IODINE STATUS AND THYROID FUNCTION AMONG PREGNANT WOMEN IN A TERTIARY HEALTH CENTRE IN GUSAU, NIGERIA

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ABSTRACT

Background: Iodine is an essential micronutrient essential for thyroid hormone synthesis. Treatment of iodine deficiency during the late gestation period does not improve or correct foetal or neonatal neurological development and inadequate iodine intakes during pregnancy may result in varying degrees of hypothryoidism affecting pregnancy outcomes adversely. The study was designed to determine Iodine status of pregnant women in various trimesters and assess the thyroid hormones and iodine levels association among them. Materials and Methods: A total of 192 pregnant women in their various trimesters and 65 non-pregnant, non-lactating age-matched controls were evaluated. Spot urine samples were measured for pregnant women in each trimester and controls for iodine levels using modified Sandell-Kolthoff method. Serum samples were assayed for levels of Thyroxine (tT4), Triiodothyronine (tT3), and thyroid-stimulating hormone (TSH) in each trimester in subjects and controls by Enzyme-linked immunoassay method. Data were analyzed using SPSS version 21 for the mean ages and median urinary iodine concentration (UIC) for pregnant women, controls and then for each trimester of pregnancy. p < 0.05 was considered statistically significant for correlation of iodine levels between the various trimesters and thyroid hormones. Results: Mean ages ± standard deviation for pregnant women and controls were 25.51 ±4.97 years and 26.50 ± 6.33 years, respectively (p > 0.05). Median urinary iodine concentration (UIC) for pregnant women and controls were 124 µg/L and 143 µg/L, respectively. Trimester-specific median UICs were 134 µg/L, 125 µg/L, and 117 µg/L for the first, second, and third trimesters, respectively. Conclusion: The study suggested a positive correlation between UIC and tT3, tT4 in the first, second and third trimesters. A negative correlation between UIC and TSH was also established in all the trimesters. The degree of women with iodine deficiency increased with advancing gestational period.

KEYWORDS: Iodine, urine, pregnancy, thyroid, trimesters, Gusau.

INTRODUCTION

Iodine is an essential micronutrient for all animal species, including humans,[1] which is necessary for the synthesis of thyroid hormones; Thyroxine (T4) and Triiodothyronine (T3).[2] In pregnant women thyroid hormones are required for development and maturation of brain and neurological network of the foetus.[3] Transplacental passage of iodine and Thyroxine from mother to foetus takes place throughout pregnancy.[4] That is why in pregnant women thyroid hormones synthesis is physiologically increased that requires more iodine. Moreover, renal clearance of iodine from the kidney is increased and a part of the available iodine from the maternal circulation is diverted to the foetus for thyroid hormones synthesis by the foetal thyroid gland.[5] For healthy pregnant women with iodine sufficiency, maternal gland readily adjusts the hormonal output due to ample supply of iodine. This state is difficult to achieve when iodine intake of pregnant women is limited and leads to a relative iodine deficiency state in mother as well as foetus.[6] Iodine deficiency is detrimental to both mother and foetus leading to goitrogenesis and hypothyroxinaemia in mother and consequently suboptimal brain development in foetus.[7]

The recommended dietary intake of iodine is 150µg/day for adult and 200 µg/day for pregnant women. Hence,
the urinary iodine concentration (UIC) for pregnant women were considered inadequate (below 150µg/L), adequate (150–249 µg/L), more than adequate (250–499 µg/L) and excessive (above 500 µg/L), respectively. In non-pregnant population, UIC of 100–199 µg/L is considered adequate while mild iodine deficiency is represented by UIC of 50–99 µg/L. Several indicators are usually utilized in the assessment of iodine status of a population namely: Thyroid size by palpation or ultrasonography, urinary iodine concentration (UIC), thyroid stimulating hormone, and thyroglobulin measurements in blood. Iodine excretion from spot urine samples has been widely accepted as a satisfactory index of iodine intake. Iodine deficiency disorders is the most common cause of preventable mental impairment worldwide. An estimated 1.571 billion people worldwide live in iodine-deficient environments and thus at the risk of IDD (United Nations Children’s Fund). World Health Organisation estimated that two billion people worldwide are iodine deficient.

140 million people were thought to be affected by some degree of mental impairment in Africa. In Nigeria, a national goiter rate of 7.7% was reported by UNICEF in 2004 and 20 million Nigerians were affected by IDD. About 590,000 babies were born with intellectual impairments annually in Nigeria. Iodine deficiency was a singular cause of most cases of mental retardation on children in Nigeria. Economic loss is estimated to be $220 million per year to the Nigerian economy. As part of the strategies to reduce the prevalence of IDD in Nigeria, universal salt iodization (USI) programme was introduced in 1995. To ensure effective iodization and iodine sufficiency among Nigerian population, the Federal government passed an act in 2001 mandating the iodization of all edible or table salts. By 2003, the national household coverage of iodized salt was 97.3% and Nigeria was the first African country to be declared iodine sufficient in 2007. Soon after that, the level of salt iodization dropped to < 75%. Recently, Nigerian food and nutritional policy, target to achieve and sustain universal house hold access to iodized salt by 2025.

MATERIALS AND METHODS

A total of 192 pregnant women in their various trimesters and 65 non-pregnant, non-lactating age-matched controls were evaluated the pregnant subjects were recruited during their visit at the antenatal clinics of Yariman Bakura Specialist Hospital, Gusau while the controls were recruited from volunteers in the adjoining community, staff of the hospital and patient’s relations. The ages of the participants ranged between 16 and 41 years. All subjects were apparently healthy with no evidence of renal, endocrine, diabetes and hypertension that would affect thyroid function. None of the participants was on the restricted salt intake. Each subject had resided in the locality for at least 1 year before the study. Ethical approval was obtained from Yariman Bakura Specialist Hospital and written informed consent was obtained from the subjects. Spot urine samples were collected in cleaned urine bottles, labelled with the participant’s identifier code and stored in batches, at -20°C in a freezer, until analysis. 4ml of venous blood was collected without anticoagulant in a plain test tube, it was allowed to clot at room temperature, centrifuged and the serum was collected and Stored at -20°C until analysis. A well structured questionnaire was used to collect data on the demographic factors, knowledge of iodine deficiency/status and mental state among the studied population. Simple Spread Sheet was used to collect data and information from the volunteers. Spot urine samples were measured among pregnant women in each trimester and controls for level of urinary iodine excretion using modified Sandell-Kolthoff method. Serum samples were assayed for levels of Thyroxine (T4), Triiodothyronine (T3), and Thyroid-stimulating hormone (TSH) in each trimester in subjects and controls by Enzyme-linked Immunoassay method. Data were analyzed using SPSS version 21 to obtain the mean ages and median urinary iodine concentration (UIC) for pregnant women in each trimester of pregnancy and in controls. P ≤0.05 was considered statistically significant and a correlation of iodine levels between the various trimesters and thyroid hormones was evaluated.

RESULTS

Urinary iodine concentration (UIC) of 192 pregnant women, 65 non-pregnant and non-lactating women of child bearing age controls was used to evaluate iodine status. The results obtained as shown in Table 1, were the median UIC in 1st (134ug/L), 2nd (125ug/L), 3rd (117µg/L) trimesters, and controls (143 µg/L), respectively. Usage of iodized salt was found to be 73.5%.

Table 1: Median UIC, TSH, tT3 and tT4 levels.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Median-UIC (µg/L)</th>
<th>Median-TSH (µIU/ml)</th>
<th>Median tT3 (µg/ml)</th>
<th>Median tT4 (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Trimester</td>
<td>134</td>
<td>1.60</td>
<td>1.46</td>
<td>8.13</td>
</tr>
<tr>
<td>Second Trimester</td>
<td>125</td>
<td>1.70</td>
<td>1.80</td>
<td>6.93</td>
</tr>
<tr>
<td>Third Trimester</td>
<td>117</td>
<td>1.85</td>
<td>2.20</td>
<td>7.60</td>
</tr>
<tr>
<td>Controls</td>
<td>143</td>
<td>1.50</td>
<td>1.49</td>
<td>7.80</td>
</tr>
</tbody>
</table>

There was no significant difference (p = 0.255) between UIC in the 1st trimester and the 2nd trimester. The UIC between controls and 3rd trimester varied significantly (p = 0.002). There was no significant difference (p = 0.354)
between UIC in the 2nd and 3rd trimester. There was significant difference \((p<0.047)\) between UIC in First Trimester and Third Trimester. There was significant difference \((p<0.030)\) between UIC in Second Trimester and Controls.

### Table 2: Distribution of results in percentage (%) of various trimesters based on pregnant population.

<table>
<thead>
<tr>
<th>Range</th>
<th>Status</th>
<th>First Trimester (%)</th>
<th>Second Trimester (%)</th>
<th>Third Trimester (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150</td>
<td>Inadequate</td>
<td>28 (53.9)</td>
<td>43 (61.4)</td>
<td>46 (65.7)</td>
</tr>
<tr>
<td>150-499</td>
<td>Adequate</td>
<td>14 (26.9)</td>
<td>23 (32.9)</td>
<td>20 (28.6)</td>
</tr>
<tr>
<td>&gt;500</td>
<td>Excessive</td>
<td>10 (19.2)</td>
<td>4 (5.7)</td>
<td>4 (5.7)</td>
</tr>
</tbody>
</table>

The results, in Table 2 and Figure 1, showed that, among the pregnant women, in the first trimester, 28 (53.90%) had inadequate UIC (<150 μg/L), 14 (26.9%) had adequate UIC (150 -249 μg/L), 10 (19.2%) had more than adequate UIC (250 -499 μg/L) and none of the pregnant women in this trimester exceeded UIC (>500 μg/L). In second trimester, 43 (61.4%) had inadequate UIC (<150 μg/L), 23 (32.9%) had adequate UIC (150 -249 μg/L), 4 (5.7%) had more than adequate UIC (250 -499 μg/L) and none of the pregnant women in this trimester exceeded UIC (>500 μg/L).

The results obtained from this study UIC in all the trimesters was <150μg/L and this confirmed the iodine deficiency among pregnant women in Gusau. This report agreed with the previous studies in United State[23], Turkey[24] and Nigeria.[25] Increased demand for micronutrients predisposes women of reproductive age, pregnant and lactating women to micronutrient deficiencies.[27] This result also suggested that the quantity of iodized salt consumed did not meet the increased demand for iodine. Increased iodine requirement during pregnancy is imperative for the foetus to compensate for increased loss.

**DISCUSSION**

The results also showed a progressive decrease in the median UIC with advancing gestational period, which can be attributed to the increased demand of iodine by the foetus as a result of the pregnancy.[26] The normal median UIC of controls subjects obtained from this study confirmed the contribution of pregnancy as regards to lower UI concentrations in pregnant subjects.

Increased demand for micronutrients predisposes women of reproductive age, pregnant and lactating women to micronutrient deficiencies.[27] This result also suggested that the quantity of iodized salt consumed did not meet the increased demand for iodine. Increased iodine requirement during pregnancy is imperative for the foetus to compensate for increased loss.

The usage of iodized salt among the study subjects was found to be 73.5% which was in line with the national
household coverage of iodized salt in Nigeria reported to be <75%.\textsuperscript{[28]}

The result of the present study therefore suggested that the quantity of iodized salt consumed is not meeting the increased demand for iodine during pregnancy when it was juxtaposed with the normal results obtained from the control subjects.

There was positive correlation (Table 3) between UIC and tT3, tT4 in the first, second and third trimesters. Alternatively, a negative correlation between UIC and TSH was also established among pregnant subjects in all the trimesters.

CONCLUSION

Pregnant women in Gusau were found to have inadequate urinary iodine concentration during progressive gestational period. They should be encouraged to either consume iodine-rich food or take appropriate multiple micronutrient capsules including iodine to improve their iodine status during pregnancy. Thus, the existing iodine supplement through salt iodization programme should be continued and monitored strictly to enhance a satisfactory iodine levels during pregnancy.

RECOMMENDATIONS

Further studies are suggested to help evaluate iodine contents and goitrogenic substances of staple foods in the study area and conduct a state wide population study of UIC among pregnant women and their offspring to serve as the base-line data for massive iodine supplementation in view of its effects on the mental health of the developing foetuses.

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