Original article

Screening of pregnant women for iodine deficiency and iron deficiency during early gestation in Vadodara

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ABSTRACT
BACKGROUND: Over the past decade, there has been increasing focus on iodine deficiency during pregnancy, yet 38 million newborns in developing countries every year remain unprotected from the lifelong consequences of brain damage associated with iodine deficiency. Pregnant women are often iron deficient and iron deficiency has adverse effects on thyroid metabolism. Hence, to prevent both the mother and baby from the consequences of iodine and iron deficiency, pregnant women should be screened as early as possible.

OBJECTIVE: To screen pregnant women for iodine deficiency and iron deficiency during early gestation. Methods: Pregnant women (≤15 weeks) attending antenatal clinic (January–March 2010) in Jamnabai General Hospital, Vadodara were enrolled for the study. Urine and blood samples were collected from 225 pregnant women for estimation of urinary iodine, haemoglobin and thyroid hormones.

RESULTS: Out of the total population (n=225), only 52 % had normal thyroid hormone levels. Median urinary iodine concentration (UIC) was 274.82 µg/l and 21.6 % of the population had UIC < 150 µg/l. Mean TSH and FT_4 was 2.29±1.6 µIU/ml and 10.20±2.5 pmol/dl, respectively, with 22 % pregnant women having TSH >2.5 µIU/ml and normal FT_4 (subclinical hypothyroidism), 15 % having FT_4 <8.36 pmol/dl and normal TSH (hypothyroxenemia) and 11 % having both (overt hypothyroidism). Mean haemoglobin was found to be 9.2±1.1 g/dl. Out of the total population screened 93 % had haemoglobin levels below 11 g/dl. Conclusion: Iodine and iron nutrition in pregnant women (LIG) of Vadodara is observed to be sub optimal, which may compromise the potential development for adequate mental and psychomotor development of the offspring during gestation.

KEYWORDS: pregnancy, iron deficiency, iodine deficiency

INTRODUCTION

Currently, iodine deficiency is the world's leading cause of preventable mental impairment, affecting an estimated 18 million babies each year. Iron deficiency anaemia (IDA), the most wide-spread nutritional deficiency, can have life-long effects on a child's cognitive development and learning abilities and put women at greater risk of death during childbirth. Iodine is critical for brain development and iron is critical for mental and physical ability[1].

Iodine is an integral part of thyroid hormones, and thus plays a crucial role in foetal organogenesis, and in particular in brain development. This takes place during early gestation and involves delicate targeting throughout the central nervous system[2]. Iodine uptake by the thyroid is higher in pregnancy and iodine reserve in the thyroid can decrease to approximately 40 % of preconception levels. World Health Organization (WHO) has recently increased their recommended iodine intake during pregnancy from 200-250 microgram/day[3]. Increased requirement of a mother for iodine during pregnancy is caused as a result of an increased requirement for thyroxine (T_4) in order to maintain normal metabolism in the mother, a transfer of T_4 and iodide from mother to the foetus and increased loss of iodide through the kidneys due to an increase in the renal clearance of iodide.

Thyroid gland stores iodine from the diet, which is independent of maternal iodine status and is not entirely dependent on the current dietary intake during gestation. Adequate pre-conceptional iodine can safeguard sufficient stores of thyroid hormone to support the mother and foetus, at least in the first trimester. However if pre-conceptional dietary intake is deficient the increasing demands of later pregnancy may produce a deficit, this if remained untreated can result in a hypothyroxinaemic state[4]. During the first two trimesters of pregnancy the foetus is entirely dependent on the maternal thyroid hormone supply as the foetal thyroid does not develop until 13-15 weeks of gestation [4, 5]. As the foetus progresses into the third trimester, it develops the ability to produce its own thyroid hormones but it is still dependent on maternal iodine for hormone synthesis [6].

Iodine deficient status in the mother is associated with impaired foetal development, both mental and physical. Epidemiological studies and case reports show that even a relatively minor degree of maternal hypothyroxenemia during the first half of gestation is potentially dangerous for optimal foetal neurodevelopment.

Pregnant women are often iron deficient and iron deficiency has adverse effects on thyroid function. During the second and third trimester, pregnant women are highly vulnerable to iron deficiency because their increased iron needs are rarely met by dietary sources. Iron deficiency has multiple adverse effects on thyroid metabolism. It decreases circulating thyroid hormone concentrations, likely through impairment of the heme-dependent thyroid peroxidise (TPO) enzyme.

Hence, to prevent foetal brain damage, pregnant women should be screened for iodine deficiency and iron deficiency anaemia as early as possible.

MATERIALS AND METHODS

Study area and population:

The study was carried out in Vadodara district of Gujarat state, India. Iodine deficiency disorders (IDD) is a public health problem in Gujarat and Vadodara district is considered as a new pocket of IDD[7]. Many studies have been conducted in different states of Gujarat to study the prevalence of iodine deficiency and thyroid function in school aged children. However, no data is available on prevalence of iodine deficiency and thyroid dysfunction in pregnant women of Vadodara.

Between January–March 2010, 225 pregnant women [low income group (LIG)] who checked in for antenatal assessment in Jamnabai General Hospital, Vadodara were enrolled for the study. Only those pregnant women were included for screening that came before 15 weeks of gestation, who were not a known thyroid patient and aged between 18-37 years.

Data collection:

All the pregnant women were given a consent form (in Gujarati) and the purpose of the study was explained to them. After obtaining consent from them, background information, socio-economic status, medical history and anthropometric measurements were recorded. The characteristics of the study population are given in table 1.

Sample collection and storage:

Venous blood was collected using a plain serum separating tube from pregnant women during their first visit to the hospital for thyroid hormone and haemoglobin analysis. Haemoglobin estimation was performed on the spot by hospital staff and results were recorded. Remaining blood sample was used for thyroid hormone analysis. After 30 minutes samples were centrifuged and serum was separated. The samples were than stored at -18 ^{0}C till analysis. The analysis was carried out in June 2010 at Radiation Medicine Centre (RMC), Bhaba Atomic Research Centre (BARC), C/o Tata Memorial Annexe, Parel, Mumbai, India.

Haemoglobin was assessed using Acid Heamatin (Sahali's Haemoglobinometer) method. Urinary iodine concentration (UIC) was assessed using Simple Microplate (Sandell- Kolthoff reaction) method[8]. Thyroid function was assessed by measuring the concentration of thyroid stimulating hormone (TSH, Immunotech), free thyroxine (FT_4, Immunotech), total thyroxine (TT_4, In-house kit, BARC) and thyroglobulin (Tg, In-house kit, BARC) by radioimmunoassay.

Permission for the study was obtained from concerned health authorities of the state and ethical approval was obtained from Baroda Medical College, Vadodara.

Statistical analysis:

Simple descriptive analysis of the data was carried out using SPSS (version 14) and the results are expressed as mean ± SD and percentages.

RESULTS

The mean age of study population was 23.31±3.6 years. All pregnant women were belonging to low socio economic status and most of them had completed their education till primary level only. No alcohol intake and smoking habits were found in the study population. Mean weight and height was found to be 45.65±8.2 kg and 150.08±5.3 cm, respectively and 10.4 % pregnant women had height <145 cm. Anthropometric data reveals that 36 % of the pregnant women were thin and nearly 50 % were normal.

Iron status

For pregnant women, haemoglobin concentration of ≥11 g/dl is considered as normal[9]. Haemoglobin concentration between 10.0-10.99 g/dl is considered as mildly deficient, between 7.0-9.9 g/dl is considered as moderately deficient and <7 g/dl is considered as severely deficient. Mean haemoglobin of the study subjects was 9.2±1.1 g/dl at 15 weeks and only 7 % of the pregnant women had normal haemoglobin concentrations. Our observations state that, out of 93 % pregnant women who were anaemic, 26 % were having mild anaemia, 64 % had moderate anaemia and 3 % had severe anaemia. Consumption of iron rich foods was low among the study population (data not presented here).

Iodine status:

TABLE I: CHARACTERISTICS OF THE STUDY POPULATION

Characteristics	Percentage
Religion	
Hindu	69
Muslim	31
Occupation	
Housewife	100
Working	-
Education	
Illiterate	7
Primary	69.3
SSCE	22. 7
Graduation	1
Parity and abortions	
Primpara	41.8
Multipara	58.2
No abortions	82.2
1 or more abortions	17.8
Smoking habits	
Never	100
Not in pregnancy	-
Alcohol intake	
Never	100
Not in pregnancy	-

TABLE II: THYROID HORMONES OF PREGNANT WOMEN DURING 1ST TRIMESTER

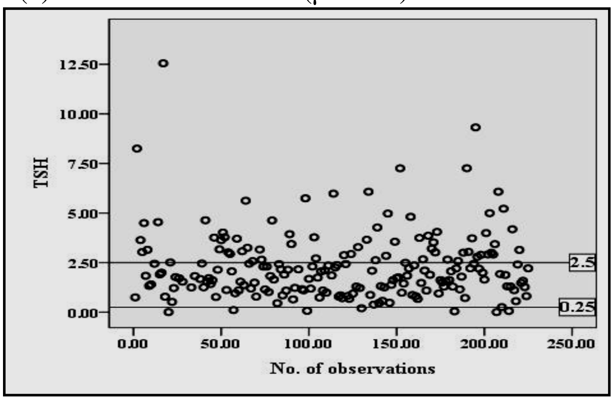
Thyroid hormone	Median (range)	Normal value (kit)
TSH µIU/ml	1.95 (0.107-12.55)	0.25-5.10
FT_4 pmol/dl	10.50 (1.54-17.91)	8.36-27.02
TT_4 µg/dl	10.24 (5.14-16.34)	4.20-13.0
Tg ng/ml	3.9 (0.1-32.3)	0.0-50.0

Median urinary iodine concentration (UIC) was 274.82 µg/l and 21.6 % of the population had UIC <150 µg/l, indicating iodine deficiency. Maternal Overt Hypothyroidism (OH) can be defined as TSH concentration >2.5 µIU/ml and FT_4 concentration below normal range. In maternal Subclinical Hypothyroidism (SCH), patient may not have symptoms but the concentration of TSH is above 2.5 µIU/ml with normal FT_4 concentrations. Maternal Hypothyroxinemia (HT) can be defined as normal TSH concentrations with FT_4 concentration below normal range. Out of the total population (n=225) screened, 52 % had normal thyroid hormone levels. Mean TSH, FT_4, TT_4 and Tg were found to be 2.29±1.6 µIU/ml, 10.20±2.5 pmol/dl, 10.24±2.0 µg/dl and 5.6±5.7 ng/dl, respectively. Table 2 gives median values for TSH, FT_4, TT_4 and Tg.

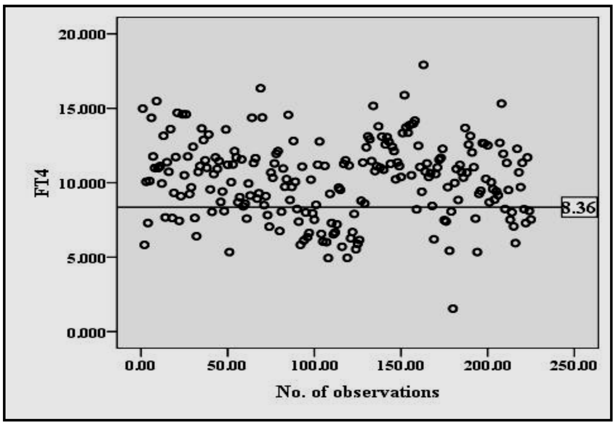
Prevalence of overt hypothyroidism, subclinical hypothyroidism & hypothyroxenemia was found to be 11%, 22% and 15% respectively. Only 1 subject was found with TSH level >10 µIU/ml (figure 1a).

FIGURE I: DISTRIBUTION OF TSH AND FT_4 DURING 1ST TRIMESTER

I (a) Distribution of TSH (µIU/ml)



I (b) Distribution of FT_4 (pmol/dl)



DISCUSSION

Our study is the first attempt to provide data on iodine deficiency during early pregnancy in pregnant women of Vadodara. Many studies have been conducted in Gujarat aiming to map the prevalence of iodine deficiency; however most of them have focused on iodine status of children. WHO has increased the iodine requirements of pregnant women, where as the intake of pregnant women remains the same. Hence there is a need to spotlight this vulnerable group. For ensuring adequate iodine intake for pregnant women, besides strengthening the USI programmes, additional complementary strategies should be considered. Early screening of pregnant women for iodine deficiency can play an important role.

Apart from iodine, adequate maternal nutrition is important for the health and reproductive outcomes of women, child survival, and development. Low pre-pregnancy body mass index (BMI) and short stature of women are risk factors for poor birth outcomes and delivery complications. In developing countries maternal underweight is the leading risk factor for preventable death and disease; it also leads to low work productivity. Early detection of underweight pregnant women alarms us regarding the growth and development of the foetus.

Iron requirements are greater in pregnancy than nonpregnant state. 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 [(10)]. This may result in increase in severity of IDA unless iron supplementation is initiated for the mother. Iron status of the study population was found to be alarming. Only few of them had haemoglobin levels above 11 g/dl. With such low levels of haemoglobin in the first trimester, there are chances that these pregnant women will become more anaemic during second and third trimester and they might deliver low birth weight babies with low mental and physical ability. Iron deficiency anaemia has important consequences for maternal and child health. In developed countries most women enter pregnancy with normal haemoglobin concentrations and variable amounts of stored iron. In contrast, large numbers of women in developing countries are anaemic at the onset of pregnancy [(11)]. Our findings reflect similar situation, moderate anaemia was found in majority of subjects at the onset of pregnancy.

Human foetal ontogeny begins at 10-12 weeks of gestation and continues to develop until delivery, but during early pregnancy, foetal thyroid hormone requirement is dependent on maternal supply[12,13]. Perinatal outcomes are therefore dependent not only on maternal thyroid status during pregnancy but also on the gestational age at which maternal hypothyroidism occurs. According to Glinoer[14]. When severe enough, iodine deficiency may induce maternal and foetal hypothyroxenemia from early gestation onwards

Several complex physiological changes take place during pregnancy, which tend to modify the economy of the thyroid and have a variable impact at different time sets during gestation. If daily iodine intake is not sufficient, respite an increase in glandular uptake to 60 %, the equilibrium (thyroidal pool of inorganic iodide and two main organs, thyroid and kidneys) remains more or less unbalanced, since the iodine entry resulting from both uptake and recycling is insufficient to fulfil the increased requirements for thyroid hormone production. If iodine deficiency exists during early onset (first trimester), the already low intra-thyroidal iodine stores become more depleted and when iodine deficiency continues during second and third trimester, it tends to become more severe.

In India, the household usage of iodized salt is 71.1 % and in Gujarat it is 71.4 % [15]. WHO has recommended two major approaches to give additional iodine to pregnant women. For countries where household usage of iodized salt is between 20-90 %, pregnant women should be given a daily oral dose of iodine as potassium iodide so that the iodine intake is 250 µg/day, either alone or combined with other minerals and vitamins. The other method is as a single annual oral dose of 400 mg of iodine as iodized oil[3]. In Vadodara, Gujarat Government is providing iodized salt to pregnant women through *anganwadi* [ICDS (Integrated Child Development Services) centres]. Apart from iodized salt, energy dense foods are also provided to pregnant women in the form of *sukhdi, upma* and *sheera* under NRHM (National Rural Health Mission) programme.

Kapil et al have carried out a study on pregnant women in three urban slum communities of Delhi. They aimed to identify the prevalence of micronutrient deficiencies and found that 15.1 % of pregnant women were having combined prevalence of IDD and IDA[16]. In our study both IDD and IDA were found. A combination of iodine and iron deficiency anaemia can result in decrease thyroid hormone production as iron is an important component of TPO enzyme. Iron deficiency may block a child's ability to use iodide and iodide prophylaxis may be of no use if iron is not constituted simultaneously.

CONCLUSION AND RECOMMENDATIONS

Iodine and iron deficiency may affect infant's development that are irreversible such as eye-hand co-ordination, manipulation, understanding of object relations, imitations, early language development and motor development if not taken care at an early stage. Hence, it is very important and crucial that the pregnant women attain sufficiency of iodine and iron before pregnancy. Rather it is recommended that during adolescence the girls should be supplemented with adequate iodine and iron. So that they enter pregnancy with sufficient enough stores to give birth to a healthy baby and herself remains healthy. Iodine and iron nutrition in pregnant women (LIG) of Vadodara is observed to be sub optimal, which may compromise the potential development for adequate mental and psychomotor development of the offspring during gestation. Iodized salt and iron supplements have a beneficial impact on thyroid status of both the mother and the newborn. Prevention of fetal iodine deficiency is feasible, provided that iodine requirements of the mother are met both, before and throughout gestation and continued through lactation. It is suggestive that public health experts should review these situations and provide appropriate recommendations countrywide.

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