

METHODOLOGY

The present study is an analytical cross sectional study carried out in Kabir Medical College and its affiliated hospital during January 2025 to June 2025. The study aimed to determine the prevalence of vitamin A deficiency in pregnant

women and to examine the association between maternal and neonatal hemoglobin concentration.

The respondents in this study were 72 pregnant women who were taken using the convenience sampling, non-probability sampling method, consecutive sampling. All pregnant women who met the selection criteria and attended the obstetric department during the study period were recruited, with informed consent. The sample size was determined based on the anticipated number of patients for the duration of the study and the feasibility of performing biochemical testing.

Pregnant women in the third trimester with singleton pregnancies were included in the study. Multiple pregnancy, chronic liver disease, renal disease, known hemoglobinopathies, active bleeding, severe acute infection, and history of recent blood transfusion were exclusion criteria. Women who received vitamin A supplements as part of their regular prenatal care were also not included as part of the supplementation since this would have a direct effect on their serum vitamin A status.

Demographic and obstetric data was collected on a proforma after enrolment. The information gathered was maternal age, place of residence, education level, socioeconomic status, gravidity, parity, gestational age, antenatal care visits, diet of vitamin A rich food, use of iron-folic acid, BMI and history of anemia during pregnancy. Patient information for the clinical context was gathered from patient interviews and hospital records.

Maternal venous blood samples were taken aseptically before delivery and/or on admission for delivery. Hb concentration was determined by the hematology analyzer used in the hospital laboratory. Serum Vitamin A (SA) level was determined using laboratory method available in the hospital and Vitamin A deficiency was defined as serum retinol level $<0.70 \mu\text{mol/L}$. Maternal anaemia was defined as haemoglobin concentration $<11 \text{ g/dL}$ during pregnancy. Neonatal information was collected, including gender, birth weight, gestational age at delivery, Apgar score (if available) and whether the infant was admitted to NICU. The concentration of neonates hemoglobin was recorded from cord blood or early neonatal blood sample depending on the hospital's laboratory procedure. Anemia status in the newborn were classified according to the reference ranges adopted by the hospital laboratory.

Data quality was ensured through predesign of the proforma, ensuring completeness of all entries and checking the laboratory values with the official hospital reports. Blood samples were

handled by experienced laboratory personnel with standard procedures. To minimize measurement variation, the same operational definitions were used throughout the study.

The data were entered and analysed by IBM SPSS Statistics version 26. The quantitative variables, which include maternal age, gestational age, serum vitamin A level, maternal hemoglobin, neonatal hemoglobin, and birth weight, were given as mean and standard deviation. Qualitative variables like residence, parity, vitamin A status, maternal anemia, neonatal anemia and low birth weight were presented as frequencies and percentages.

The independent sample t-test was used to compare the mean maternal and neonatal hemoglobin levels of the two groups: vitamin A deficient and normal vitamin A. The association between categorical variables was tested using

Chi-square test or Fisher's exact test as appropriate. The correlation between maternal serum vitamin A level and the maternal and neonatal hemoglobin concentration was tested by Pearson or Spearman correlation. The P value was defined as < 0.05 to be statistically significant.

RESULTS

A total of 72 pregnant women were studied. The average maternal age was 27.48 years (SD 4.91) and the average gestational age at enrollment was 34.62 weeks (SD 2.71). The age group of most participants was 25–30 years, from rural area and multigravid. Most of the women were multipara and rural. Most participants were low or middle of socio-economic status, which can be associated with the quality of diet and intake of micronutrients during pregnancy.

Table 1. Maternal demographic and obstetric characteristics, n = 72

Variable	Category	Frequency (n)	Percentage (%)
Age group	18–24 years	18	25.0
	25–30 years	34	47.2
	>30 years	20	27.8
Residence	Urban	29	40.3
	Rural	43	59.7
Education status	No formal education	24	33.3
	Primary/Middle	26	36.1
	Matric or above	22	30.6
Socioeconomic status	Low	31	43.1
	Middle	34	47.2
	High	7	9.7
Parity	Primigravida	21	29.2
	Multigravida	51	70.8
Gestational age	<37 weeks	16	22.2
	≥37 weeks	56	77.8

Over half of the women indicated a low consumption of vitamin A containing foods.

Anemia during pregnancy was also common with 54.2% of the participants.

Table 2. Nutritional and clinical profile of pregnant women, n = 72

Variable	Category	Frequency (n)	Percentage (%)
Antenatal care visits	Regular	41	56.9
	Irregular	31	43.1
Iron-folic acid supplementation	Yes	46	63.9
	No	26	36.1
Vitamin A-rich food intake	Adequate	30	41.7
	Inadequate	42	58.3
BMI status	Underweight	17	23.6
	Normal	39	54.2
	Overweight/obese	16	22.2
History of anemia in pregnancy	Yes	39	54.2
	No	33	45.8
Interpregnancy interval	<2 years	28	38.9
	≥2 years	44	61.1

Vitamin A deficiency was found in 45.8% of pregnant women. 61.1% of the mothers were anemic, the mild anemia being the most common.

Table 3. Maternal vitamin A and hemoglobin status, n = 72

Variable	Mean $\pm$ SD / Frequency	Percentage (%)
Serum vitamin A level ($\mu\text{mol/L}$)	0.76 $\pm$ 0.24	—
Maternal hemoglobin concentration (g/dL)	10.43 $\pm$ 1.21	—
Vitamin A status		
Deficient	33	45.8
Normal	39	54.2
Maternal anemia status		
Anemic	44	61.1
Non-anemic	28	38.9
Severity of maternal anemia		
Mild anemia	22	30.6
Moderate anemia	19	26.4
Severe anemia	3	4.2
No anemia	28	38.9

The average hemoglobin concentration among the newborns was 14.21 $\pm$ 1.43 g/dL. One-fourth of newborns had neonatal anemia and 26.4% had low birth weight.

Table 4. Neonatal characteristics and hemoglobin profile, n = 72

Variable	Category / Mean $\pm$ SD	Frequency (n)	Percentage (%)
Neonatal gender	Male	38	52.8
	Female	34	47.2
Birth weight (kg)	2.71 $\pm$ 0.43	—	—
Birth weight status	Low birth weight	19	26.4
	Normal birth weight	53	73.6
Gestational age at birth	Preterm	14	19.4
	Term	58	80.6
Neonatal hemoglobin concentration (g/dL)	14.21 $\pm$ 1.43	—	—
Neonatal anemia	Present	18	25.0
	Absent	54	75.0
NICU admission	Yes	11	15.3
	No	61	84.7

Maternal hemoglobin was significantly lower in the vitamin A deficient pregnant woman than in those who were vitamin A normal. Neonates of vitamin A deficient mother also had significantly reduced mean hemoglobin levels and increased incidence of neonatal anemia.

Table 5. Comparison of maternal and neonatal hemoglobin according to maternal vitamin A status

Variable	Vitamin A deficient group n = 33	Normal vitamin A group n = 39	p-value
Maternal hemoglobin (g/dL)	9.84 $\pm$ 1.08	10.93 $\pm$ 1.12	<0.001
Neonatal hemoglobin (g/dL)	13.55 $\pm$ 1.31	14.77 $\pm$ 1.28	<0.001
Birth weight (kg)	2.56 $\pm$ 0.39	2.84 $\pm$ 0.42	0.005
Maternal anemia	27 (81.8%)	17 (43.6%)	0.001
Neonatal anemia	13 (39.4%)	5 (12.8%)	0.009
Low birth weight	13 (39.4%)	6 (15.4%)	0.020

There was a positive correlation between the maternal and neonatal hemoglobin concentrations and maternal serum vitamin A. This indicates that babies and mothers who didn't have as much vitamin A had lower hemoglobin levels as well.

Table 6. Correlation of maternal serum vitamin A with maternal and neonatal hemoglobin

Variables	Correlation coefficient r	p-value
Maternal vitamin A level vs maternal hemoglobin	0.46	<0.001

Maternal vitamin A level vs neonatal hemoglobin	0.39	0.001
Maternal hemoglobin vs neonatal hemoglobin	0.42	<0.001
Maternal vitamin A level vs birth weight	0.31	0.008

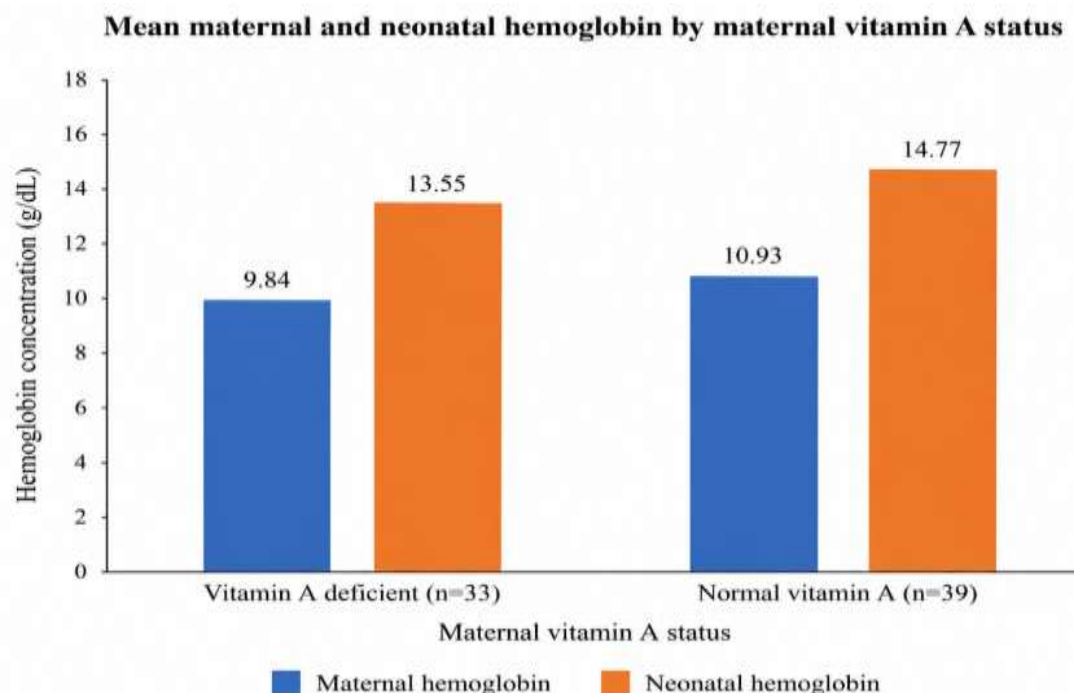


Figure 1. Mean maternal and neonatal hemoglobin concentration according to maternal vitamin A status.

The graph shows that mothers with vitamin A deficiency had lower mean hemoglobin concentration than mothers with normal vitamin A status. Neonates born to vitamin A-deficient

mothers also had lower mean hemoglobin levels compared with neonates of mothers with normal vitamin A levels.

DISCUSSION

The present study evaluated the association between maternal vitamin A deficiency during pregnancy and maternal as well as neonatal hemoglobin concentration. The findings demonstrated that vitamin A deficiency was common among pregnant women and was significantly associated with lower maternal hemoglobin levels, reduced neonatal hemoglobin concentration, increased maternal anemia, and higher frequency of neonatal anemia. These observations indicate that maternal micronutrient deficiency may influence both maternal health and neonatal hematological status (12-14).

The rate of vitamin A deficiency was close to 50% in the pregnant women of this study. This high frequency could be related to low nutritional status, low socioeconomic status, low antenatal nutritional counselling and low dietary diversity in pregnant women. The vitamin A rich food group consumption may be limited due to higher proportion of females in the study who were rural and/or in low income category. In developing countries, vitamin A deficiency continues to be a public health problem, especially for women of

reproductive age, due to the need for higher vitamin A requirements during pregnancy and the potential for exacerbating any underlying vitamin A deficiency (14-16).

Anemia was noted among over 50% of the subjects, and there was a significant decrease in hemoglobin levels among women who were deficient in vitamin A. Vitamin A is involved in several important roles in erythropoiesis, iron metabolism, immune function, and mobilization of iron from tissues to circulation. Iron deficiency can also result from the lack of vitamin A, and may exacerbate iron deficiency even in the presence of iron supplementation. The positive association of maternal vitamin A and maternal hemoglobin in the present study was consistent with the biological association between micronutrient balance and maternal hemoglobin during pregnancy (17).

The study also showed that neonates from VAD mothers had lower mean Hb levels and more cases of neonatal anemia than neonates from normal VAE mothers. The fetal iron stores and placental nutrient transfer can be directly

affected by maternal nutritional deficiencies during pregnancy. This fetally compromised erythropoiesis and neonatal hematological reserves in turn, may be due to reduced maternal vitamin A and hemoglobin levels. The results indicate that nutritional status of the mother influences the result of the birth of the newborn and may in turn lead to health problems during early childhood (18).

Mothers who were vitamin A deficient in the current study had a higher incidence of LBW and PTD. While the study aimed to identify associations rather than causality, sub-optimal micronutrient status of mothers could negatively affect placental development, immunity and fetal development. Intrauterine growth retardation and poor neonatal adaptation is common with nutritional deficiencies during pregnancy. In addition, the increased incidence of NICU admission among infants born to vitamin A deficient mothers might further demonstrate the general effects of maternal malnutrition on the wellbeing of neonates (19, 20).

This study is clinically significant as it emphasizes the importance of having better information about nutrition status of mothers during the ante-pregnancy phase. Routine screening in many low resource areas is limited to iron deficiency anemia and vitamin deficiencies may not be detected. Based on the present findings, it seems that maternal VA deficiency correction in addition to the routine iron supplementation could be beneficial to improve the maternal hemoglobin status and neonatal hematological status. Nutritional counselling, nutritional education and adequate antenatal supplementation programs,

therefore, could help to enhance pregnancy outcomes.

The study has several strengths. At the same time, it compared maternal vitamin A status with maternal hemoglobin and neonatal hemoglobin in the same population. Standard laboratory measurements and maternal and neonatal outcome was measured. Some restrictions should also be taken into account, however. The study was done in a limited number of subjects and at one center and may not be generalizable. History of dietary intake was used in part and may be subject to recall bias. Furthermore, other micronutrient deficiencies were not examined, such as vitamin B12, folate, or zinc, which could also potentially affect the concentration of hemoglobin.

CONCLUSION

Maternal vitamin A deficiency was common among pregnant women in this study and showed a significant association with lower maternal and neonatal hemoglobin concentration. Pregnant women with vitamin A deficiency had a higher frequency of maternal anemia, while their newborns demonstrated increased rates of neonatal anemia and lower birth weight. These findings emphasize the importance of adequate maternal nutrition during pregnancy and support the need for early nutritional screening, dietary counseling, and micronutrient optimization as part of routine antenatal care. Further large-scale multicenter studies are recommended to better understand the long-term maternal and neonatal effects of vitamin A deficiency during pregnancy.

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