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OF IODINE DEFICIENCY DISORDERS

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UNICEF Report 2008

Sustainable Elimination of Iodine Deficiency: Progress since the 1990 World Summit for Children

Universal salt iodization is one of the most successful public health efforts of the past two decades

UNICEF estimates that less than one fifth of households in the developing world were using iodized salt at the time of the World Summit for Children in 1990. Some experts believe universal salt iodization may be the most successful public health effort of the past two decades. The proportion of households consuming adequately iodized salt has increased to some degree in every region of the world, yet large differences in levels of consumption remain. Two regions are close to achieving the goal: Latin America and the Caribbean, with 85 per cent of households

THE INTERNATIONAL COUNCIL FOR CONTROL OF IODINE DEFICIENCY DISORDERS (ICCIDD) is a nonprofit, nongovernmental organization dedicated to sustained optimal iodine nutrition and the elimination of iodine deficiency throughout the world. Its activities have been supported by the international aid programs of Australia, Canada, Netherlands, USA, and also by funds from UNICEF, the World Bank and others.

consuming adequately iodized salt, and East Asia and the Pacific, with 84 per cent.

Since the 2002 United Nations Special Session on Children, many countries have reported continued progress towards the goal of eliminating iodine deficiency through universal salt iodization. Others face severe challenges. In 2006, UNICEF identified 16 countries in need of special efforts and extra support. If these countries achieve universal salt iodization, about 85 per cent of households worldwide will be consuming adequately iodized salt.

Progress goes beyond numbers. Another mark of achievement is program maturation, which has been reflected in widespread agreement on the techniques for solving the problem, government responsibility for financing, improved political and regulatory environments, strengthened monitoring systems, stronger partnerships, and realization of the key role of advocacy and communication.

The efforts towards universal salt iodization have resulted in five guiding principles that are crucial to sustained success:

■ Secure political commitment: Robust, continuous government commitment and industry motivation are essential. This commitment needs to be maintained through regular advocacy.

■ Form partnerships and coalitions: Partnerships between governments and donors, between governments and salt producers, and among all those supporting elimination efforts need to be strengthened at all levels.

■ Ensure availability of adequately iodized salt: The salt industry must recognize iodization as a fundamental responsibility; governments must work with salt producers to improve their capacity; and producers must maintain and improve this capacity. This will require collaboration between governments, manufacturers and traders.

BOX 1:

IDD AND THE MILLENNIUM DEVELOPMENT GOALS

Goal 1 – *Eradicate extreme poverty and hunger*: Eliminating IDD increases learning ability and intellectual potential, leading to better educated citizens earning higher wages.

Goal 2 – *Achieve universal primary education*: Improved cognitive development and learning potential leads to improved school performance and reduced drop-out rates.

Goal 3 – *Promote gender equality and empower women*: Eliminating IDD in children reduces women's childcare burdens, frees up household resources and allows women more time for income-generating work.

Goal 4 – *Reduce child mortality*: Reducing iodine deficiency lowers rates of miscarriage, stillbirth and other pregnancy complications, and neonatal deaths.

Goal 5 – *Improve maternal health*: Lower rates of thyroid disease and other clinical results of iodine deficiency improve the health of women of reproductive age.

Goal 8 – *Develop a global partnership for development*: Programmes for sustainable elimination of iodine deficiency strengthen partnerships at global, regional and country levels. They also leverage resources and commitments through alliances of public organizations, civil society and the private sector.

■ Strengthen monitoring systems: A continuous and effective monitoring system is essential. Three types of monitoring are needed, covering the salt iodization process from the factory to the household, the impact on a population's iodine levels, and the overall sustainability.

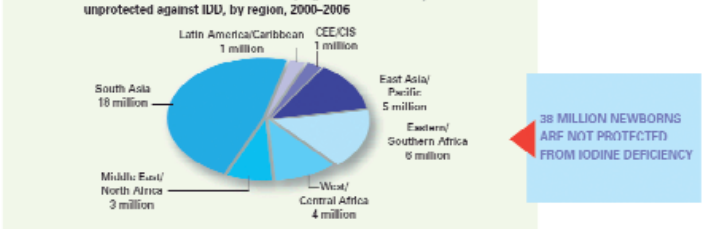
■ Maintain education and communication: Communication efforts should articulate concrete accountabilities and include specific messages tailored to the entire range of audiences, including national leaders, the salt industry, the media, technical and professional groups, teachers and families.

For a copy of the complete report: UNICEF, 3 United Nations Plaza, New York, NY 10017, USA. Tel.: (+1 212)326-7000 pubdoc@unicef.org ISBN: 978-92-806-4304-6

FIGURE 3: Household consumption of adequately iodized salt, worldwide, 2000–2006

Source: United Nations Children's Fund, *Progress for Children: A World Fit for Children statistical review*, UNICEF, New York, December 2007, p. 9.

FIGURE 5: Distribution of infants born in developing countries annually who are unprotected against IDD, by region, 2000–2006



Source: United Nations Children's Fund, *Progress for Children: A World Fit for Children statistical review*, Number 6, UNICEF, New York, December 2007, p. 8.

Iodine deficiency in 2007: Global progress since 2003

A new WHO report concludes there has been global progress in iodine deficiency control since 2003, but IDD continues to affect almost 1 in 3 individuals worldwide

Bruno de Benoist, Erin McLean and **Maria Andersson** Department of Nutrition for Health and Development, WHO, Geneva, Switzerland and the Human Nutrition Laboratory, ETH Zürich, Switzerland.

Introduction

In 2004, the World Health Assembly (WHA) adopted a resolution that the Member States should report on the global situation of iodine deficiency every 3 years. Thus, the first report was made in 2007 with revised estimates. This report presents these new global and regional estimates of iodine deficiency based on UI, using updated information for countries with new data and 2003 estimates for the remaining countries. It also describes the current trends in data collection for both school aged children and pregnant women.

Recently published nationally representative data on urinary iodine (UI) in school aged children, collected between 1997 and 2006, were used to update country estimates of iodine nutrition. These estimates, alongside the 2003 estimates for the remaining countries were used to generate updated global and regional estimates of iodine nutrition. The median UI was used to classify countries according to the public health significance of their iodine nutrition status. Progress was measured by comparing current prevalence figures to those from 2003.

Results

New nationally representative data from UI surveys conducted between 1997 and 2006 were available for 41 countries. These estimates along with 89 country estimates produced in 2003 (53 of which are nationally representative) allowed global and regional estimates to be made using data for 130 countries. For 63 countries with no UI data, an estimate could not be made. The available UI data covered 92.4% of the world's population of 6–12 year olds (Table 1). Regional population coverage varied from 85.1% in the Western Pacific Region to 98.8% in the South-East Asia Region.

Based on the current estimates, the iodine intake of 31.5% (264 million) school-age children worldwide is insufficient (Table 2). Iodine intake is below requirements in 73 million children in South-East Asia and in 54 million children in Africa. In both Europe and the Eastern Mediterranean the figure is approximately 40 million children while in the Western Pacific and the Americas, 31 million and 12 million children respectively do not have enough iodine in their diet. The greatest proportion of children with inadequate iodine intake lives in Europe (52.4%) and in the Eastern Mediterranean (48.8%) while the smallest proportions are found in the Americas (10.6%) and the Western Pacific (17.0%). Extrapolating from the proportion of school-age children to the general population, it is estimated that two billion individuals have an insufficient iodine intake (Table 2).

On a national level, iodine intake was insufficient in 47 countries, adequate in 49, more than adequate in 27 and excessive in 7. Of the 47 countries with insufficient intake, 10 were classified as moderately deficient and 37 as mildly deficient. No countries were categorized as severely deficient. Complete country-specific data are available in the WHO Global Database on Iodine Deficiency.

The prevalence of school aged children with an insufficient iodine intake decreased by 5% since 2003 (Figure 1). The largest decreases occurred in south-east Asia (9.6%) and in the Western Pacific (9.2%). The Americas Region was the only Region which remained stable with a prevalence of 11%.

For pregnant women, there was insufficient data generate estimates of iodine deficiency in this critical population group. However, in five of six recently conducted national surveys in both school aged children and pregnant women, the median UI was lower in pregnant women and in 3 cases the median in pregnant women was below the cut-off which suggests insufficient iodine intake in this population group despite the fact that the median UI in school aged children suggested an intake that was adequate or even more than adequate.

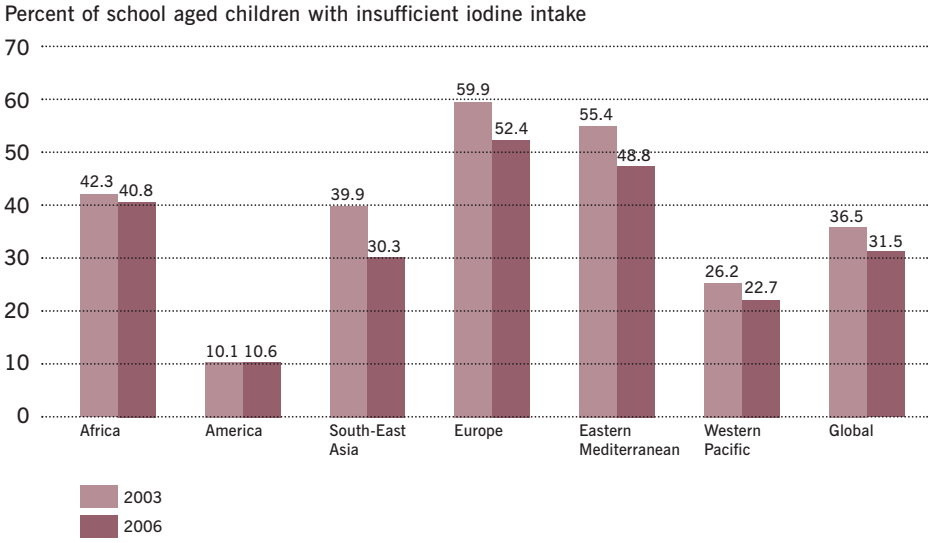
Table 1: School-age children (6–12 years): population coverage by urinary iodine surveys carried out between 1993 and 2006, by WHO Region

WHO Region	Total number of school-age children (millions)	Urinary iodine	
		Number (millions)	Proportion (%)
Africa	141.3	126.8	89.7
The Americas	109.1	100.4	92.1
South-East Asia	241.4	238.5	98.8
Europe	73.8	63.4	85.8
Eastern Mediterranean	88.7	77.6	87.5
Western Pacific	183.2	167.3	91.3
Total	**837.5**	**774.0**	**92.4**

Table 2: Proportion of population and number of individuals with insufficient iodine intake in school-age children (6–12 years) and in the general population (all age groups), by WHO region, 2006

WHO Region	Insufficient iodine intake (UI < 100 µg/l)			
	School-age children		General population	
	Proportion (%)	Total number (millions)	Proportion (%)	Total number (millions)
Africa	40.8	57.7	41.5	312.9
Americas	10.6	11.6	11.0	98.6
South-East Asia	30.3	73.1	30.0	503.6
Europe	52.4	38.7	52.0	459.7
Eastern Mediterranean	48.8	43.3	47.2	259.3
Western Pacific	22.7	41.6	21.2	374.7
Total	**31.5**	**263.7**	**30.6**	**2000.0**

Figure 1: Change in the prevalence of individuals with an insufficient iodine intake between 2003 and 2006.



Discussion

The current estimates are subject to several limitations. Approximately half of the countries had conducted nationally representative surveys, representing 60% of the population; the reminder had made only one or more subnational surveys, or had no data. Subnational data may under or overestimate the extent of iodine deficiency depending on the area surveyed. Oftentimes iodine deficiency surveys are conducted in areas where it is believed there is a problem resulting in an overestimation of the prevalence, while other times easily accessible areas are surveyed, where the population potentially has greater access to iodized salt, and this may underestimate iodine deficiency. It is heartening that between the 2003 and 2007 estimates, 3 countries that had no data and 14 countries for which their previous estimate was based on subnational data conducted nationally representative surveys.

In conclusion, the overall global situation of iodine deficiency has improved since 2003. From a surveillance viewpoint, more countries are collecting data and monitoring their progress and there has been an increase in the collection of nationally representative data. More surveys in pregnant women are required since they are the group most susceptible to the effects of iodine deficiency and their situation is not reflected in data collected solely in school aged children. The complete report can be found in the Food and Nutrition Bulletin (2008 Sep;29(3):195-202).

ICCIDD investigates the rising price of iodized salt in Central Africa

Daniel N. Lantum ICCIDD Regional Coordinator for Africa

Iodized salt needs to be affordable even for the poorest in central Africa

Introduction

There may be a crisis developing in the salt production and marketing business in the Central African Region. Iodized salt is running scarce in the popular markets and prices have increased from 2000 CFA (1 euro = 656 CFA francs) to 2500-2800 CFA per bag of 18kg. The stability of the USI/IDD control program in the region may be threatened. To investigate the matter, Daniel Lantum, ICCIDD Regional Coordinator for Africa, traveled to the port town of Douala, Cameroon from 25-30 October 2008, and visited salt enterprises there.

Findings

- Tariffs on imported iodized salt from Senegal have been increased by the Cameroon Government; as a result, the landing price of an 18kg bag has risen from about 2000 CFA to 2500 CFA.
- Local refineries import their crude salt material from Egypt in 1 ton sacks, packed in heavy containers – technological innovations intended to improve the quality of salt as well as to protect against corrosion of shipping vessels. These innovations raise the price of the iodized salt product, an increase that the population, as consumers, must pay for.
- Two local refineries are working hard to maximally produce iodized salt to meet the market demands. SOCAPURSEL recently imported 10,000 metric tons of salt to complete the 60,000 metric tons which it planned to produce in 2008. Africa Salt Company imported 20,000 metric tons (in 182 containers) which are currently being iodized under strict industrial conditions of good hygiene and a highly motivated workforce.
- Some salt dealers who were sequestering imported iodized salt at former low prices have now liberated their old stock and are selling it at higher prices of 2500 CFA in Douala and at even higher prices of 2800-3000 CFA per 18kg bag in rural areas.
- In trade policy terms, the government slammed high tariffs on imported salt in order to protect local salt producers and encourage them to keep up production (Both the crude and finished product are affected by the tariffs).

Summary

- The impression is that although the price of iodized salt product has risen, enough salt is likely to be available without breaking iodized salt consumption practices.
- Thus, the regional USI/IDD program is not at serious risk since all of the salt in the market is iodized, and the possibility of the entry of cheaper non-iodized salt is unlikely.

Recommendations

- ICCIDD should join the local producers of iodized salt in advocating the continued consumption of iodized salt irrespective of cost constraint.
- Mass media should be briefed to explain the causes of the rising price of common salt to the population.
- ICCIDD should negotiate with the major local iodized salt producers on the advantages of using the ICCIDD logo on their packaging
- ICCIDD should congratulate the Minister of Public Health of Sao Tome and Principé for recently ordering 550 metric tons of high quality iodized salt, enough to likely satisfy the entire national requirement for more than one year. As a follow up, ICCIDD should visit Sao Tome and Principé Islands to assess and confirm that their USI coverage has increased to more than 90% and to advocate its sustainability.
- ICCIDD should continue to monitor the local reaction to the price rise in iodized salt products. It should also contact the Customs Department to obtain the details on the new tariffs and their official explanations for the increase.

How to increase consumption of iodized salt in India: a situation analysis

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Trends in iodized salt consumption

Today in India, only 51.1% of the population consume adequately iodized salt. This is far from the universal salt iodization (USI) goal of at least 90% household coverage (1). Coverage in India has remained stagnant at about 50% since 1998 (Fig. 1) (2,3,4). Similarly, there has been little change in the percentage of households consuming salt that is iodized, but at inadequate levels: 25% in 2005 compared to 21.6% in 1998 (Table 1). Almost one quarter of all salt continues to have no iodine. There is an urgent need to understand why India is stagnating at this level of iodized salt consumption. What are the missing actions?

There is a wide difference in iodized salt coverage among Indian states (Table 1). In 14 out of 29 states, over 90% of the population consumes salt with some iodine. Only one state, Manipur, meets the USI goal with over 90% coverage. Consumption of salt with adequate levels of iodine (>15 ppm) is remarkably better than the national average in eight northern states as well as in the eastern states of West Bengal, Bihar and Jharkhand. The mode of transport of salt seems to influence the availability of iodized salt in a state. Salt transported by rail is cost effective for distances of over 500 km while road transport is economically advantageous for shorter distances.

Only about 50% of India's population is covered by adequately iodized salt

Iodized salt moving by rail may be checked by the Salt Department for iodine levels prior to allocation of rail rakes. This system puts pressure on the salt producers to iodize salt, but not necessarily with appropriate levels of iodine. The system has its weakness but appears to influence the availability of iodized salt moving by rail to states including the states of the North-east, West Bengal and Bihar which are located far from the salt producing regions.

However, today road transport more often is chosen by salt producers: it not only saves cost and time but also is free from the worry of checking of iodine levels by the Salt Department. For these reasons, there has been a significant increase in movement of salt by road: 58% is transported by rail and 42% by road. The adverse impact of absence of a monitoring mechanism for road transported salt is reflected in the poor availability of iodized salt in the three salt producing states (Gujarat, Tamil Nadu, Rajasthan) as well as in the states of Haryana, Maharashtra, Andhra Pradesh, Karnatka and Madhya Pradesh where over 25% edible salt is reported to have no iodine.

However, this correlation is not evident in four states, Delhi, Punjab, Himachal Pradesh and Kerala; there is possibly higher demand for refined iodized salt in these states due to higher literacy and a better economic situation, as well as better monitoring of iodine levels in salt, particularly in Himachal Pradesh.

Production of iodized salt: progress in the last decade

India has the capacity to produce 11.6 million metric tons (MMT) of iodized salt against the national requirement of 5.4 MMT and current production of 4.9MMT (5). A study of salt production has shown that there has been a significant increase in production of powdered, packed, non-refined iodized salt as well as refined iodized salt. Today, about 42 refineries are in operation in India and have a total capacity to produce 3.76 MMT of iodized salt, that is, 69.6% of the edible salt requirement of the country. However the actual production of refined iodized salt is reported to be 1.6MMT in 2005. This is a dramatic increase from only 0.24 MMT in 1995.

The production of non-refined packaged salt in attractive packs has also increased significantly in the last decade. Non-refined iodized salt is produced by medium size producers, who, trying to reduce costs and increase profit, often do not incorporate adequate iodine in packaged edible salt and yet sell the products incorrectly labelled as "iodized" salt. The cost savings of inadequate or no use of potassium iodate has become increasingly attractive with the increase in its cost from Rs 600 per kg in 2001 to Rs 1050 per kg in 2007 (6). Producers realize there is a lack of monitoring, and it remains a major challenge to address this problem. On the other hand, small producers iodize salt using the crude technology of chakki (grinding stone) and "pile hand spray" and are financially in a position to market iodized salt locally in villages situated near to the salt producing states (6). The adverse impact of small producers on availability of iodized salt therefore is apparent primarily in the salt producing states. With the commitment to achieve the USI goal, the small producers cannot be ignored.

It is evident that a monitoring system is critical for encouraging the production of salt with the recommended level of iodine by both the medium and small producers. However, support for monitoring over the past decade has been marginal. As a first step, there is an urgent need to map and computerize the data of the medium and small producers. Effort needs to be made not only to sensitize and motivate these producers, but also to support establishment of a sustainable monitoring mechanism during the production process and ensure stringent measures are taken to enforce the ban on noniodized salt (5) issued by the Government of India in May 2006.

Schoolchildren, India's vast human resource, need iodine to reach their full potential

In the past few years, a lot of attention at the production level has been directed at technological support for improving salt quality and iodization. However, these efforts have often not been directed at improving the quality of bargara salt (big crystal salt produced in the Rann of Kutch) which is 22% of the total edible salt produced in the country. Bargara salt cannot be crushed into powder or pakkaged in one kilo packs since hard lumps of salt are formed within a few weeks. These low cost crystal salts continue to capture the rural market of the large states of Madhya Pradesh and Uttar Pradesh. Conditions of storage, transport and marketing are invariably unhygienic in these remote rural areas, which are often flooded with inexpensive bargara salt. Traditionally, these crystals are washed and used by consumers. Iodine incorporated in the superficial layer of salt is washed away and finally the poorer households use big crystal salts with negligible or no iodine. The technical issue related to crushing of bargara salt needs to be addressed urgently: a study of the salt trade in Uttar Pradesh in 2001 revealed that 49.3% of salt entering the state is bargara salt and very often this is the only type of salt available in the market (7).

Reaching the salt wholesalers and recognizing their strategic role

Pressure on iodized salt producers to produce and supply only powdered packed iodised salt can be achieved and sustained through the network of wholesalers who procure salt from salt producing regions. This implies mapping of wholesalers based in various districts and sensitizing them to their role in mental and physical health of the population. Further, a system needs to be put in place to keep sustained pressure on the wholesalers to adhere to the PFA Act.

This can be achieved by testing, at least every 6 months, the salt for iodine levels through middle school and high school network. This strategy was successful in the state of Uttar Pradesh (UP), and was based on the principle that buying and selling iodized salt must be perceived not only a basic responsibility of salt manufacturers and industry, but also of wholesalers and retailers (8).

As a first step in the above strategy in the state of UP, a study on mapping of salt wholesalers and understanding the salt trading system, including understanding the knowledge, attitude and practices of salt traders was undertaken. This was done with a view to accelerate efforts to influence availability, marketing and accessibility of iodized salt. The study revealed that a total of only 344 primary wholesalers supplied salt to the entire state with a population of 180 million. Of these, 126 wholesalers marketed 80% of the salt and were located in only 15 of the total 70 districts of the state. This critical group of wholesalers, located in 15 districts, was targeted. Effort was made to make the salt traders understand and appreciate their contribution in the optimum mental development of young children and school performance. The salt wholesalers were equipped with Salt Testing Kits (STKs) to ensure adequate iodine content in the salt they procured.

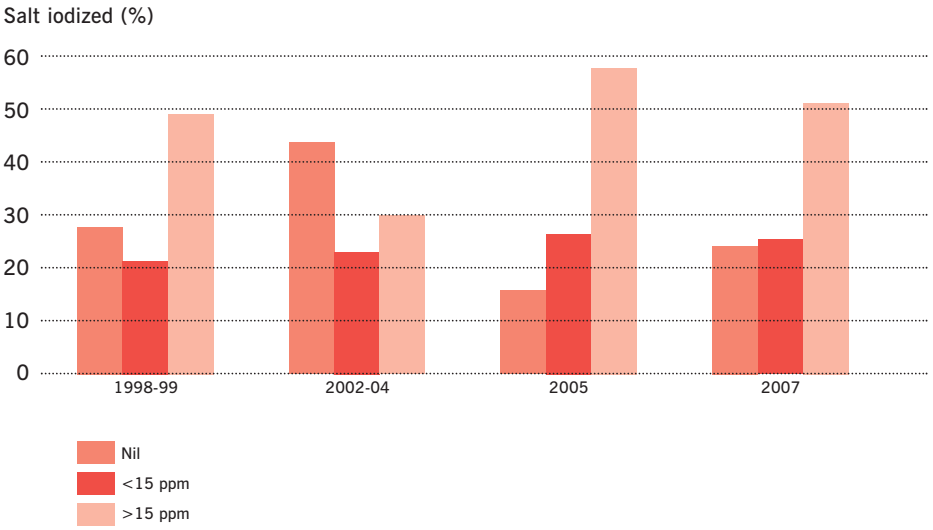
Simultaneously, the business interest of wholesalers was protected. Demand was created for powdered packaged iodized salt and for checking iodine levels through the involvement of middle and high school children. The community was reached through the launch of a "child-to-community" approach. The households with salt samples not having adequate levels of iodine were visited by a group of students to sensitize them about the importance of iodine. Over 217,000 salt samples, about 26,000 samples per quarter, were brought to school by school children and these were tested for iodine content.

The testing of these salt samples brought by children was complemented with every 6 month testing of open and packaged salt procured from local markets. Each and every brand of packed salt and 2-3 samples of open salt available in the markets of the administrative block headquarters of the district were collected. This was followed by testing of these samples by salt testing kits during the school assembly in the presence of school children. In a block with a 100,000 population, on average a total of 12-15 brands of packaged salt were available in a particular block market. Children were informed of the specific iodized salt brands with no or low levels of iodine and were informed of the importance of discontinuing its usage. These children were encouraged to disseminate the information of the salt testing results in their neighborhood and community.

The school activities not only influenced consumption of iodized salt, but also galvanized the entire chain linking consumers, retailers and wholesalers. Pressure resulting from these school based activities had an immediate impact on reduction in the sale of salt with no iodine. The school efforts were complemented by equipping the wholesalers to test iodized salt, along with technical support to get selected salt samples tested by the titration method in a dedicated laboratory. The impact was visible in the shift in the pattern of sale of iodized salt. In less than 2 years, salt procured with no iodine decreased from 38% to 15.3% and salt marketed with adequate iodine level increased from 28.6% to 64.9%.

The UP state strategy revealed that there is a need to appreciate the strategic role of wholesalers. Identification and inclusion of salt wholesalers and not only the salt manufacturers is crucial for making a rapid shift in iodized salt marketing and consumption practices. However, while educating traders in their social responsibilities regarding the USI goal, there is also a need to address their business interests. Demand creation for iodized salt and routine testing of salt for iodine level through the school network contributes to the protection of their business interest as well as promoting correct marketing practices. Moreover, involvement of middle and high school children, representing a larger geographical area, is an effective strategy not only for creating demand for iodized salt in the population, but also for influencing business practices of a large network of wholesalers and retailers.

Figure 1: Trends in consumption of iodized salt in India



Action plan

There is an urgent need to develop and establish a system not only for creating demand and increasing production of iodized salt, but also for monitoring iodine levels in salt over the entire chain from production, loading, procurement to consumption. Monitoring is critical to encourage production and sale of salt with an appropriate level of iodine. The Salt Department has 100 field offices and 26 laboratories (9), and the current system for monitoring needs to be critically reviewed and redesigned. This needs to be complemented with efforts to establish systems for monitoring at production and consumption level.

All wholesalers should be equipped with salt testing kits and a state-based system should be established to provide a laboratory service to wholesalers to allow them to have procured salt periodically tested by titration. For example, in each state, a medical or a home science college could be identified for a cluster of 20-25 districts where salt samples could be routinely tested using titration. It should be ensured that the wholesalers and retailers have access to these laboratories for testing samples of salt. These state based laboratories should be equipped with facilities to computerize the data and share it with the Salt Department, as well as with an external monitoring cell which might be based at the Indian office of ICCIDD.

In the initial five years, the monitoring inputs should be complemented with school based periodic testing of all salt brands and selected samples of open salt being sold in the market, along with a system for disseminating the data on salts with inadequate or no iodine. These actions of testing salt will create an environment of alertness in the chain of iodized salt retailers, wholesalers and producers. This will help generate the required market pressure to move India from the stagnant position of only 50% of household salt being appropriately iodized towards the USI goal of at least 90% salt being iodized with at least 15ppm of iodine.

State	Iodine Content of salt Adequate (> 15 ppm)	
	NFHS II (1998-99)	NFHS III (2005-06)
Andhra Pradesh	27.4	31.0
Arunachal Pradesh	84.1	83.6
Assam	76.9	71.8
Bihar	47.0	66.1
Chhattisgarh	-	54.9
Delhi	82.9	86.0
Goa	77.9	64.8
Gujarat	56.1	55.7
Haryana	71.0	55.3
Himachal Pradesh	90.5	82.5
Jammu and Kashmir	52.9	75.8
Jharkhand	-	53.6
Karnataka	43.4	43.3
Kerala	39.3	73.9
Madhya Pradesh	56.7	36.3
Maharashtra	60.1	61.0
Manipur	87.9	93.8
Meghalaya	63.0	81.9
Mizoram	91.2	85.9
Nagaland	67.2	83.3
Orissa	35.0	39.6
Punjab	75.3	74.6
Rajasthan	46.3	40.8
Sikkim	79.1	78.3
Tamil Nadu	21.2	41.3
Tripura	-	75.5
Uttaranchal	-	45.9
Uttar Pradesh	48.8	36.4
West Bengal	61.8	69.1
India	**49.4**	**51.1**

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Adequate iodine nutrition in the U.S. population

This article is excerpted from an editorial in the journal Thyroid by **Dr. Elizabeth Pearce** of Boston University Medical Center, USA, (Pearce E. U.S. iodine nutrition: where do we stand? Thyroid 2008;18(11):1143-44).

Surveillance of urinary iodine values of the U.S. population has been carried out at intervals since 1971. Caldwell et al. (1) have reported the most recent U.S. National Health and Nutrition Examination Survey (NHANES) iodine data, for the 2003–2004 sample. Reassuringly, there has been no significant change since the last NHANES survey in 2001–2002. Following a precipitous drop in urinary iodine values between NHANES I (1971–1974) and NHANES III (1988–1994), U.S. dietary iodine intake appears to have stabilized. Importantly, the U.S. population overall remains iodine sufficient.

The groups most vulnerable to the effects of iodine deficiency are pregnant and lactating women, infants, and very young children. Decreases in maternal thyroxine associated with even mild iodine deficiency may have adverse effects on the cognitive function of offspring. It has recently been suggested that mild iodine deficiency may also be associated with attention deficit and hyperactivity disorders. Although median urinary iodine thresholds in children under age 2 have recently been established, the NHANES surveys do not provide any information about the urinary iodine status of children younger than age 6 because of the difficulty of obtaining urine samples in this group. Dorey and Zimmermann (2) have recently validated a simple method for collecting infant urine samples in diaper pads for measurement of iodine concentrations, which should provide useful information in the future. There are currently no published data for urinary iodine in U.S. infants. In this country and elsewhere, neonatal screening programs are designed to detect congenital hypothyroidism, and elevated neonatal thyroid stimulating hormone values are more frequent in severely iodine deficient regions. Alterations in maternal dietary iodine intake have been proposed as one potential cause for an observed 73% increase in the incidence of congenital hypothyroidism in the United States between 1987 and 2002 (3).

Iodine nutrition in pregnant women in the U.S. remains a concern

Unfortunately, U.S. women of reproductive age remain the most likely group to have low urinary iodine values. According to WHO guidelines, median urinary iodine values for pregnant women between 149 and 249 μg/L are consistent with iodine intake in the optimal range. The median value among 90 pregnant women in the 2003–2004 NHANES sample was 181 μg/L, which is consistent with adequate iodine nutrition. This result needs to be interpreted with caution, however, given the relatively small sample size; it has been suggested that 100–500 samples for each subgroup are required to accurately estimate a population's iodine sufficiency.

Iodine nutrition in the United States has been achieved by a process sometimes described as "silent prophylaxis." Sources of iodine in the U.S. diet have been difficult to identify because there are a wide variety of potential sources, there is a marked variation in the iodine content of some common foods, and the amount of iodine in foods is not listed on the packaging. There are no validated U.S. questionnaires for the determination of dietary iodine intake.

Although it is reassuring that overall U.S. iodine consumption currently seems to be both adequate and stable, more work remains to be done in identifying vulnerable subpopulations that may be at risk for mild iodine deficiency. Encouragingly, the Food and Drug Administration has recently published results of its 2003–2004 Total Diet Study, the first systematic survey of U.S. food iodine sources since the early 1990s (7). Like the NHANES data, the Total Diet Study results suggest that average U.S. iodine intake is currently sufficient. It is anticipated that the in-progress NHANES sample will include thyroid function tests and urinary iodine measurements for all participants. This may provide enough statistical power so that a better assessment of iodine intake in population subgroups will be available in the future.

Table 1: Comparison of the median UI in selected age and population groups in the U.S. from 1988 to 2004.

Median urinary iodine concentration (µg/L)			
Age or population group	**1988-94**	**2001-2002**	**2003-2004**
6-11 y	237	249	229
Pregnant women	141	173	181
Women of reproductive age (non-pregnant)	127	132	131
All (ages 6 y and older)	145	168	160

Data from reference 1.

Because individuals at risk cannot be reliably identified either by spot urine measurements or by dietary history, a public health approach to iodine supplementation in the United States has been advocated, particularly for pregnant women and women of childbearing age. The use of iodized salt should continue to be promoted. In addition, the National Academy of Sciences has recommended that consideration be given to adding iodine to all U.S. prenatal vitamins (4). The American Thyroid Association has also recommended that all women receive dietary supplements containing 150 µg iodine daily during pregnancy and lactation and that all prenatal vitamins contain 150 µg of iodine (5). These recommendations have not yet been adopted. Currently, only 69% of 127 nonprescription and 28% of 96 prescription prenatal multivitamins marketed in the United States contain any iodine and many contain less than the recommended amount (6).

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IDD control in Thailand: a new 5-year master plan

Thailand remains iodine deficient but the National IDD Control Board has ambitious plans to move forward

The Department of Health, Thailand, January 2008

On March 21, 2006, a meeting of the National IDD Control Board (NIDDCB) was held in Thailand. Her Royal Highness the Princess Maha Chakri Sirindhorn (see photo next page) graciously presided as the President, the Secretariat was the Minister of Public Health, and key persons in other Ministries and in the IDD network participated, including the Ministry of Interior, Ministry of Industry, Ministry of Commerce, Ministry of Education, the President of Iodized Salt Producers Association, the Thai Red-Cross, UNICEF, WHO, ICCIDD, the Dean of the Faculty of Medicine, Mahidol University, the Office of National Economic and Social Development Board, the Bureau of the Budget, and the Government Pharmaceutical Organization.

At the conclusion of the meeting, the NIDDCB confirmed the importance of IDD control for IQ development, approved the master plan of the IDD control program for the next five years (2006-2010), and agreed on the respective responsibilities of the government and other members of the Thai IDD Network.

The six main strategies in the master plan of the Thai IDD Control Program are:

Thai infants, particularly in rural areas, need more iodine

1. Quality iodized salt production and distribution. The key elements for this strategy are:

- Enhanced collaboration between rock salt and sea salt producers; quality control and certification model being developed in 4 regions of Thailand in the form of the salt producers association
- Set up iodized salt funds and strengthen the salt producers association to ensure salt producers are responsible for potassium iodate supplies
- Improve and develop effectiveness and sustainability of internal and external quality control of the iodized salt surveillance system
- Study tours to learn "best practices"
- Set up the iodized salt quality con trol system (protocol is being drafted)

2. Monitoring and surveillance. Routine salt monitoring and assessment of iodine status

3. Empower local administrative organizations to participate in IDD control; include the IDD control program into the Quality of Life Development project.

4. Communication and social marketing. Strengthen messages linking iodine sufficiency to better I.Q. and mental development; develop advocacy tools for salt producers; and develop messages for food industry to encourage use of iodized salt.

5. Research. Explore feasibility of additional vehicles for iodine fortification, i.e. fish sauce; evidence-based report linking IQ and iodine nutrition; and the role of the administrative organization in implementing IDD program into local programs.

6. Supporting strategies. Fortified iodine in many kinds of food and support for iodine drinking water for remote areas.

In April 2006, Department of Health, Ministry of Public Health (MOPH) and the iodized salt producers association signed a memorandum of understanding (MOU) for the promotion of cooperation to produce quality iodized salt, in order to improve the intelligent quotient and quality of life of Thai people in all age groups.

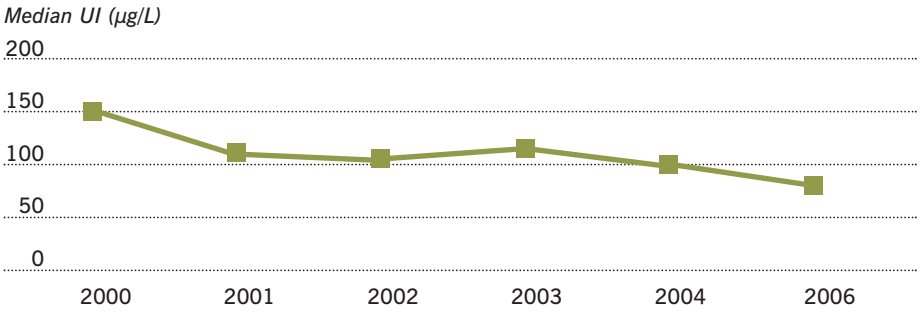
The contents of MOU were:

- Improve the monitoring and quality control system of iodized salt.
- Present the certification "Nutrition Seal" to iodized salt producers who produce qualified iodized salt.
- Promote public consumption of iodized salt by using marketing strategies.
- Facilitate the participation and cooperation of networking in the IDD control program.

Since the June 25 (National Iodine Day 2005), the Department of Health has awarded a nutrition seal (see photo) to adequately iodized products such as iodized salt, fish-sauce and instant noodles, in order to strengthen good quality production of iodized salt products. As of May 2006, there were 38 iodized products that have received the nutritional seal. Five were fortified fish sauce (iodine & iron), two were fortified instant noodles (iodine, iron and vitamin A), and the rest were iodized salt.

IDD strategies were redefined with more focus on the relationship between iodine and IQ development instead of goiter. Full implementation of the government IDD control program was supported by the National Public Health Foundation, UNICEF and WHO, as follows.

Figure 1: Median urinary iodine concentrations in pregnant women in the national Thai surveillance program 2000-2006.



The National Public Health Foundation support includes:

- "Smart Thai Children, Thailand Prospers"
- "National IDD Day on June 25"
- Iodized salt incorporated into antenatal care services throughout the country by distribution of 2 kgs of iodized salt (~7 gram/person/day) to every expecting mother during pregnancy.
- Iodized salt testing kits integrated in school-based food safety programs

UNICEF support:

- Project to support establishment of the salt producers association and also the project to improve quality of salt production.

WHO support

- $12,000 fund for research "A study of production and distribution of iodized salt in Thailand".

In May 2006, the IDD team from the Department of Health, led by the Director-General of the Department of Health, and a representative of the salt producers association visited the iodized salt producers in Udonthani and Mahasarakham Provinces. The salt producers presented several obstacles to producing iodated salt. The two main obstacles were insufficient support for the costs of potassium iodate and the low awareness of Thai people about the benefits of consuming iodized salt. The Director-General of Department of Health advised local staff and producers about the iodized salt fund and the coordination with local administrative organizations in dealing with the insufficiency of potassium iodate. The importance of strengthening the control system of iodized salt production was emphasized. The Department of Health will continue to support knowledge and technique in the production and control of adequate and sufficient iodized salt, and also communicate with people in order to increase their awareness of the benefits of consuming iodized salt.

The Thai National IDD Control Board was presided over by Her Royal Highness the Princess Maha Chakri Sirindhorn

The Department of Health awards a nutrition seal to adequately iodized food products

In June 2006, the big campaign of National Iodine Day was held at the Hua Lampong railway station. The Chairperson was the Minister of Public Health and the participants were representatives from Department of Health, directors of all provincial health promotion centers, the deputy-director of Border Patrol Police division, the chief of the Thai restaurant association, the chairman of the salt producers association, student health volunteers and their teachers, and the fortified food producers. The aim of this campaign was to increase the Thai people's awareness of consuming iodized salt and the relationship of iodine and IQ development. The Minister of Public Health presided over the ceremony and provided a certificate for food producers who have produced adequately fortified food. Iodine test kits were provided to attendees. The model of the iodized salt package was provided to the chairman of the salt producers association. Additionally, a caravan of iodized salt was discharged from the Hua Lampong subway station to several center points of the city of Bangkok. The event was also announced on the mass media and covered by national television.

There were also several meetings among salt producers and Department of Health which aimed to strengthen the salt producers association and find ways to set up and deal with iodized salt funds. The main objective of setting up iodized salt funds is to assure salt producers are taking responsibility for their own potassium iodate.

Several coordinating meetings were conducted between the Ministry of Public Health and its partners, including representatives from the Department of Health, National Health System Reform Office, the Department of Mental Health, and the Department of Medical Science, Ramathibodi Hospital, Mahidol University. At these meetings, the partners analyzed data on urinary iodine levels collected by the Department of Health, data on neonatal screening from Ramathibodi Hospital, and data on mental and IQ development from the Department of Health and Ramathibodi Hospital. Results of these analyses were integrated for national and provincial GIS mapping. The preliminary report indicated a strong relationship between iodized salt consumption and IQ, as well as the following data:

- The result of the urinary iodine surveillance system of Thailand in 2006 showed that the median urinary iodine level of whole country was 82.5 μg/L. The median values were 92.5, 61.1, 84.4 and 101 μg/L in the North, the Northeast, the Central and the South regions, respectively. The proportion of moderate-to-severe IDD based on the UI distribution increased from 25.4% in 2004 to 33.9% in 2006. Similarly, the proportion of the total population affected by IDD increased from 49.3% in 2004 to 57.4% in 2006. The median UI in pregnant women appears to have fallen significantly over the period 2002-2006 (Figure 1)
- The result of the study of production and distribution of iodized salt in Thailand estimated the quantity of iodized salt produced was 193,308 tons per year which was lower than recorded in the salt producer records.
- Random checks of household coverage by adequately iodized salt in communities and community shops increased from 54.4% in 2005 to 63.8% in 2006. In 2007 the coverage was 81.5%

In the latest developments, the Thai Cabinet approved the revolving fund for fiscal year 2008 for procurement of potassium iodate, and in November 2007, the Department of Health, Ministry of Public Health and partners in the food processing companies and association of livestock feeding production signed an MOU on IDD control. The next steps will include workshops on IDD control for the members of sub-district administrations and the municipalities of all 76 provinces, analysis of data on the source of salt in the diets of Thai people, and continued implementation of the ambitious five year (2006 – 2010) IDD control project.

Iodized fish sauce on the market

The Thai IDD program has ambitious plans to provide women with enough iodine for a healthy pregnancy

Reducing the iodine content of over-iodized salt in the Democratic Republic of Congo improves iodine nutrition

Théophile Ntambwe Kibambe ICCIDD Sub-regional Coordinator, Francophone West-Central Africa

The Democratic Republic of the Congo (DRC) had historically been a severely iodine deficient area. In October 1993, with publication of an inter-ministerial order regulating production, quality control and trade of iodized salt, the DRC adopted a USI strategy to control IDD. This national regulation has been implemented since 1994, particularly the prohibition of the import of noniodized salt, and the control of salt iodine levels at retail points in the country and in households. It stipulated an iodine content of 100 ppm at point of production.
In 2000, a national study showed that 96.7% of household salt was iodized but the median UI was 495 µg/L, in the excessive range according to WHO. Because of this, in 2003, a revision of the national regulation on iodized salt was issued, reducing the stipulated salt iodine content to 40 ppm at point of production.

Table 1: Salt iodine content

Provinces	Number of salt samples	Mean iodine concentration
11	1036	35.8 ppm

Table 2: Urinary iodine concentrations

Provinces	Number of urine samples	Median UI
11	617	249 µg/L

Table 3: Distribution of iodine status

Iodine status	Frequency	Proportion (%)
Severe deficiency (< 20 µg/L)	0	0 %
Moderate deficiency (20-49 µg/L)	1	0.2 %
Mild deficiency (50-99 µg/L)	8	1.3 %
Optimal (100-199 µg/L)	420	68.0 %
More than adequate (200-299 µg/L)	185	30.0 %
Excess (≥ 300 µg/L)	3	0.5 %
Total	**617**	**100 %**

In the DRC, careful monitoring and adjustment of salt iodine levels has reduced excess iodine intakes in children

Table 4: Comparison of the distribution of urinary iodine in children in 2000 and 2007

	2000	2007
< 50 µg/L	3.8 %	0.2 %
50-99 µg/L	6.3 %	1.3 %
100-299 µg/L	23.7 %	98.0 %
≥ 300 µg/L	66.2 %	0.5 %

Table 5: Indicators of IDD elimination in the DRC

Indicator	Goal	Current results
Iodized salt coverage	> 90 %	97.5 %
Urinary iodine		
Proportion < 50 µg/L	< 20 %	0.2 %
Proportion < 100 µg/L	< 50 %	1.5 %
Median	100-200 µg/L	249 µg/L
Prevalence of goiter		
Prevalence in children 6 to 12 yrs old	< 5 %	1.0 %

According to the recommendation of the World Health Assembly calling on all Member States to report on progress towards the elimination of IDD, in 2007 the Ministry of Health completed a representative national survey. This was done to evaluate the current IDD situation in the DRC, 13 years after the introduction of iodized salt. This study was conducted from July-August in 2007, in all 11 provinces of the DRC. Details of this study were recently published in the IDD Newsletter (Ntambwe KT. From severe endemic cretinism to iodine sufficiency: an IDD success story in the Democratic Republic of the Congo. IDD Newsletter. Volume 26, n° 4. November 2007).

The results of the surveys of salt iodine content as well as urinary iodine concentrations in school children have recently been made available. As shown in Table 1, the mean salt iodine concentration was 35.8 ppm. As shown in Tables 2-4, the median UI in school children has fallen from 495 µg/L in 2000, to 249 µg/L in 2007. Although the median UI remains in the 'more than adequate' range according to WHO guidelines, it is much improved from the clearly excessive level in the 2003 study. Table 5 shows the current situation in the DRC regarding indicators of IDD elimination. Through careful monitoring of urinary iodine concentrations, and a reduction in the iodine content in over-iodized salt, the country is moving close to successful elimination of IDD.

Successful control of iodine deficiency in southern Guizhou Province, China

Iodized salt brings a brighter future to a region historically crippled by severe endemic cretinism

Chengkai Zhu Qiangnan Center for Disease Control, Guizhou province, China

Buyi and Miao Minority Autonomous Prefecture (Qiangnan) is located in southern Guizhou Province on the Yungui Highland with an altitude between 400-1200 meters above sea level. This Prefecture has a total population of 3.91 million. In 1976, the visible goiter rate was 34% and the incidence of endemic cretinism was 5.7%. The cretinism rate was extremely high in the Kaiyou area, and many families had multiple cases of cretinism: the survey found 3 families had 4 cretins, 13 families had 3 cretins and 43 families had 2 cretins!

A subsequent study in 1978 in Qiangnan Prefecture reported the total goiter rate in schoolchildren was 34% and there were 10,086 cases of cretinism, with all the cretins of the neurological form. At this time, the median UI was as low as 37 μg/gr creatinine, and table salt was sea salt produced in Guangxi Province, which contained iodine concentrations <5 ppm.

The iodized salt program was started in 1977, expanded to the surrounding areas along the railways in 1978, and finally covered the whole Qiangnan Prefecture by 1985. At the beginning of the salt program, iodized oil injections or oral iodized oil were given to women of childbearing age; at least 10,000 women received iodized oil injections and 100,000 were given oral iodized oil. These treatments were very effective at reducing the incidence of new cretins. Tablets of dry thyroid glands and supplements of minerals and vitamins were also given to cretins, and although these sometimes helped correct hypothyroidism and improve physical development, they had no benefits on mental retardation.

Monitoring activities were done every 2-3 years and demonstrated that the visible goiter rate had decreased to 24% in 1979, compared to 41% in 1976. The goiter rate continued to decrease and by 1984-1988, the visible goiter rate was 2.8%, median UI was 137 μg/gr creatinine, mean iodine concentration in salt was 16 mg/kg. and there were no new cretins born.

Current situation

The national USI program with 35-40 mg iodine/kg salt has been implemented in China since 1995. Qiangnan prefecture was involved in the Chinese National Monitoring Activity with the goal of elimination of IDD. Monitoring in 1999 showed the median UI in schoolchildren was 410 μg/L, and mean salt iodine content was 41 mg/kg. In response, in 2000 China reduced the iodine concentration in salt from 40±20mg/kg to 35±15mg/kg. The most recent monitoring in 2006 found more than 90% of households are covered by adequately iodized salt, total goiter rate in schoolchildren is <5% and the median UI is 331μg/L. These results indicate iodine nutritional status in the population remains higher than desirable, and suggest the iodine concentration in salt should be further reduced to achieve optimal iodine intakes.

The authors thank Dr. Xiaosong Li, (Guizhou Provincial CDC, China) and Prof. Zupei Chen (Tianjing Medical University, China) for help with this report.

Iodine sufficient children in Guizhou can grow normally and learn better at school

Meetings and Announcements

GAIN-UNICEF Partnership Project on universal salt iodization

GAIN and UNICEF have formed the USI Partnership Project, "Intensification of Business-Oriented Approaches towards the Global Elimination of Iodine Deficiency through Universal Salt Iodization" through funding from the Bill and Melinda Gates Foundation.

According to Arnold Timmer, Senior Adviser, Micronutrients UNICEF, the main objective of the USI Partnership Project is not only to reach high levels of coverage in selected countries, but also to consider how best to involve the private sector to move countries along the continuum towards program sustainability. A review of lessons learned from previous efforts to support salt iodization programs reinforces the need to develop new business models by actively engaging the salt industry thus improving prospects for long term sustainability. Furthermore, data on the performance of this project and the impact of improved iodine nutrition on overall social and economic development will be important to provide a foundation for a broader fortification agenda, and to further demonstrate the success of USI.

This project will help to strengthen national programs to:

- Increase the overall supply of adequately quality iodized salt
- Support government oversight, national ownership and the regulatory environment
- Develop market-based approaches to stimulate long-term demand for iodized salt

Furthermore, the partnership project will represent a departure from previous global efforts which aimed primarily to reach high levels of coverage, by placing emphasis on supporting those systems and capacities needed to ensure program sustainability. UNICEF and GAIN will jointly implement this grant in thirteen countries (Bangladesh, China, Egypt, Ethiopia, Ghana, India, Indonesia, Niger, Pakistan, Philippines, Russia, Senegal and Ukraine) covering a total population of 2.3 billion people.

GAIN will take overall responsibility for program components related to Salt Supply, Evidence and Results, while UNICEF will take the lead on Advocacy and Communication: ensuring acceptance, demand creation and market demand issues.

Through the activities of this joint project, it is aimed to achieve significant increases in coverage in each of the target countries to at least 90% of the population with adequately iodized salt. With this increased availability of iodized salt, it is expected that at least 790 million additional people will have access to adequate iodine intake, while approximately 20 million newborn infants will be protected from the adverse consequences of iodine deficiency.

Abstracts

Costeira MJ et al. Iodine status of pregnant women and their progeny in the Minho region of Portugal. Thyroid. 2008 Nov 3. [Epub ahead of print]

The objective of this study was to evaluate in the Minho region of Portugal the iodine status of women throughout pregnancy and after delivery, and of their offspring. Urinary iodine concentration (UI) was determined in 78 nonpregnant premenopausal women, in 140 pregnant women in the three trimesters of pregnancy and after delivery, and in their 142 offspring. Milk iodine concentration was determined at day 3 and 3 months after delivery. Both nonpregnant and pregnant women had iodine deficiency (ID), as documented by median UI of <75 μg/L and milk iodine concentration of <100 μg/L. Concordant with the mother's ID, median neonatal UI was low (71 and 97 μg/L at 3 days and 3 months of age). These observations suggest that iodine supplementation should be implemented throughout pregnancy and lactation in this region of Portugal.

Liu HL et al. Effects of drinking water with high iodine concentration on the intelligence of children in Tianjin, China. J Public Health (Oxf). 2008 Oct 23. [Epub ahead of print]

This study investigated the effects of drinking water with high concentrations of iodine on the intelligence of children in Tianjin, China. Participants were recruited from the total population of primary school children attending years 1-4 with ages ranging from 8 to 10 years. Intelligence quotient (IQ) was assessed using the combined Raven's test, second edition. A total of 1229 students were recruited with a mean IQ of 105.8. Water analyses indicated iodine concentrations were high in one rural region and exceedingly high in another with median values of 137.5 and 234.7 μg/L, respectively. There was a significant association between residing in the very high water iodine region and a reduction of IQ by an average of about nine points (P = 0.022), after adjusting for the potential confounding factors. The authors concluded that exposure to high iodine concentrations in drinking water has detrimental effects on the intelligence of children.

Mian C et al. Iodine status in pregnancy: role of dietary habits and geographical origin. Clin Endocrinol (Oxf). 2008 Sep 10. [Epub ahead of print]

A study was conducted on iodine status during pregnancy and its dependence on dietary habits, racial and geographical origin, and time since arrival in Italy. The study enrolled 322 consecutive pregnant women: 217 Italians, 62 Eastern Europeans and 43 from Northern and Central Africa. All women completed a food frequency questionnaire on their dietary habits. In the group as a whole, the median UIC was 83 μg/L; it was significantly lower in Africans and Eastern Europeans than in Italians (medians 45 and 46 versus 100 μg/L, respectively. A significant link emerged between UIC and cow's milk intake. Iodine supplements were used by 40% of the women, and UIC were higher in those who did so than in those who did not (median 103 versus 75 μg/l). Multivariate analysis showed that milk was the only variable influencing UIC. The authors concluded that iodine levels are low among pregnant women in the region, particularly in foreign women, and that cow's milk intake is their main source of iodine.

Andersson M, et al. Adequate iodine nutrition in Sweden: a cross-sectional national study of urinary iodine concentration in school-age children. Eur J Clin Nutr. 2008 Sep 10. [Epub ahead of print]

Sweden has a long-standing salt iodization program; however, its effects on iodine intake have never been monitored on a national level. The objective of this study was to evaluate iodine nutrition in the Swedish population by measuring the urinary iodine concentration (UIC) in a national sample of Swedish school-age (6-12 years of age) children. A stratified probability proportionate to size cluster sampling method was used to obtain a representative national sample of school-age children from 30 clusters. The median UIC of the children (n=857) was 125 μg/l (range 11-757 μg/l). The proportion of children with a UIC <100 μg/l was 30.0% and the proportion of children with a UIC <50 and >300 μg/l was 5.5 and 3.0%, respectively. The authors concluded that the iodine nutritional status of the Swedish population is adequate. Pregnant and lactating women with high iodine requirements may still be at risk for low iodine intake. This study will serve as the basis for future monitoring of iodine nutritional status in Sweden.

Sánchez-Vega J, et al. Inadequate iodine nutrition of pregnant women from Extremadura (Spain). Eur J Endocrinol. 2008 Oct;159(4):439-45.

The study aim was to evaluate the iodine nutrition of pregnant women in the Spanish region of Extremadura. A representative sample of pregnant women from the general population was analyzed, along with another sample of pregnant women from traditionally goitrogenic areas. The results showed that changes between the first trimester and later stages of pregnancy of all biochemical variables studied corresponded with those described for other European areas with comparable iodine nutrition. Using the urinary iodine concentration value as an indicator of iodine ingestion, it was found that in the first trimester of pregnancy six out of ten women from Extremadura ingested less than the currently recommended amount (250 μg iodine/day), and approximately three out of ten of these women ingested less than half of this amount.

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