

Original Research Article

Assessment of micronutrient status during pregnancy attending at Kanpur, Uttar Pradesh, India

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ABSTRACT

Background: This impression of multiple micronutrients during pregnancy emphasizes to relatively neglected issues. Objectives was to evaluate the status and benefits of multiple micronutrient during pregnancy.

Methods: Total 180 healthy pregnant women were included, first trimester 60 cases, second trimester 60 cases and third trimester 60 cases in the age group of 18-40 years. Haemoglobin was estimated by cyanmethemoglobin method, estimation of iron was done by ferrozine method, for zinc colorimetric method, estimation of calcium OCPC method and estimation of urinary iodine was done by ammonium persulfate oxidation method.

Results: Haemoglobin are found to be in the Ist trimester 11.3g/dl, in the IInd trimester of haemoglobin 10.5g/dl, and in the IIIrd trimester it was 11g/dl and Serum iron was 71.9ug/dl in Ist trimester, 74.8 ug/dl during IInd trimester, 80.9ug/dl in IIIrd trimester. The mean serum calcium during Ist trimester was found to be 8.0 ug/dl, in the IInd trimester 7.2 ug/dl and in the IIIrd trimester 8.1ug/dl. Serum zinc in the Ist trimester 72.6 ug/dl, in the IInd trimester 70.1ug/dl, in the IIIrd trimester 66.7 ug/dl respectively. Iodine level during Ist, IInd, IIIrd trimester was found to be 122.5ug/dl, 149.1ug/d, 158.7ug/dl respectively.

Conclusions: Our study shows that poor nutrition during pregnancy has been associated with adverse maternal and child outcomes such as increased risks of infertility, abortion, fetal intrauterine growth restriction and prenatal mortality.

Keywords: Calcium, Haemoglobin, Iron, Iodine, Micronutrients, Pregnancy, Zinc

INTRODUCTION

Micronutrient status plays an important role in pregnancy and in the growth and development of the fetus. The importance of proper nutrition proceeding to and throughout pregnancy has long been known for optimising the health and well-being of both mother and baby. Trace elements, needed in minute quantities, include minerals essential for normal human development and functioning of the body.¹ Pregnancy is linked with increased demand of all the nutrients like iron, calcium,

zinc, iodine, etc and deficiency of any of these could affect pregnancy, delivery and outcome of pregnancy. Deficiency of trace elements during pregnancy is closely related to mortality and morbidity in the new born. The fact several nutrition supplementation programs for pregnant and lactating women have been in place for several decades; about 30% of babies born in India are low birth weight as compare to only 4% in some developed countries.² Micronutrient deficiencies may be associated with raised reproductive risks, ranging from infertility to foetal structural defects and long-term

disease. Iron is one of the major trace elements required during pregnancy. It is necessary for the formation of maternal and foetal haemoglobin, the oxygen-carrying component of blood. The amount of iron in an average woman's body is about 2.2gm. Since a woman's blood volume increases by 25 to 40 % during pregnancy, and the baby is manufacturing blood cells too, so the need for iron increases, which is pushing the mother at risk for anaemia. Pregnant women with iron deficiency anaemia (IDA), particularly in the first and second trimesters, have an increased risk for premature delivery and for delivering a low-birth weight infant. Some studies showed that maternal IDA is linked to altered infant behavioural and neural development.³ Iron status are concerned in some pregnancy disorders affecting mother and foetus, such as preeclampsia, prematurity and premature rupture of membranes.⁴

The recommended daily iron intake for pregnant women is 27mg/day. Main sources of iron from foods like ground beef, clams, spinach, lentils, and baked potato with skin, sunflower seeds, and cashews. It also includes pulses, cereals, jaggery, beet root, green leafy vegetables, meat, liver, egg, fish, legumes, dry beans, and iron enriched white breads etc. Iodine deficiency is the world's leading cause of preventable mental impairment, affecting an estimated 18 million babies each year. Iodine is an integral part of thyroid hormones required for adequate thyroid hormone production, and plays a crucial role in foetal organogenesis, and particularly in brain development. Throughout the first two trimesters of pregnancy the fetus is totally dependent on the maternal thyroid hormone source as the foetal thyroid does not develop until 13-15 weeks of gestation.

Iodine deficient mother is associated with impaired foetal development, increase the risk of spontaneous abortion, perinatal mortality, birth defects etc. Daily recommended iodine intake during pregnancy from 200-250microgram/day. Dietary sources of iodine include seaweed, iodized salt, dairy products and fish. Calcium has a key role to play in the development of healthy bones and teeth as well as extra-cellular fluid, muscle, and other tissues. Calcium supplementation is associated with a reduction in pre-eclampsia as well as LBW, gestational hypertension and pre-term birth.⁵

The World Health Organization (WHO) recommends 1200mg/day of elemental calcium per day for pregnant women. In pregnancy, there is an increase tubular reabsorption of Ca, subsequent decreased urinary Ca excretion. Preeclampsia and gestational hypertension are shared in nulliparous women and are noticeable by hypocalcaemia throughout pregnancy.⁶ Zinc is an essential element for optimal development of human body. It is an important element performing a range of functions in the body, as it is a co-factor for the synthesis of a number of enzymes, DNA and RNA.¹ During pregnancy, level of zinc in mother plays an important role in foetal-neonatal outcomes like growth, birth weight,

neurobehavioral development, performance of immune system and rate of mortality and adequate amount of zinc in pregnant women is essential for the optimum health of mother, embryo and neonatal RDA has recommended daily intake of 12mg for pregnant women between 12-14 years, and 11mg for pregnant women between 19-50 years. Food rich in zinc include-lamb, chickpea, cashews, mushrooms, spinach etc

METHODS

This was a cross-sectional type of study. A total of 180 healthy pregnant women, aged between 18-40 years, attending in department of Gynaecology at Lala Lajpat Rai Hospital Kanpur, India.

Inclusion criteria

- The selected age group between 18 to 40 years.
- Non-smoker, nor a drinker and not taking any drug for preceding one month except iron and folic acid.

Exclusion criteria

Patient with any obstetrical abnormalities or any disease complicating pregnancy were excluded.

Sample collection

Under aseptic conditions 4ml of venous blood was collected in without anticoagulant (plain) estimate iron and zinc and calcium centrifuged (3,000rpm, for 3-5min at 37°C) to obtain serum that was also stored at -80°C for further biochemical measurements and collected 5-10ml of urine sample in sterile urine container for estimate of iodine.

Biochemical assessment

- Haemoglobin- was estimated by the cyanmethemoglobin method,⁷
- Iron- estimation was done by Ferrozine method,⁸
- Zinc-The concentration of Zn present in diluted serum was determined by Colorimetric method,⁹
- Iodine-Method used for measuring urinary iodine is ammonium persulfate oxidation,¹⁰
- Calcium- estimation was done by OCPC method.¹¹

Statistical analysis

The results are presented in Mean±SD and percentage. Chi-square test was used to compare the categorical variables cases. Unpaired t-test was used to compare the study parameters cases. The Pearson correlation coefficient was calculated among the study parameters. The p-value<0.05 was considered significant.

All the analysis was carried out by using SPSS 21.0 version (Chicago, Inc., USA).

RESULTS

In this study, first trimester 60 cases, second trimester 60 cases and third trimester 60 cases of female were included.

Table 1: Distribution of study participants according to demographic characteristics.

Variables	Category	N	Percentage
Age group (yrs)	≤18	41	73.8%
	18-26	73	131.4%
	26-30	36	64.8%
	30-35	30	54%
Educational qualification	≤5 th	24	43.2%
	5-8	30	54%
	8-10	52	93.6%
	10-12	28	50.4%
	Graduation	22	39.6%
	Post graduate	24	43.2%

The above table shows the demographic characteristic of all the selected subjects taking into consideration for the following study.

The respective Table 2 shows the findings of mean biochemical profile such as haemoglobin in each trimester of pregnancy are found to be in the Ist trimester 11.3 g/dl, in the IInd trimester it was found to be 10.5g/dl, and in the IIIrd trimester it was found to be slightly higher than the IInd trimester i.e. 11g/dl. The mean serum calcium during Ist trimester was 8.0 ug/dl, in the IInd trimester 7.2 ug/dl which was lower than Ist trimester, in the IIIrd trimester 8.1 ug/dl. In the current study mean serum zinc during each trimester of pregnancy was - in the 1st trimester 72.6 ug/dl, in the IInd trimester 70.1 ug/dl, in the IIIrd trimester 66.7ug/dl. It was also found that mean serum iron was 71.9ug/dl in 1sttrimester, 74.8 ug/dl during 2nd trimester, 80.9ug/dl in 3rd trimester. Iodine level during Ist, IInd, IIIrd trimester was found to be 122.5ug/d, 149.1ug/d, 158.7 ug/d respectively. It was observed that iodine level was also found to be decrease in each trimester.

Table 2: Serum iron, calcium, zinc, haemoglobin during the three trimesters.

Biochemical variables	First trimester	Second trimester	Third trimester	p value
Hb (g/dl)	11.3±0.6	10.5±0.5	11±0.3	<0.0001*
Ca (mg/dl)	8.0±0.3	7.2±0.4	8.1±0.4	0.9(NS)
Zinc (ug/dl)	72.6±1.6	70.1±2.0	66.7±1.75	<0.0001*
Iron (ug/dl)	71.9±1.4	74.8±1.5	80.9±2.1	0.011*
Iodine (ug/dl)	122.5±5.1	149.1±4.2	158.7±4.8	0.32(NS)

*Significant at the 0.05 level; NS: Not Significant

The above Table 3 described the percentage of the deficient subjects and their correlations. In the above the correlation for haemoglobin deficient subject (I, II, III trimesters) was found to be significant whereas calcium

deficient subject's (I, II, III trimesters) correlation was found to be not-significant. Correlation of the Subjects (I, II, III trimesters) which are found to be zinc, iron, and iodine deficient is also found to be significant.

Table 3: Micronutrient deficiencies during pregnancy.

Biochemical parameters	I st Trimester N (60)	%	II nd Trimester N (60)	%	III rd Trimester N (60)	%	P value
Hb deficient	38	22.8	37	22.2	16	9.6	<0.0001*
Ca deficient	20	12	32	19.2	30	18	0.06(NS)
Zn deficient	22	13.2	19	11.4	28	16.8	0.04*
Fe deficient	48	28.8	30	18	28	16.8	0.0002*
I deficient	42	25.2	52	31.2	38	22.8	0.011*

*Significant at the 0.05 level; NS: Not Significant

DISCUSSION

In this present study, total sample of 180 healthy pregnant were included and their nutritional level were assessed in all the three trimester of pregnancy. Mainly nutritional level includes assessment of various micronutrient which plays important role during pregnancy i.e. haemoglobin, iron, iodine, zinc and calcium. Details of all selected pregnant women are represented in Table 1. The mean age of pregnant women was 22.2±2.1 years and the age

ranges were 18-35 years. Majority of pregnant women were in age group 18-26 years, followed by the age group ≤18. Majority of subjects had eight standards to high school standard of education, followed by high school standard to twelfth standard of education.

In this study, the level of haemoglobin was found to be continued low throughout the gestation. According to the classification of the World Health Organization, pregnant women who had haemoglobin levels less than 11.0g/dL

on the first and the third trimesters were categorized as anaemic women. the risk of low birth weight, preterm birth, and perinatal mortality was found to be higher when the haemoglobin concentration was in the anaemic range $<10.4\text{g/dl}$ before 24 weeks of gestation-compared with a midrange haemoglobin concentration of 10.4 to 13.2g/dl .¹¹

A comparison between the mean calcium during the three trimesters of pregnancy in the current study with the study done by showed that the mean calcium during each trimester was found to be lower than the findings of Khoushabi et al and Kinght et al.¹¹⁻¹³ In the current study and Khoushabi et al showed a decrease in the serum Ca. in the IInd trimester of pregnancy.

Many observational studies showed an association between zinc deficiency and low birth weight. Maternal serum zinc status during pregnancy directly effects fetal growth and infants birth weight. It effects infant's growth and morbidity outside the neonatal period due to its effects on intra uterine growth and development of immune system.¹³ During maternal period, demand of zinc during the IIIrd trimester is found to be twice higher than that in non-pregnant women. In the study conducted in Zahedan city by Salimi et al during Ist, IInd, IIIrd trimester of pregnancy was 61%, 57%, 41% respectively had their serum zinc below $70\mu\text{g/dl}$. In the current study mean serum zinc during each trimester of pregnancy was in the first trimester $72.6\mu\text{g/dl}$, in the second trimester $70.1\mu\text{g/dl}$, in the third trimester $66.7\mu\text{g/dl}$ respectively. It was found that mean serum zinc during the three trimesters of pregnancy is found to be low than the study conducted by Khoushabi et al and Knight et al.^{12,13}

Among healthy human beings, pregnant women and rapidly growing infants are most vulnerable to iron deficiency.¹³ Both groups have to absorb substantially more iron than is lost from the body, and both are at a considerable risk of developing iron deficiency under ordinary dietary circumstances. During pregnancy, more iron is needed primarily to supply the growing fetus and placenta and to increase the maternal red cell mass.¹⁴ In the present research, it was found that mean serum iron was $71.9\mu\text{g/dl}$ in first trimester, $74.8\mu\text{g/dl}$ during second trimester, $80.9\mu\text{g/dl}$ in third trimester. It was observed that serum iron was lower in the Ist trimester of pregnancy. It was found that comparison between the current research and with the findings of mean serum iron was found to be lower than the serum iron in non anaemic pregnant women.¹⁵

Table 2 was shows that the iodine during each trimester of pregnancy was found to be $122.5\mu\text{g/dl}$ during first trimester, $149.1\mu\text{g/dl}$ during the second trimester of pregnancy and 158.7 during the third trimester. Results for each trimester, representing that the women were classified as iodine deficient at each trimester. During the first trimester of pregnancy the fetus depends on maternal thyroxine provided trans placentally; and at the last stage

of pregnancy the fetus can synthesize its own, however still depends on the iodine transferred by the mother.

The above Table 3 describe the percentage of the study subjects which are found to be deficient in each trimester of pregnancy. Subjects found to be haemoglobin deficient i.e. out of 60 subjects in 38 subjects and 22.8% was found in Ist trimester. During IInd and IIIrd trimester found to be haemoglobin deficient i.e. out of each 60 subjects in 37 and 16 subjects were found to be 22.2% and 9.6%.

The percentage of subjects which are found to be Ca deficient during first, second, and third trimester of pregnancy are 12%, 19.2 %, 18% respectively. During second trimester maximum study subjects are found to be Calcium deficient. In pregnancy, the very high circulatory concentrations of estrogens and progesterone alter the concentration of many substances including calcium in the maternal blood. Studies of calcium homeostasis responses during pregnancy have shown increase in both intestinal calcium absorption and urinary calcium excretion during pregnancy and increase rate of bone turnover during pregnancy.^{16,17}

In the respective study it was found that Zn level during Ist, IInd and IIIrd trimester of pregnancy was 13.2%, 11.4%, 16.8%, respectively had their serum zinc below $70\mu\text{g/dl}$. It was found that during third trimester majority of subjects are found to have low zinc level. Regarding the zinc variations during pregnancy period, our results indicated that zinc levels of subjects kept decreasing gradually from first trimester to third trimester.

Our findings showed that there was noticeable significant difference in iron levels during three trimesters. Iron level found to be low i.e. 28.8% of the study subject during first trimester of pregnancy. The level fluctuates during IInd and IIIrd trimester of pregnancy i.e. 18% and 16.8%. During IInd and IIIrd trimester study subjects were using iron and folic acid tablets. As it is clear from the Table 3 there was obvious significant difference in iron and zinc levels during three trimesters of pregnancy.

The above Table 3 shows the level of iodine during each trimester of pregnancy in the selected study subject which was found to be 25.2% of subjects have low iodine level during Ist trimester were as during IInd and IIIrd it was found to be 31.2% and 22.8% respectively.

CONCLUSION

The current study showed a decrease in the haemoglobin and serum calcium in the IInd trimester of pregnancy. Maternal serum zinc status during pregnancy directly effects foetal growth and infant's birth weight. It was found that mean serum zinc during the three trimesters of pregnancy is found to be decrease. In each trimester, the women were also classified as iodine deficient, which was found to be 25.2% of subjects have low iodine level during Ist trimester were as during IInd and IIIrd it was

found to be 31.2% and 22.8% respectively. Iron level found to be decrease in about 28.8% of the study subject during first trimester of pregnancy.

Impact of poor nutrition and diets, the socio- cultural factors contributing to the high levels of these micronutrients deficiency problems during pregnancy, and before. Encouraging a balanced diet and ensuring the adequacy of micronutrients is essential for minimising pregnancy complications. Further, more studies can be done regarding the supplementation of the essential micronutrients during pregnancy, more important in the second trimester of pregnancy because in the respective study it was found that the micronutrient level gradually decrease in the second trimester of pregnancy.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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