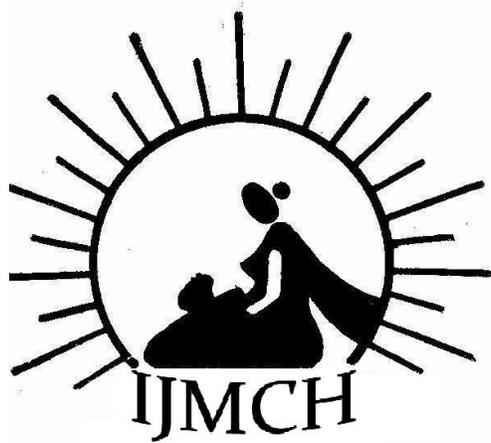


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What is the prevalence of iodine deficiency and iron deficiency anemia among pregnant women of Vadodara?

## Iodine and Iron Status of Women during Pregnancy

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### ABSTRACT

**Research question:** What is the prevalence of iodine deficiency and iron deficiency anemia among pregnant women of Vadodara?

**Setting:** Jamnabai General Hospital (JGH), Vadodara, Gujarat

**Study design:** Prospective study

**Participants:** Pregnant women attending antenatal clinic from January 2010 to March 2010

**Methodology:** A total of 80 pregnant women were studied during each trimester for iodine (urinary iodine concentration) and iron (haemoglobin) status.

**Results:** Median urinary iodine concentration ( $\mu\text{g/l}$ ) in first, second and third trimester was 264.1 (49.6-491.3), 286.0 (81.6-498.0) and 274.3 (74.1-543.6) respectively. According to urinary iodine concentration threshold used for diagnosis, percentage of population having iodine deficiency in first, second and third trimester was 22.5%, 32.5% and 20% respectively. Mean haemoglobin (g/dl) in first, second and third trimester was  $9.0 \pm 0.1$ ,  $9.1 \pm 0.1$  and  $9.4 \pm 0.1$  respectively. A significant increase of only 0.4 g/dl in mean haemoglobin between first and third trimester was found. Overall iodine intake of the population was adequate in all trimesters, whereas moderate iron deficiency was found in all trimesters.

**Keywords:** iodine, iron, pregnancy, trimester, knowledge

## INTRODUCTION

Iodine is critical for brain development and iron is critical for mental and physical ability. Currently, iodine deficiency (ID) is the world's leading cause of preventable mental impairment, affecting an estimated 18 million babies each year and Iron deficiency anaemia (IDA), can have lifelong effects on a child's cognitive development and learning abilities and puts women at a greater risk of death during childbirth. <sup>(1)</sup> Pregnant women are often iron deficient and iron deficiency has adverse effects on thyroid function.

Over the past decade, there has been increasing focus on ID during pregnancy. Iodine plays a crucial role in foetal brain development, especially during early gestation. <sup>(2)</sup> World Health Organization (WHO) had increased their recommended iodine intake during pregnancy from 150-250 µg/day. <sup>(3)</sup> The requirement during pregnancy is increased as a result of three factors: (1) an increased requirement for thyroxine (T4) in order to maintain normal metabolism in the mother; (2) a transfer of T4 from the mother to the fetus; and (3) a supposed greater than normal loss of iodine through the kidneys due to an increase in the renal clearance of iodide. Because of these three factors, the recommended dietary intake of iodine during pregnancy is higher than the value of 150 µg/day recommended for non-pregnant adults and adolescents. India bears a high burden of iodine deficiency disorders (IDDs). <sup>(4)</sup> The primary strategy for elimination of ID remains universal salt iodization (USI). <sup>(3)</sup> According to Yadav *et al*, 71.1 % of India's households consume adequately iodized salt, while approximately 9.3 % consume salt that is not iodized at all and the remaining 19.3 % of households consume salt that is not adequately iodized. <sup>(5)</sup>

In India, besides strengthening the USI programmes, additional complementary strategies should be considered to ensure optimal iodine nutrition of susceptible groups (pregnant and lactating women and children <2 years). <sup>(3)</sup> Nutrition health education (NHE) should be given to pregnant women regarding importance of iodine and iron nutrition during early onset of pregnancy. It is even better to start providing NHE to newly wedded women.

Hence, to prevent foetal brain damage from ID and to reduce the risk of maternal deaths due to iron deficiency, there is a need to monitor iodine and iron status throughout pregnancy.

Objectives of the study were- 1) to study iodine and iron status of pregnant women and 2) to study the outcome of NHE on knowledge and practices of pregnant women regarding importance of iodine and iron during pregnancy.

## METHODS

**Design:** Present study is a prospective study.

**Setting:** Study was carried out in Vadodara district of Gujarat. From January 2010 to March 2010, pregnant women who checked in for antenatal assessment in Jamnabai General Hospital (JGH), Vadodara were enrolled for the study. JGH is Vadodara's most popular hospital among low income group people. It has a delivery rate of 250-300/month, which is highest among all general hospitals in Vadodara. People from different parts of Vadodara and also from nearby small villages, come to JGH for availing antenatal services, immunization services and for delivery.

**Participants:** A total of 100 pregnant women belonging to low socio-economic status were enrolled for the study during early gestation (<15 weeks). A total of three visits (third

month, six month and nine month) were required by pregnant women. However, due to various reasons (change in address/ change in contact number/not interested in further participating) all 100 pregnant women did not come for follow-up during second and third trimester. All three trimesters data was collected from 80 pregnant women. Most of the pregnant women were educated till primary only and were housewives.

**Data collection:** All pregnant women were given a consent form (in local language) and the purpose of the study was explained to them. After obtaining consent from them, background information, socio-economic status, obstetric history and anthropometric measurements were recorded. Information on nutrient intake was recorded using 24 hr. dietary recall method.

NHE was provided (using posters) as intervention on importance of iodine during foetal brain development, role of iron in reducing risk of maternal and child mortality, healthy cooking and storage practices to minimize iodine loss, how to recognize iodized salt etc. First session was conducted at the time of enrolment. The idea was to provide knowledge regarding the importance of iodine and iron nutrition during early pregnancy and to change their incorrect practices of cooking and storing iodized salt. Reinforcement was carried out during second visit. Knowledge (K) and Practices (P) were recorded using KP questionnaire [(before (first visit) and after intervention (third visit)].

**Sample collection and method of estimation:** Blood collection for haemoglobin estimation- Finger prick method was used for blood specimen collection. 20  $\mu$ l of blood was used for estimation. Haemoglobin was assessed using Acid Haematin (Sahali's Haemoglobinometer) method (procedure followed at government hospitals as per government regulations).

Urine collection for urinary iodine estimation- urine samples were collected in a sterile 50 ml container. 50  $\mu$ L of urine was used for estimation. Urinary iodine concentration (UIC) was assessed using Simple Microplate (Sandell- Kolthoff reaction) Method. <sup>(6)</sup>

**Criteria used:** ID- It was defined using UIC ( $\mu$ g/l). Criteria recommended by WHO/UNICED/ICCIDD was used (<150= inadequate, 150-249=adequate, 250-499=more than adequate and  $\geq$ 500=excessive). <sup>(3)</sup> IDA- It was defined using haemoglobin levels (g/dl). Criteria recommended by UNICEF/UNU/WHO was used (<7= severe, 7-9.9=moderate, 10-10.9= mild and  $\geq$ 11=normal). <sup>(7)</sup>

**Ethical approval and Statistical methods:** Permission for the study was obtained from concerned health authorities of the state and ethical approval was obtained from Baroda Medical College, Vadodara, Gujarat. Statistical package for Social Sciences for Windows version 14.0 (SPSS Inc., IL, USA) was used for data analysis. Simple descriptive analysis of data was carried out. For comparing data between all three trimesters, one way ANOVA with further Bonferroni post-hoc analysis was carried out. A two-tailed p value <0.05 was considered as statistically significant.

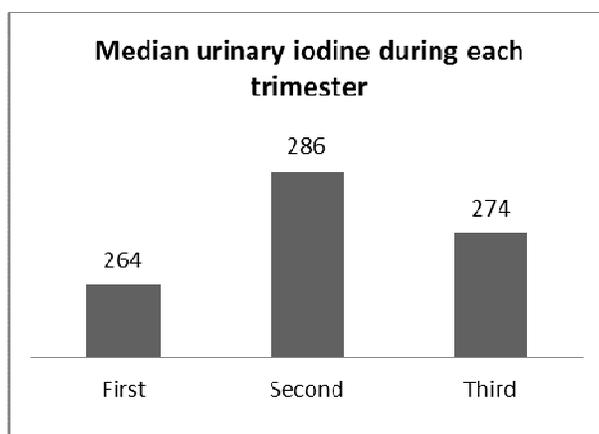
## RESULTS

A total of 80 pregnant women aged 18 to 36 years were studied [(mean(sd), 23(3.9)]. Parity ranged from 0 to 2 [mean(sd), 0.6(0.6)/women]. Per capita income ranged from Rs. 300 to 5,000 [mean(sd), 958.7(68.3)]. No alcohol intake and smoking habits were found in the study population.

**Anthropometric measurements, nutrient intake and nutrition status:** Height of pregnant women ranged from 139-164 cm [mean(sd), 151.2(5.5)], with 11.2 % pregnant women having height <145 cm. Mean weight (kg) initial (3 months) and final (9 months) was found to be 45.8±9.3 and 51.5±9.0 respectively, with a mean weight gain of 5.4±1.3 during entire pregnancy. Mean energy (kcal), protein (g) and fat (g) intake was 1,596±345, 45.9±13.1 and 51.6±15 respectively. Mean Body Mass Index (BMI) of pregnant women during early pregnancy (3 months) was 19.9±3.6 kg/m<sup>2</sup>, which increased to 22.4±3.5 kg/m<sup>2</sup> towards the end (9 months).

**Iodine deficiency:** Median UIC (µg/l) ranged from 49.6 to 491.3, 81.6 to 498.0 and 74.1 to 543.6 during first, second and third trimester respectively. Median UIC in all three trimesters was >150 µg/l (Figure 1). Percentage of population having adequate, more than adequate and excessive iodine intake is shown in Table 1.

**Figure 1: Median urinary iodine (µg/l)**



**Table 1: Distribution of pregnant women according to their urinary iodine concentration (µg/l) during each trimester**

Iodine Intake	First trimester (n=80)	Second trimester (n=80)	Third trimester (n=80)
Inadequate	18 (22.5%)	26 (32.5%)	16 (20%)
Adequate	19 (23.8%)	9 (11.3%)	18 (22.5%)
More than adequate	43 (53.8%)	45 (56.3%)	45 (56.2%)
Excessive	0 (0)	0 (0)	1 (1.3%)

**Iron deficiency anaemia:** Mean haemoglobin (g/dl) in first, second and third trimester was 9.0±0.1, 9.1±0.1 and 9.4±0.1 respectively, reflecting moderate iron deficiency in all three trimesters. Table 2 shows prevalence of anaemia during pregnancy. Increase in mean haemoglobin between first, second and third trimester was 0.1 (first and second), 0.3 (second and third) and 0.4 (first and third). On comparing the means between three trimesters, a significant increase in mean haemoglobin was found (p<0.05). Multiple comparisons between first and second, second and third and third and first trimester, showed a significant increase (0.4) in mean haemoglobin between third and first trimester (p<0.05).

**Table 2: Distribution of pregnant women according to their haemoglobin level (g/dl) during each trimester**

Iron Deficiency Anaemia	First trimester (n=80)	Second trimester (n=80)	Third trimester (n=80)
Severe	4 (5.0%)	0 (0)	0 (0)
Moderate	55 (68.8%)	55 (68.8%)	44 (55%)
Mild	18 (22.5%)	21 (26.3%)	28 (35%)
Normal	3 (3.8%)	4 (5.0%)	8 (10%)

**Knowledge and practices:** Knowledge of pregnant women regarding critical role of iodine and iron during pregnancy was poor before intervention (Table 3). NHE has shown improvement in knowledge of pregnant women and positive changes in their practices.

**Table 3: Outcome of intervention (NHE) on Knowledge and Practices of pregnant women regarding importance of iodine and iron during pregnancy**

Indicators of Knowledge and Practices of population	Responses	Intervention	
		Before	After
Percentage of population who have heard about IS	Yes	39.7 %	98.7 %
	No	60.3 %	1.3 %
Percentage of population who could recognize IS	Yes	32.1 %	94.9 %
	No	67.9 %	5.1 %
Salt keeping practices	Near flame	9.0 %	-
	Away from flame	91.0 %	100 %
Salt storing practices	Covered container	97.4 %	100 %
	Polythene	2.6 %	-
Addition of salt during cooking	Starting	60.2 %	5.2 %
	Middle	15.4 %	5.2 %
	End	24.4 %	89.6 %
Percentage of population who have heard about IFA	Yes	28.2 %	100 %
	No	71.8 %	-

## DISCUSSION

Adequate maternal nutrition is important for the health and reproductive outcome of women, child survival, and development. Low pre-pregnancy BMI and short stature of women are risk factors for poor birth outcomes and delivery complaints. Saxena *et al* conducted a study on nutritional status of rural pregnant women (n=400) of Lucknow district. <sup>(8)</sup> They have reported that overall 23.3 % of pregnant women had BMI <18 kg/m<sup>2</sup>. In present study percentage of underweight pregnant women was 30.9 % during early gestation. In developing countries maternal underweight is the leading risk factor for preventable death and disease, it also leads to low work productivity.

Urinary iodine is a sensitive indicator of recent iodine intake (days). It is one of the most popular indicators used for assessment of iodine nutrition. According to UIC threshold used

for diagnosis, percentage of population having iodine deficiency in first, second and third trimesters was 22.5 %, 32.5 % and 20.8 % respectively. Chakraborty *et al* studied IDD among pregnant women (n=200) in a tertiary care hospital of Kolkata, India. <sup>(9)</sup> Authors have reported that only four cases out of 200 pregnant women had an UIC of less than the lower cut-off value for UIC recommended by the WHO corresponding to optimal iodine intake. Wang *et al* studied iodine status of pregnant women in China. According to their study urinary iodine medians of pregnant women in the first, second, third trimesters were 174 µg/l, 180 µg/l and 147 µg/l respectively. <sup>(10)</sup> However in present study, median UIC was highest in second trimester followed by third and first. Studies in population with mild iodine deficiency from communities in Swiss and United Kingdom studies have provided gestation specific data. <sup>(11, 12, 13)</sup> This data reveals a decrease in UIC with advancing gestation; however data from Hong Kong reveal an increase in UIC with advancing gestation. <sup>(14)</sup> The explanation for these differences is unclear, but ethnic variation in diet structure or degree of overall iodine deficiency may play a role. <sup>(15)</sup> Our UIC values indicate that, overall iodine intake of the population was adequate in all trimesters, despite that iodine deficiency was found in a significant proportion of pregnant women in all three trimesters.

Iron requirements are greater in pregnancy than non-pregnant state. Iron deficiency anaemia has important consequences for maternal and child health. In developed countries most women enter pregnancy with normal haemoglobin concentrations and variable amount of iron stores. Zimmermann *et al* studied iron status of Swiss pregnant women in second and third trimester. Mean haemoglobin (g/dl) in second and third trimester was found to be 12.3 and 12.1 respectively. <sup>(16)</sup> In contrast, large numbers of women in developing countries are anaemic at the onset of pregnancy. In a study conducted by Singh *et al* on women (384 pregnant, 400 lactating and 409 non-pregnant non-lactating controls) in Rajasthan, authors have found that majority of the women were anaemic. <sup>(17)</sup> Prevalence of severe anaemia was three-fold higher among pregnant and lactating women in comparison to controls. It is a known fact that, as pregnancy progresses, iron requirements for foetal growth will rise steadily in proportion to the weight of the foetus. This may result in increase in severity of IDA unless iron supplementation is initiated for the mother. <sup>(18)</sup> Severity of anaemia in present study was found only in first trimester, reflecting that the iron status improved in second and third trimester. This improvement is due to consumption of Iron Folic Acid [IFA (ferrous sulphate), 60 mg of elemental iron + 0.5 mg folic acid twice a day] tablet by pregnant women, which they have started during fourth month and continued till delivery.

Despite a high prevalence of maternal anaemia in Gujarat and lots of government programmes (anemia awareness), the knowledge regarding importance of IFA was very poor among pregnant women (table 3). Percentage of women who have ever heard about iodized salt (IS) increased by 59 % and of women who could recognize IS increased by 62.8 % after providing NHE.

According to Rana *et al*, cooking losses of iodized salt ranges from 6.5%- 51.0%. <sup>(19)</sup> In order to get maximum iodine from our salt, it is necessary to take care of few small but important things like- proper storage of iodized salt, healthy cooking practices etc. A marked improvement was found in salt keeping practices of pregnant women. After intervention, everyone has started keeping iodized salt away from flame. Salt storing practices of the population were fair, and became good after NHE (Table 3). A favourable change was observed in practices of pregnant women after NHE on addition of salt during cooking. We

observed that better cooking practices were followed by mothers like- adding salt after 75 % cooking is done, closing the lid while cooking etc. These small changes in their practices of storing, keeping and cooking iodized salt will definitely increase the iodine content of their diet.

### CONCLUSION

Overall iodine intake of population was adequate. However, 20-32 % population had iodine deficiency during pregnancy. There is lack of data on trimester specific reference intervals for urinary iodine as we have for thyroid hormones. There is urgent need to study iodine and thyroid status of pregnant women in India and establish appropriate reference intervals for both urinary iodine and thyroid hormones.

Respite taking IFA (twice a day), moderate iron deficiency anemia was found throughout pregnancy with only a minor increase in haemoglobin of 0.4 g/dl from third to nine month. Though IFA consumption helped in reducing severity of anemia from first to third trimester; it did not bring desirable increase in haemoglobin levels. This finding emphasizes urgent need to revise strategies for combating iron deficiency anemia in Gujarat.

A combination of both (iodine and iron deficiency) can result in decrease thyroid hormone production. Iron deficiency may block a child's ability to use iodine. Our data supports the need of dietary diversification (improving access to foods that are rich sources of iron and ascorbic acid) along IFA, fortification of foods with iron (double fortified salt) and to provide NHE to pregnant women on important role of iodine and iron during early pregnancy. NHE should be given to pregnant women regarding importance of regular consumption of IFA and iodine rich foods. This would help to sustain these two minerals in the body.

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