Maternal Iodine Deficiency in Rural Bangladesh

Despite a national salt iodization strategy, evidence of insufficiency during pregnancy and subsequent consequences for offspring exists.

Severe iodine deficiency in pregnant women has long been recognized to increase the risk of miscarriage and stillbirth, and is associated with mental retardation and developmental delays in the offspring of women affected during their pregnancies. Consequences of mild to moderate iodine deficiency for mothers and their offspring are less well established but remain a concern. Adverse effects of iodine deficiency are mediated through the reduced production of thyroid hormones, with the most visible consequence of persistent iodine deficiency being goiter, which results from the expansion of the thyroid gland to capture any available circulating iodine. Thyroid hormone production is the only known role for iodine in the body, but these hormones are permissive for a myriad of body functions. Appropriate fetal development in early pregnancy is dependent on thyroid hormone (thyroxine) produced by the mother, and once the fetal thyroid gland itself has matured in later gestation, the offspring depends on a maternal supply of iodide across the placenta and through breast milk in the postpartum period. Thus, the timing of iodine deficiency during pregnancy may be related to the type or extent of consequences for the offspring.

Unlike many other micronutrients which are concentrated in certain food sources, iodine content of locally-procured foods reflects the amount of iodine in soil, which then accumulates in plant and animal products in the food chain. Iodine depletion of soil is likely to occur where leaching or loss of topsoil is common, resulting in iodine-poor foods. Under such conditions, a typical approach for ensuring the availability of iodine to a population is to enact universal salt iodization, such that salt fortified with iodate is distributed through local markets. Bangladesh adopted universal salt iodization in 1989, and while this has improved iodine status in Bangladesh as assessed by national surveys, iodine insufficiency remains a concern.

To ensure the nutritional health of pregnant women with respect to iodine status, a World Health Organization (WHO) Technical Consultation in 2007 proposed increasing the recommendations for iodine intake of pregnant women from 200 to 250 µg/day. Correspondingly, new guidelines for the assessment of iodine status using urinary iodine (UI) excretion, which reflects recent intake of iodine, have been made specifically for pregnant women. These recommendations increase the cutoff for the population median UI that indicates adequacy of intake from 100 µg/L to a range of 150–249 µg/L among pregnant women.

The new focus on pregnant women reflect the concern for iodine adequacy specifically during this life stage and a recent recognition that pregnant women may remain iodine insufficient due to the increased demands for iodine during pregnancy even when other members of a household have achieved iodine adequacy.

To determine the extent and consequences of iodine deficiency among pregnant women of rural Bangladesh, the JiVitA Project, in collaboration with the Institute of Nutrition and Food Science, Dhaka University, measured household salt iodine content and UI among women participating in the JiVitA-1 trial substudy in early (N=1376; <16 wk gestation) and late (N= 1114; >32 wk gestation) pregnancy to determine whether current levels of salt iodization were sufficient to support adequate iodine status. In fact, we found that over 80% of women had urinary iodine concentrations below 150 µg/L (Figure), with an early pregnancy median UI of 65 µg/L, demonstrating that women of the region were typically moderately iodine deficient as they entered their pregnancies.

When plotted against the content of iodine in household salt, JiVitA-1 data showed that during pregnancy median UI did not reach 150 µg/L until the iodine content of household salt was at least 32 and 51 ppm during early and late pregnancy, respectively. These levels are far above the 15 ppm currently considered to be adequate salt iodine content at the household level. We then sought to determine whether maternal factors associated with the presence of salt containing at least 30 ppm in households could be ascertained. Age, nutritional status, and socioeconomic variables were not associated with the content of iodine of salt in households. These findings suggest that all women in this region are at risk of iodine deficiency and that more targeted means of reaching pregnant women may be needed to ensure iodine adequacy during pregnancy.

We have begun to examine the consequences of maternal iodine deficiency on outcomes for...
infants and children of JiVitA-1 study participants. Among a subset of infants in whose mothers UI data were available during both early and late pregnancy, being born low birth weight was over twice as likely when mothers were persistently iodine deficient during pregnancy (Table; unpublished data). Some differences in anthropometry persisted when children were revisited at 5 years of age: children whose mothers were most severely iodine deficient in the third trimester of pregnancy weighed less, were shorter, and had smaller chest circumferences than children with mothers who had adequate iodine status in pregnancy. The extent to which in utero iodine deficiency affects cognitive outcomes in offspring is not well described. To determine the consequences of iodine insufficiency on cognitive and motor development of children, we assessed offspring is not well described. To determine the consequences of iodine insufficiency on cognitive and motor development of children, we assessed

Maternal Iodine Status N Low Birth Weight, N (%) OR (95%CI)¹

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>Low Birth Weight, N (%)</th>
<th>OR (95%CI)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient</td>
<td>39</td>
<td>15 (38.5%)</td>
<td>–</td>
</tr>
<tr>
<td>Sufficient</td>
<td>90</td>
<td>47 (52.2%)</td>
<td>1.45 (0.63, 3.43)</td>
</tr>
<tr>
<td>1st TM only</td>
<td>57</td>
<td>33 (60.0%)</td>
<td>2.20 (0.88, 5.70)</td>
</tr>
<tr>
<td>Sufficient</td>
<td>344</td>
<td>209 (61.5%)</td>
<td>2.54 (1.21, 5.50)</td>
</tr>
</tbody>
</table>

Abbreviation: TM, trimester
¹Adjusted for parity, gestational age, maternal education, and height

Table. Association of maternal iodine status during pregnancy with low birth weight.

Iodine deficiency remains a nutritional problem in Bangladesh, with consequences that persist from pregnancy exposure at least into the early childhood years. Children born to iodine deficiency mothers may be at risk of adverse health and developmental outcomes that may be mediated through compromised growth and cognitive function. Longer-term consequences remain to be determined, but attention should be focused on the prevention of iodine deficiency in women of reproductive age in rural Bangladesh.

References