The hormone thyroxine, essential for the normal development of the brain and body of new-borns and children, has four iodine atoms in its molecule. The thyroid gland, which synthesises this hormone, beginning from the second trimester of intra-uterine life, extracts iodine with great efficiency from its blood supply to meet the needs for thyroxine biosynthesis. In iodine deficient environments, the thyroid gland enlarges several-fold in size, in an adaptive response to increase its efficiency in taking up iodine from the environment. The prevailing belief was that the adaptively enlarged thyroid gland (goitre) succeeded in secreting adequate thyroxine to meet bodily needs. However, we published scientific evidence\(^1\) to show that more than half the adult goitrous subjects living in severely iodine deficient regions of India (an estimated 170 million) may not produce enough hormone to meet bodily needs. These results were subsequently confirmed by six different investigators from three different continents, where iodine deficiency is widely prevalent\(^2\).

The functional consequences of thyroxine deficiency in an adult can be largely reversed by ensuring adequate thyroxine intake as medication. However, there is accumulated evidence to show that the developmental damage to brain caused by thyroxine deficiency in utero and during the first year of life is not reversible by thyroxine given later in life. It, therefore, became a matter of priority to look at the functional status of the thyroid of new-borns. A cost effective and sensitive assay for thyroxine was developed and adapted for a filter paper-cord blood spot mode of sample collection by post, from new-borns of the remote endemic areas of India\(^3\). Over 22,000 new-borns were screened from different parts of India with and without iodine deficiency, to determine the incidence of neonatal chemical hypothyroidism (NCH). NCH was diagnosed if the cord blood thyroxine level was less than 3 μg per cent and the corresponding TSH measured was more than 50μu/ml. Table 1 summarises the data obtained from different parts of the country.

The data showed that the incidence of NCH was about a hundred-fold more in seriously iodine deficient endemic districts of the Terai regions of UP where an estimated 30 million people live! To understand the impact of this magnitude of prevalence of NCH in the Terai region, we conducted studies in an endemic village of the region to determine the prevalence of known thyroxine-deficiency related neurological deficits\(^5\). The results (summarised in Table 2) showed that a significant proportion of the village population had objective evidence of compromised brain development in the form of left-shift of IQ score distribution among school children from iodine deficient areas when compared to non-iodine deficient areas, 20 per cent prevalence of nerve deafness and 3-5 per cent prevalence of cretinism.

Impact of salt iodisation programme: Salt iodisation was launched in the whole of Uttar Pradesh on October 2, 1987, the birthday of Mahatma Gandhi. An evaluation of the impact of the Salt Iodisation Programme in UP showed a remarkable decline (Table 3) in incidence of NCH as a result of normalising the nutritional iodine intake through salt (as reflected in the urinary iodine excretion by the population).

The role of dietary goitrogens: On the other hand in five loci in the country, encompassing different

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**TABLE 1**

<table>
<thead>
<tr>
<th>Area</th>
<th>Goitre Prevalence (%)</th>
<th>Cretinism Prevalence (%)</th>
<th>Incidence of NCH (per thousand births)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deoria (UP)</td>
<td>80</td>
<td>3-5</td>
<td>133</td>
</tr>
<tr>
<td>Gorakhpur (UP)</td>
<td>70</td>
<td>0-4</td>
<td>85</td>
</tr>
<tr>
<td>Gonda (UP)</td>
<td>60</td>
<td>0-4</td>
<td>75</td>
</tr>
<tr>
<td>Delhi</td>
<td>29</td>
<td>NIL</td>
<td>6</td>
</tr>
<tr>
<td>Kerala (coastal)*</td>
<td>1.3</td>
<td>NIL</td>
<td>1</td>
</tr>
</tbody>
</table>

* No prevalence of endemic goitre or iodine deficiency.

**TABLE 2**

<table>
<thead>
<tr>
<th>Category of Defect</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cretinism</td>
<td>3-5</td>
</tr>
<tr>
<td>Hearing defect (nerve deafness)</td>
<td>20</td>
</tr>
<tr>
<td>* Feeble mindedness (IQ&lt;69)</td>
<td>23</td>
</tr>
</tbody>
</table>

* IQ estimation done in school children.

**TABLE 3**

<table>
<thead>
<tr>
<th>District</th>
<th>Incidence of Neonatal Chemical Hypothyroidism in Three Terai Districts of Uttar Pradesh, India, before and after Successful Salt Iodisation*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-iodisation</td>
</tr>
<tr>
<td>Deoria</td>
<td>133</td>
</tr>
<tr>
<td>Gonda</td>
<td>75</td>
</tr>
<tr>
<td>Gorakhpur</td>
<td>85</td>
</tr>
</tbody>
</table>

* Data on the basis of 5,500 new-borns screened from three districts.
* Studies carried out during 1989-92.
TABLE 4
Incidence of NCH and Urinary Thiocyanate Excretion Status in the Five Areas of Study* (mean ± SD)

<table>
<thead>
<tr>
<th>Area</th>
<th>Incidence of NCH/ thousand</th>
<th>Urinary Thiocyanate Excretion µg/dl</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poderu tribal (AP)</td>
<td>57</td>
<td>1.068±0.445</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Saharanpur (UP)</td>
<td>31</td>
<td>0.864±0.438</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Barabanki (UP)</td>
<td>52</td>
<td>1.773±0.753</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bilaspur (HP)</td>
<td>20</td>
<td>0.723±0.296</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Delhi</td>
<td>21</td>
<td>0.718±0.277</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Coastal Kerala</td>
<td>1</td>
<td>0.504±0.197</td>
<td>(Control)</td>
</tr>
</tbody>
</table>

P value* when compared to control area.

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geographical regions we carried out studies which showed that despite adequate intake of iodine through iodised salt, as reflected in the urinary iodine excretion pattern among school children of the respective areas, the incidence of NCH continued to be 18-52 per 1,000 births. As these figures are several-fold higher than the incidence of NCH observed in coastal Kerala without iodine deficiency or endemic goitre (Table 1), therefore the role of environmental factors other than iodine deficiency that influence neonatal thyroid function in these loci were examined.

Dietary goitrogens are well recognised and important among such factors. Considering the fact that a large number and variety of plant foods are consumed far and wide in the country, we thought it appropriate to look for the most frequently reported plant goitrogens namely cyanogenic compounds. Cyanogenic goitrogens of plant food get detoxified to thiocyanate in the body. Thio­cyanate effectively blocks iodine concentration by the thyroid gland and thus causes thyroid dysfunction. Urinary thiocyanate excretion reflects cyanogenic goitrogen ingestion by people. Therefore, the levels of urinary thiocyanate excretion by school children was examined in the areas where we observed high residual incidence of NCH and related it to the incidence of NCH per 1,000 births (Table 4).

The results of these studies7 showed that urinary thiocyanate excretion in areas with continuing high residual incidence of NCH was significantly higher than the thiocyanate excretion observed in the control area with 1:1,000 incidence of NCH. These results clearly imply that in several areas in the country iodine deficiency may have been made worse by the copresence of cyanogenic goitrogen ingestion by the people.

Fortunately, it has been shown that thiocyanate induced inhibition of iodine uptake by the thyroid cells can be overcome by appropriate increase in iodine concentration in body fluids. On the basis of these reports, it can be inferred that the continuing residual incidence of NCH can also be remedied by fortifying salt supplied to such areas by an appropriately higher PPM level of iodine to ensure the necessary per-caput daily consumption of iodine. However, the exact effective levels of salt iodisation required for this purpose, and the logistical measures to be adopted to achieve this in selective areas remain to be worked out.

Meanwhile, efforts to eradicate nutritional iodine deficiency from the country through salt iodisation have made remarkable progress. Notable success in this regard has been in the northern Indian states where the problem of nutritional iodine deficiency is prevalent in its worst form. Several other states of the Union have issued the legal notification essential for enforcing salt iodisation countrywide in accordance with a policy adopted by the Central Council of Health in 1986. However, according to a recent report from the Salt Commissioner’s Office, iodised salt off-take by many states, particularly from the southern and western parts of the country, is far from satisfactory. It should be ensured that a programme that has demonstrably improved the thyroid function of hundreds of thou­sands of new-borns, thus saving them from irreversible brain damage, is pursued vigorously and competently.

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References
7. Ravi Kumar: PhD thesis submitted to the All India Institute of Medical Sciences faculty, 1996.

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NUTRITION NEWS

- We congratulate Dr Kamala Krishnaswamy on her appointment as the Director of the National Institute of Nutrition, Hyderabad.
- Nutrition Society of India — XXX Annual Meeting of the Society will be held at Udaipur from November 19 to 20. The scientific programme will include:
  - Symposia on 'Nutrition, Brain and Behaviour' and 'Food and Nutrition in Semi-arid Regions'.
  - Gopalan oration by Dr B.N. Tandon.
  - Dr Srikantia Memorial Lecture by Dr M.V.R. Rao.

The Foundation is grateful to FAO for a matching grant towards the cost of this publication.
Universal Salt Iodisation (USI) Programme, India — Progress And Achievements
Sheila Vir

Following the successful Kangra Valley (Himachal Pradesh) Project on iodised salt in the late 1950s, iodisation of all edible salt was accepted by the Government of India as the sustainable low cost solution for the prevention of iodine deficiency disorders (IDD). In 1984, following the evaluation of the Goitre Control Programme by the Nutrition Foundation of India (NFI), the Government of India announced the Policy of Universal Salt Iodisation (USI) — the initial target year being 1992.

Full support of private salt producers (producing over 95 per cent of the salt supply) was sought and a subsidy on the supply of the fortificant chemical (potassium iodate) was provided for a fixed period, that is, up to mid-1992. Legal measures were instituted to define levels of iodine at production (30 ppm of iodine) and community levels (15 ppm of iodine) and state governments were encouraged to issue legal bans on the sale of non-iodised salt.

In 1992, the constraints in reaching the USI goal were reviewed. The Government of India accorded high priority to the elimination of IDD since it was recognised that iodine deficiency did not result in goitre alone but had serious consequences on the mental and physical development of children. The Government of India reiterated its commitment to 'Universal Accessibility of Salt by 1995'. The National Goitre Control Programme (NGCP) was changed to the 'National IDD Control Programme' (NIDDCP) to put emphasis on the wider implications of iodine deficiency, not limited to goitre alone.

Towards reaching the USI goal by 1995 and elimination of IDD by the year 2000, a new intensification phase of USI was launched by the Government of India (Ministries of Industry and Health) in collaboration with UNICEF and focussed on:

- Increasing the production of iodised salt to ensure that the goal of Universal Salt Iodisation (USI) is attained by the end-1995.
- Creating universal demand for iodised salt at consumption level.
- Strengthening the monitoring system at the production and consumption levels.

Despite success, there are gaps in the USI programme which need to be filled in the next three years as a part of the effort to achieve and sustain universal availability of iodised salt. Clearly, an inadequate number of iodisation plants or lack of technology is not the problem. The challenge for reaching the goal of elimination of IDD by the year 2000 depends on the issuance of a ban in all states, high priority to enforcement of the ban by state governments as well as salt producers and consumers, operationalisation of an effective monitoring system at both production and community levels and measures to sustain production and demand for iodised salt. Future programme activities, therefore, need to concentrate on ensuring sustainability of the USI programme and the establishment of a system to monitor progress towards reaching the year 2000 goal of 'Elimination of IDD'.

The author is Project Officer — Nutrition, UNICEF (India).

FOUNDA TION NEWS

- Prof A.K. Susheela, who will shortly be retiring from her current post of professor at the All India Institute of Medical Sciences, will be joining the Nutrition Foundation of India as Honorary Consultant from August 1. The Fluorosis Control Programme which she has been heading with distinction for several years will thereafter function from the NFI. Dr Susheela will also be in charge of NFI projects related to 'Food Safety'.

Study Circle Lecture
- Dr H.P.S. Sachdev (Professor and In-charge of the Department of Paediatrics, Clinical Epidemiology division, MAMC, New Delhi) spoke on: 'Nutrition of Women and Children in India: Changing Trends' on April 29.

- Dr Shieila Zurbrigg (Dalhousie University, Canada) spoke on: 'Food, Nutrition and Malaria Mortality' on May 19.

- Dr K. Srim (Senior Consultant, Tamil Nadu Hospital, Chennai) spoke on: 'Enteral and Parenteral Nutrition' on June 18.

President's Engagements


- Fund Raising

NFI gratefully acknowledges the generous contribution from Dr Barry M. Popkin (USA) to its corpus fund.