Short Communication

Micronutrient Deficiency in Pregnancy: Time to Think Beyond Iron and Folic Acid Supplementation

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Abstract

Background: Micronutrients play an important role in influencing pregnancy outcomes. Anemia is common among pregnant women against which iron and folic acid supplementation programs are already in action. The study aimed to estimate the prevalence of anemic and selected micronutrient status among pregnant women. **Materials and Methods:** It is a community-based cross-sectional study. The study was carried out among pregnant women registered in Primary Health Center, Kallur, Tirunelveli district, Tamil Nadu, India, using a semi-structured data capture tool. The blood samples were collected following standard procedure. **Results:** The micronutrient status among 139 pregnant women were selenium <1%, copper <1%, zinc 11.5%, iodine 14.4%, Vitamin B12 41.7%, and ferritin 42.4%. Vitamin B12, zinc, and selenium levels showed a significant difference with reference values among the three trimesters. Iron and folic acid supplementation was followed by 58.7% of pregnant women. Multiple micronutrient deficiency with anemia was found among 54.6%. **Conclusion:** Anemia and micronutrient deficiency are high among pregnant women in this region. Since iron and folic acid supplementation strategies are already being implemented by the government, it is high time that we extend our health policy beyond that and plan for micronutrient supplementation as well.

Keywords: Anemia, ferritin, micronutrients, pregnancy, Vitamin B12

Introduction

Optimal micronutrient status is essential for health, psychological well-being, and work capacity. The nutritional status of women has been identified as an overall indicator of the well-being of the society, and moreover, women need to enter pregnancy with adequate stores of micronutrients to meet the high nutrient demands of pregnancy and lactation. Various physiological changes take place during pregnancy from the time of conception till birth, and maternal nutrition not only influences her health but also pregnancy outcomes and the health of the neonate.[1]

Micronutrient deficiencies are highly prevalent among pregnant women. The World Health Assembly global nutrition targets 2025 aims to reduce the incidence of low birth weight, which requires a comprehensive strategy that involves multiple elements, of which improving maternal nutritional status is the foremost one.[2]

Requirements for several nutrients increase during pregnancy to meet maternal and fetal demands, which often exceed those met by physiological adaptations, necessitating an increased intake to meet these demands.[3] Although the importance of iron and folic acid in pregnancy has been frequently studied, the role of other micronutrients on maternal health is not adequately explored. Micronutrients like Vitamin B12, Folic acid, Vitamin A, Calcium, Zinc, Copper and Selenium play an important role in the overall development of the fetus and maternal metabolism.[4,5]

Focusing on these trace elements will help to understand the relationship between nutritional status and pregnancy outcomes. Since existing health policies and systems deliver

Access this article online

Quick Response Code:

Website: www.ijcm.org.in

DOI: 10.4103/ijcm.ijcm_743_21

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How to cite this article: Gopal M, Sunitha K, Arockiasamy J, Sibqathulla MJ, Yuvaraj J, Kalyanaraman S. Micronutrient deficiency in pregnancy: Time to think beyond iron and folic acid supplementation. Indian J Community Med 2022;47:425-8.

Received: 04-05-21, **Accepted:** 16-10-21, **Published:** 10-10-22

iron and folic acid supplements to pregnant women, the need for exploring the status of other micronutrients needs focus and emphasis.

The objective of the present study was to estimate the micronutrients status including anemia in pregnant women in rural part of Tirunelveli district, Tamil Nadu, India.

Materials and Methods

A community-based cross-sectional study was conducted among pregnant women in Kallur, Tirunelveli district, Tamil Nadu, India during August 2015 to September 2016. All pregnant women who registered at Kallur Primary Health Center for Antenatal care were line listed, and the study participants were selected following the cluster sampling method. Based on the prevalence of anemia among women in rural Tirunelveli, sample size of 240 was calculated. The National Family Health Survey-4 (NFHS-4) data were used to recruit the participants of pregnant women included in the study. After obtaining written informed consent, relevant data were collected from the pregnant women at their household by trained technicians using a semi-structured, predesigned, and pretested data capture tool developed in the local language.

Estimation of Micronutrients

A total of 240 pregnant women participated in the study. Venous blood sample was taken for estimation of Haemoglobin and micronutrients of importance in pregnant women, namely, ferritin, Vitamin B12, zinc, copper, and selenium levels. The estimation of micronutrients was done at the ICMR-Centre for Promotion of Nutrition Research and Training, New Delhi. Casual urine samples were collected and transported at 4°C for the estimation of urinary iodine concentration at the laboratory. The hemoglobin levels were used to classify anemia.[6] Deficient status of micronutrients was determined using cutoff values for serum ferritin[7] ≤15 ng/ml, Vitamin B12[8] ≤203 pg/ml, zinc[9] ≤700 µg/L, copper[10] ≤900 µg/L, selenium ≤23 µg/L,[10] and urine iodine 150–249 µg/L.[11] Of the 240 samples, the analysis report was completed for all the micronutrients in 139 mothers.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26 for Windows (SPSS Inc., USA). Descriptive statistics such as mean and standard deviation, frequencies and percentages were determined. Pearson's correlation was computed to examine how the variables were related to the micronutrients. One-way ANOVA, independent sample *t*-test, Chi-square test, and Fisher's exact statistic were also used for analysis, with the significance level of $P < 0.05$.

Results

The mean age of 240 pregnant women was 24.46 ± 3.95, and 80% of them belong to the age group of 20–30 years. 92.9% were Hindus, and the remaining were Christians and Muslims. Among them, 68 (28.3%) belonged to Scheduled Caste and 161 (67.1%) belonged to Backward Class. Pregnant women lived in nuclear and joint families in the ratio 1:1.2. Among the 240 participants, 87.1% of women had <5 members in their family and 166 (69%) were educated above middle school. Of the 166, 65 (39.2%) pregnant women were undergraduate/bachelor degree holders and 39 (16.3%) of them were working as laborers/cultivators, whereas the remaining were housewives. As far as the socioeconomic status is concerned, 201 (83.8%) belonged to the upper socioeconomic class.

Of the 240 participants, 122 (50.8%) were bearing their first child, whereas 87 (36.25%) were pregnant for the second time. Based on the gestational period, it was noted that 43 (17.9%), 98 (40.8%), and 99 (41.3%) belonged to the first, second, and third trimester, respectively. A total of 44 (18.3%) reported to suffer from morbidity conditions during the past 3 months.

Anemia

The mean hemoglobin value among the 240 pregnant women was 11.28 ± 2.02 (gm/dl) with mean values of 11.26 ± 2.12, 11.30 ± 2.04, and 11.28 ± 1.97 (gm/dl) in the first, second, and third trimester, respectively. The prevalence of anemia was 52.5% (74-moderate anemia and 52-mild anemia). The various characteristic features among pregnant women based on their anemic status are shown in Table 1.

Micronutrients status

The panel of micronutrients estimated was completely available for 139 pregnant women, and further discussion on micronutrients is limited to them only. Various characteristic features along with the micronutrient status are given in Table 2. The deficiency status of micronutrients were ferritin 59 (42.4%), Vitamin B12 58 (41.7%), zinc 16 (11.5%), copper 1 (<1%), selenium1 (<1%), and Iodine-20 (14.4%). An excess in copper level was observed among 92 (66.18%) pregnant women. The values of Vitamin B12, zinc, and selenium showed a significant difference among the three trimesters with $P = 0.008$, 0.005, and 0.000, respectively [Table 2].

Since copper and selenium deficiency was reported in <1% of individuals, further micronutrient deficiency analysis was compared with the anemic status and reported. Among 139 antenatal mothers, 29 had deficient amount of both Vitamin B12 and ferritin.

Considering multiple deficiency of the micronutrients, 46 (33.1%) women did not have any deficiency, whereas 57 (41%), 32 (23%), and 4 (2.9%) had at least one, two, or three deficiencies, among the listed micronutrients

Levels of Vitamin B12, zinc, and selenium decrease as the gestational age increases. Age of the pregnant females showed a significant positive correlation with hemoglobin ($r = 0.273$; $P = 0.001$). Vitamin B12 reported positive correlation with zinc ($r = 0.212$; $P = 0.012$) and ferritin ($r = 0.195$; $P = 0.022$), whereas zinc and selenium ($r = 0.253$; $P = 0.003$) shows positive correlation. Selenium has highly significant correlation with copper ($r = 0.386$; $P = 0.000$).

Table 1: Characteristic features of pregnant women based on their anemic status

Characteristics	Variables	Anemic status (*n*=240)			*P*
		No anemia (*n*=114)	Mild anemia (*n*=52)	Moderate anemia (*n*=74)	
Mean hemoglobin value		13.2±0.6	10.7±0.6	8.8±0.5	0.000*
Age (years)	<20 (*n*=27)	8	7	12	0.376‡
	21-30 (*n*=192)	96	40	56	
	>30 (*n*=21)	10	5	6	
Parity	Primi (*n*=122)	56	30	36	0.732†
	2nd(*n*=87)	42	18	27	
	≥3 (*n*=31)	16	4	11	
Trimester	1st (*n*=43)	21	9	13	0.840‡
	2nd (*n*=98)	48	18	32	
	3rd (*n*=99)	45	25	29	
Co-morbid status	Yes (*n*=44)	21	5	18	0.110‡
	No (*n*=196)	93	47	56	
Family size (members)	<5 (*n*=209)	94	49	66	0.100†
	≥5 (*n*=31)	20	3	8	
Educational status	Illiterate (*n*=1)	1	0	0	0.854†
	Primary and middle school (*n*=73)	36	14	23	
	High school (*n*=101)	43	25	33	
	Degree holder (*n*=65)	34	13	18	
Occupational status	Workingwomen (*n*=39)	17	9	13	0.866‡
	Housewife (*n*=201)	97	43	61	
	Upper class (*n*=201)	94	41	66	
IFA consumption	Yes (*n*=141)	68	32	41	0.761‡
	No (*n*=99)	46	20	33	

*One-way ANOVA, †Fisher exact statistic, ‡For all the other variables, Chi-square test is used. IFA: Iron and folic acid

Discussion

Micronutrient concentrations were evaluated in the present study among pregnant women. The prevalence of anemia among pregnant women was found to be 52.5%. It was observed that Vitamin B12, zinc, and selenium showed significant differences among the three trimesters. Multiple micronutrient deficiency along with anemia was reported among 27 (19.4%) pregnant women. Hemoglobin and copper levels were significantly associated with the age of the pregnant women.

Analyzing the importance of maternal health and to prevent anemia, the National Nutritional Anemia Prophylaxis Program was started in 1973, and then later, iron and folic acid supplementation was integrated into the Reproductive and Child Health Program.[12] In this study, 52.5% of the pregnant women had anemia which is consistent with the NFHS-4 finding of 50.3% anemia among pregnant women, with 45.7% in urban areas and 52.1% in rural areas.

In this study, 12% of pregnant women showed zinc deficiency with a significant difference among the three trimesters. During pregnancy, the micronutrient demand is indispensable, and the study conducted by Yasoghara *et al*. in 1991 showed a progressive decrease in the zinc concentration till term, that is a 20% decrease in normal zinc levels as compared to the levels in control women of similar gestational age.[13] Similarly, selenium also showed a significant difference among the three trimesters. It represented a gradual significant decrease from the first to third trimester but within the normal levels. Selenium concentration varies in pregnant women from country to country. A mini review by Zachara in 2016 observed that, although contrary results are proved by various studies, the results are dependent on the actual initial content of selenium in the body of the pregnant women,[14] which in turn is dependent on many other environmental factors such as selenium content in the soil, type of food consumed, place of residence, and many others.

Hemoglobin and copper were found to be significantly associated with the age of the pregnant women [Table 2]. Both early and delayed pregnancy often suffer from malnutrition and anemia, thus fail to provide appropriate conditions for the development of their fetus making the probability of higher level of adverse outcomes.[15]

Conclusion

Our study suggests that anemia still persists to be a public health problem and a growing cause of concern among pregnant women. Multiple micronutrient deficiencies are more common than single deficiencies. The results may call for closer screening and monitoring the micronutrient status of pregnant women at antenatal clinics. The study is an initiative to explore the micronutrient status among pregnant women to

Table 2: Distribution of mean values of micronutrients among pregnant women

	Ferritin (ng/ml)	Vitamin - B12 (pg/ml)	Copper (μg/L)	Zinc (μg)	Selenium (μg/L)	Iodine (μg/L)
Age group (years)						
≤20	27.09±17.63	295.79±141.14	2074.74±473.37	1216.59±600.18	89.68±31.06	206.33±103.02
21-30	25.87±25.03	297.51±190.51	2119.26±587.94	1314.83±660.41	85.21±23.91	212.78±92.33
≥31	19.41±13.86	279.00±153.62	2346.44±382.25	1224.18±599.79	87.54±30.49	204.17±116.85
P	0.703	0.958	0.463	0.784	0.763	0.938
Parity						
Primi	26.87±25.15	304.68±92.04	2055.92±499.48	1303.32±596.23	84.37±24.36	203.09±82.70
2nd	23.58±20.63	264.75±134.42	2182.62±618.79	1344.66±753.89	88.37±26.49	226.54±111.75
≥3rd	26.67±26.00	363.40±250.49	2283.56±631.65	1087.83±425.91	85.33±26.25	198.25±83.34
P	0.734	0.151	0.246	0.397	0.684	0.34
Trimester						
1st	23.23±18.53	366.43±160.91	1971.91±641.73	1657.83±988.62	100.31±30.89	208.99±104.31
2nd	26.70±24.77	316.68±198.57	2200.28±564.24	1295.13±610.23	88.21±25.14	215.94±93.29
3rd	25.32±24.25	238.10±150.77	2105.95±516.89	1132.65±395.88	76.65±18.49	206.54±93.82
P	0.828	0.008	0.234	0.005	0.000	0.863
Anemic status						
Normal	28.81±27.69	328.32±214.47	2113.36±595.96	1356.88±611.10	85.18±25.88	219.60±99.38
Mild	26.04±21.59	281.32±185.14	2048.16±461.36	1136.86±430.70	87.01±26.32	205.69±74.34
Moderate	21.95±18.46	265.37±130.28	2170.51±561.08	1280.62±735.84	86.50±24.63	204.09±96.31
P	0.282	0.154	0.69	0.421	0.943	0.647

untangle and understand their complex interplay culminating in adverse pregnancy outcomes.

Recommendations

Although initiatives, such as IFA supplementation, are already being undertaken by the government for pregnant women, it is time to extend and amend our health policies taking multiple micronutrient status of the pregnant women into account.

Limitations

The limitations of the study included its small sample size, lack of data on dietary practices, and its cross-sectional nature without adequate knowledge on prepregnant nutrient status of these mothers that could not establish the exact link for the micronutrient deficiencies. Research on a longitudinal basis will strengthen and establish the physiological link between various sociodemographic factors and micronutrients.

Financial support and sponsorship

This study was financially supported by the Indian Council of Medical Research (ICMR), New Delhi, India.

Conflicts of interest

There are no conflicts of interest.

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