INTERNATIONAL COUNCIL FOR CONTROL
OF IODINE DEFICIENCY DISORDERS

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In this Issue:

Iodine deficiency and women's health

Globally, an estimated 20 million infants are born each year at risk of brain damage from iodine deficiency. In Tanzania, iodine deficiency in utero predicts lower schooling attainment ten years later, and this effect appears to be stronger in girls.

Adequate dietary iodine is an important determinant of cognitive ability in humans (1). In areas of severe iodine deficiency, poor thyroid status during pregnancy can cause cretinism and adversely affect cognitive development in children; to prevent fetal damage, iodine should be given before or early in pregnancy.

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.

In-utero iodine deficiency may have gender-specific effects

A recent paper (2) has documented the impact of IDD on learning ability by examining the effect on child schooling of the intermittent distribution of oral iodized oil supplements (380 mg iodine) in districts of Tanzania between 1986 and 1997. Because fetal brain development is highly vulnerable to IDD, the authors examined whether children born to mothers who likely were covered by iodized oil during their pregnancy exhibited higher rates of grade progression at school 10-14 years later.

Tanzania historically suffered from high rates of IDD. In the 1970s, about 25% of the population was estimated to suffer from IDD, including 3% with severe and 22% with moderate symptoms (van der Haar et al., 1998). Tanzania had one of the largest and most intensive iodized oil distribution programs, ultimately covering ca. 25% of the population and protecting nearly 2 million babies born during periods of iodine supplementation.

The authors examined district-specific iodized oil distribution records to compare children covered in utero to slightly older and younger children within the district who were in utero during program gaps and delays, and whose mothers were likely iodine deficient during gestation. The study was based on the premise that since fetal IDD permanently limits intellectual functioning, it will influence later school performance. The authors made two assumptions which may or may not be correct: 1) that iodized oil offers protection to women for two years: and 2) that only adequate iodine in the 1st trimester would be beneficial to cognitive development.

The findings suggest that reducing fetal IDD has significant benefits on a child's cognitive ability and schooling attainment: children likely to be protected from iodine deficiency during their first trimester in utero attain an average of 0.36 – 0.51 years of education above siblings and older and younger children in their district who were not. Furthermore, the estimated effects were substantially larger and more robust for girls. Iodine supplementation did not reduce rates of illness or school absence due to illness, suggesting that they improve schooling through their effect on cognition rather than their effect on health. But the data also indicate that the iodine supplements may have reduced child but not fetal or infant mortality, with no evidence of gender differences; this could have negatively biased their estimates so that the positive effect of iodine on education may actually be greater than their estimates.

The authors examined the relationship between school participation and baseline IDD and the fraction of population consuming adequately iodized salt across several African countries. They found a link between baseline iodine deficiency and decreased female secondary schooling. They also found early salt iodization had a positive effect on female primary schooling attainment. Extrapolating their estimates from Tanzania, they estimated that the average increase in years of schooling attained in Central and Southern Africa attributable to USI could ultimately be as large as 7.2% of baseline average schooling levels.

In Tanzania, girls attain fewer years of schooling due to the extremely low rate at which girls pass the national secondary school qualifying exam. The authors conclude that the greater adverse effect of in-utero iodine deficiency on females may help explain gender differences in schooling attainment in not only Tanzania but also in many parts of the developing world. The possible role of IDD in contributing to gender differences in schooling outcomes in such settings is a provocative and novel insight provided by this study.

Mechanisms

Why might girls be more sensitive to in-utero iodine deficiency? It is well known that severe iodine deficiency in pregnancy may cause deficiency of thyroid hormone and deficits in motor and cognitive behavior in the offspring. Very limited evidence from animal models suggests greater sensitivity of the female fetus to maternal thyroid hormone deficiency. Pregnant rats whose thyroid glands are removed during gestation produce offspring that have significant deficits in maze learning. Female offspring were more vulnerable to the detrimental effects on learning, while learning in male offspring was only slightly impaired (3).

More recently, Chan et al. (4) reported that in guinea pigs, a 48 h period of maternal nutrient deprivation at gestational day 50 results in fetal hypothyroxinemia. Thyroid hormone action in the developing brain is mediated by nuclear thyroid hormone receptors (TRs). With maternal nutrient deprivation, TR mRNA expression was significantly increased in the brain of the male fetuses, but decreased in the female brains. The authors concluded that maternal nutrient deprivation resulted in sex-specific changes in TR mRNA expression, and that these changes may represent a protective mechanism to maintain appropriate thyroid hormone action in the face of fetal hypothyroxinemia in order to optimize brain development (Chan 2005).

A call for action

In a recent article in the New York Times (5), Kristof and WuDunn argue that improving iodine nutrition in the developing world may be particularly beneficial for the lives of women and girls. Along with other proposals to improve the plight of women in developing countries, they recommend:

"…President Obama might consider… that the United States sponsor a global drive to eliminate iodine deficiency around the globe, by helping countries iodize salt. About a third of households in the developing world do not get enough iodine, and a result is often an impairment in brain formation in the fetal stages. For reasons that are unclear, this particularly affects female fetuses and typically costs children 10 to 15 I.Q. points. Research by Erica Field of Harvard found that daughters of women given iodine performed markedly better in school. Other research suggests that salt iodization would yield benefits worth nine times the cost."

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Integrating small salt producers in Rajasthan into India's universal salt iodization strategy

Lucie Bohac Coordinator, Network for Sustained Elimination of Iodine Deficiency and **Deepti Gulati** formerly Senior Nutritionist, U N World Food Program, India

The State of Rajasthan in northwest India

In conjunction with the meeting of the Board of the Network for Sustained Elimination of Iodine Deficiency in Jaipur in February 2009, a field visit for the Board was arranged to Nawa, Rajasthan, the site of a World Food Program - Micronutrient Initiative project focusing on bringing small salt producers into the framework of India's Universal Salt Iodization strategy.

Background

India bears a high burden of iodine deficiency disorders. According to surveys conducted in 325 districts of the union territories, 263 districts have endemic iodine deficiency with an estimated prevalence of over 71 million people with insufficient iodine intake. Every year over 13 million infants are born unprotected from IDD.

To address this public health problem, India has adopted Universal Salt Iodization as the strategy to eliminate iodine deficiency. According to the National Family Health Survey (NFHS-3), just over 51% of India's households consume iodized salt, while approximately 24% consume salt that is not iodized at all and the remaining 25% of households consuming salt that is not adequately iodized. Low levels of awareness about iodine deficiency and the need for consuming iodized salt were among the key issues identified.

India annually produces 17.85 million metric tons of salt. Although India is the world's third largest salt producer, salt production is generated by only three states: Gujarat produces approximately 70% of the salt destined for human consumption, followed by Tamil Nadu 15% and Rajasthan at also 15%. Of the 2.5 million metric tons of salt produced by Rajasthan, 1.5 million is for human consumption. The small salt producers in Rajasthan hold a significant share of the salt market, producing about 88%, or 1.32 million metric tons, of the state's total production destined for human consumption.

Reports from the Salt Department of the Government of India, indicate that the leakage of non-iodized or inadequately iodized salt into the market tends to be attributed to salt sold by small producers whose capacity to iodize salt is limited.

Project to engage small salt producers

In 2006, the World Food Program (WFP) and Micronutrient Initiative (MI) entered into a strategic partnership to engage small salt producers to bring them into the framework of the USI strategy.

Specifically, the objectives of this project were to:

1. Increase awareness about IDD in the community and create a demand for iodized salt, and
2. Build the capacity for salt iodization among salt producers to enable them to produce adequately iodized salt on a sustainable basis.

The project focused on the 350 small salt producers (SSPs) in four districts (Nagaur, Ajmer, Jodhpur and Jaisalmer), whose annual salt production was 1500 MTs or less, and who had valid legal documents related to the ownership of salt-pans. The Centre for Community Economics and Development Consultants Society (CECOEDECON), a Rajasthan based implementing partner, was selected to implement the project.

The main components of this project include:

- Forming Self-Help Groups (SHG) comprised of the participating small salt producers in order to build the economies of scale in iodized salt production and marketing;
- Providing machinery and equipment for salt processing and iodization as well as a potassium iodate (KIO3) subsidy and ensuring its regular supply;
- Building the capacities of SHGs through:
  - training on machine operations, maintenance and iodization techniques
  - training on quality control and assurance
  - building their managerial capacities including group dynamics, inventory management and operating under established business practices;
- Supporting the SHGs to improve their infrastructure and production capacity;
- Formalizing the SHGs into legally federated bodies to enable them to leverage their own credit and marketing needs;
- Developing marketing networks to promote the sale of adequately iodized salt produced by the SHGs;
- Creating a demand for adequately iodized salt at the community level through a targeted public awareness campaign

The Process

The Network Board Members were split into several groups so that a variety of Self Help Group operations could be visited. Board members remarked how deeply the small salt producers felt ownership of the project and how well they understood the context of their business and the value of salt iodization.

To ensure that the project was grounded within the area villages and stakeholders, a Participatory Rapid Appraisal was undertaken provide the situation analysis of the local villages including:

i. The social and cultural milieu of the area
ii. Ownership of salt farms
iii. Needs and aspirations of small salt producers
iv. Other factors that limit / support iodization of salt, including supply of electricity, rail / road links, quality of brine, etc.
v. Needs and challenges of salt industry in the project area
vi. Available marketing structures

Based on the outcome of the Appraisal and semi-structured interviews, a detailed reference Capital Investment Plan (CIP) was developed. The Investment Plan allowed the producers to realistically estimate the costs of producing and processing adequately iodized salt as well as the profit that would be accrued, the latter being one of the motivators for these producers to come together under one umbrella.

Ownership by and accountability of the small producers was established through "Tripartite Agreement" with WFP and MI on the maintenance and upkeep of the equipment provided to them and also included a 10% contribution of the cost of the machine and the potassium iodate (KIO3) by the SHG members.

To further instill the coherence and collaboration among the producers in the Self Help Group, a bank account in the name of each SSP-SHG group was opened. Each member deposited Rs. 200/- (US$ 4) as his or her contribution and membership fee. The 10 % contribution towards the cost of the plant and cost of total KIO3 to be received was added to this, leading to an initial deposit of about Rs. 60,000/- (US$ 1200) for each group. Guidelines on Internal Lending and Repayment were developed when the SHG was initially formed. Thus, this account became the revolving fund which the group would use as working capital and as leverage to secure bank loans.

Training on operating the crusher-cum salt iodization machine, process of salt crushing and iodization, maintenance of plant, packaging and quality control of salt was conducted by the Salt Department of Government of India and the MI team. This makes the SSPs aware of and trained to be able to comply with national standards of monitoring. Thus a quality assurance system was developed to test the iodine content in the salt and a "zero-tolerance" policy adopted for inadequate iodization of salt produced by its SHGs.

Along with capacity building for iodization, the small producers were provided with training on established business practices and a set of "Records and Registers" was specifically designed to help them track salt production, quality of iodization, sales and other transactions as well as a meeting decisions log.

To further consolidate the self-regulatory element of the SHGs, they became federated and registered with the Office of the Registrar of Cooperative Societies of the Government of Rajasthan, with their own governing by-laws. Becoming formally federated makes the SHGs subject to external government audits and scrutiny of relevant documents and transactions. Ultimately, this requires that the SHGs also comply with the relevant laws in relation to salt iodization.

Creating the brand and market demand for their product presented the SHGs with a significant challenge as each group tended to market under different brand name. Consequently, it was proposed that they use a common brand name marketed under their federated body. This move not only provides brand identity but also distributes the orders from salt traders among the SHGs, giving a helping hand to those which could not get sufficient orders from traders.

Active community - based campaigns were established to address the low levels of awareness about IDD and the need for iodized salt. The IDD messages continue to be reinforced by piggy-backing onto national events such India's Independence Day, Republic Day, National Nutrition Week, Hunger Campaign, Stand Up and Speak Out Against Poverty.

The Results

In a presentation of their achievements to the visiting Members Board of the Network, the Presidents of the Self Help Groups acknowledged that there are inherent uncertainties about their salt business such as the seasonality of the salt industry and the fact that the iodization plants are not always owned by the small salt producers hence represent additional costs, or the actual salt farms were a distance from the rail or road link to the consumer. Nevertheless, they were proud of their achievements.
Key milestones of the project's success include:

- Within a brief period of 20 months, the 20 SHGs collectively produced approximately 185,000MTs of adequately iodized salt that is expected to have reached almost 50 million people;
- The small salt producers have acquired technical skills in relation to salt iodization and skills for record keeping, basic business management, and internal quality control – all of which enable them to better partake in India's efforts to eliminate iodine deficiency through universal salt iodization;
- Incorporating the SHGs into a Federation has opened several avenues for the SHGs by developing linkages with other financial institutions and markets;
- Under the brand names of Keerti (salt with higher moisture content) and Sukhara (free flowing sun-dried salt) developed for this project, the SHGs are reaching out to new markets and are able to access different government schemes for the salt industry;
- Campaigns about IDD awareness and the benefits of iodized salt are now being undertaken within the schools, helping with demand creation which is necessary to support the production of iodized salt;
- At the behest of Salt Department, Government of India and the request of SSPs in those districts, this project is now being replicated in two additional districts of Rajasthan.

Challenges remaining

Taking advantage of the visiting Network Board Members, which included senior officials of some of the world's major salt producers and associations, Presidents of the Self Help Groups discussed with the Board Members some of the challenges that lie ahead.
As with any pilot project, successes need to be consolidated and remaining challenges addressed in order to ensure that this model is indeed a sustainable approach to engaging small salt producers into the national USI framework.
Moving ahead, maintenance of salt iodization equipment needs to be sustained, the self regulatory mechanisms of salt producers need to be enhanced, the internal monitoring and quality assurance systems need to be reinforced with those of the government, competitiveness and marketing of the SHGs' products need to be sharpened to support sales and the commercial procurement of KIO3 needs to be initiated.

Iodine excess in East Cameroon due to over-iodized salt

Daniel N. Lantum ICCIDD Regional Coordinator for Africa

Historically, the Kadey and Lom et Djerem Divisions in the East Province of Cameroon have been long-recognized regions of severe IDD. In 1954, Robert Massesyeff, a French scientist, reported the goiter prevalence among adults in Kadey was 58%. Alarmed by such statistics, Leweinstein was dispatched in 1968 by the World Health Organization office in Brazzaville to verify the findings, which he did. But despite severe IDD in the vast rural territory, the sketchy medical services could only offer Lugol's Iodine as a remedy to those who reported to hospital. Subsequently, intramuscular injection of Lipiodol was introduced in parish clinics and health centers for adult patients presenting with goiter. In 1974, Nguessi, a medical student at the University of Yaounde, was dispatched to investigate the biological and epidemiological aspects of goiter in Batouri. He reported that even goats and sheep in the region were goitrous. The WHO/UNICEF/ICCIDD First African Regional IDD Conference of March 1987, held at Yaounde, Camerron, recommended countries carry out baseline surveys and embark on universal salt iodization as the best strategy to fight iodine deficiency. In 1989-1990, Lantum and collaborators in Cameroon conducted a national study to establish the national IDD baseline, and reported the goiter rate was 29.4%. The government enacted an Order in May 1991 to organize the utilization of iodized salt for the prevention and control of IDD. The implementation of this order was immediate since the then lone salt distributor in the country had already stock-piled 10,000 metric tonnes of iodized salt in readiness, and his refinery had the capacity of producing 50,000 tonnes per year - more than the country's annual consumption. The USI program was officially launched by the Ministry of Public Health in June 1991.

In 1994, a follow-up survey was conducted by Lantum and collaborators, and they found that USI was already well established in the East Province of Cameroon, including Betare-Oya. Wassep Tinda, in 1995, studied children of 5-12 years in three primary schools in the area. The goiter rate was 26%; the availability of iodized salt in households was above 90% and the median urinary iodine concentration was 111 µg/L indicating elimination of iodine deficiency. In 1997, the African Seven Inter-Country Study organized by WHO/UNICEF/ICCIDD selected Betare Oya as a sentinel site for Cameroon and the results confirmed virtual IDD elimination thanks to universal salt iodization.

By early 2009, to confirm long-term sustainability of USI in Betare-Oya and the East Region of Cameroon, Dan Lantum, the ICCIDD Regional Coordinator for Africa, traveled to the area from 3-8th February 2009. The ICCIDD team visited four schools in the area. Household salt samples collected from pupils were tested using MBI Rapid Test Kits, and 90% were positive for iodine. Pupils in each of the four schools then provided 50 spot urine samples. Retail salt samples at the local markets were also tested with rapid kits. The last phase of the survey consisted of iodized salt inspection at the Bertoua Regional Market. The dealers are Arab-speaking and they are supplied by large-scale dealers who come from Douala with huge trucks, drop a limited number of bags at Bertoua, and continue their away towards the Northern provinces of Cameroon or to the Central African Republic. No non-iodized salt was found in the Market and the salt dealers were quite happy to be congratulated for selling good quality salt.

The salt and urine samples were analyzed at the International Reference Laboratory for Iodine (IRLI) at the Institute of Medical Research and Study of Medicinal Plants (IMPM) at Yaounde. The analysis of the salt specimens collected from four schools and the market at Betare-Oya found a range of iodine content from 6 to 216 ppm, with a median value of 102 ppm. About 40% of the samples were in line with the legally stipulated value of 100 ppm at production, set in the 1991 Order by the Ministry of Health. This is still in force, despite several recommendations from experts to reduce the iodine level to the WHO recommended range of 20-40ppm. Of the 200 urine samples, 199 were in good condition for analysis. The median (range) urinary iodine concentration (UI) was 298 µg/L (54-1959 µg/L), and the distribution of UI values is shown in Table 1.

The significant finding of this study is that 56% of household salt samples were iodized in the range of 101-216 ppm, above the 100ppm level stipulated by current legislation, and far above the 20-40ppm level recommended by WHO. As a result, 49.8% of spot urine samples were above 300µg/L, indicating clearly excess iodine intake. Excess iodine consumption has also been found in recent years by ICCIDD studies in West and North Cameroon. These results suggest the Cameroon government should consider a revision of the 1991 Government Order stipulating an iodine level of 100 ppm in salt.

Table 1: **Distribution of urinary iodine concentrations in school children in Eastern Cameroon in 2009.**

UI (µg/L)	Category of iodine status	Number of samples (%)
0-20	Severe deficiency	0
20-50	Moderate deficiency	0
50-100	Mild deficiency	11 (5.5)
100-300	Adequate or more than adequate	89 (44.7)
>300	Excessive	99 (49.8)

Increasing iodine intakes in populations through the use of iodized salt in bread baking

Gregory Gerasimov ICCIDD Regional Coordinator for Eastern Europe and Central Asia

Over past two decades significant progress has been achieved globally in elimination of iodine deficiency through universal salt iodization (USI). The main focus of national IDD elimination programs was on iodization of table salt used at the household level. In many developing countries, homemade foods are the mainstay of family diets and therefore iodization of household salt can be effective.

Salt consumption patterns in industrialized countries are remarkably different. In these countries, approximately 75% of the total salt intake comes from processed foods. Discretionary use of table salt added during cooking and/or to the table contributes to only 15% of salt consumed and naturally occurring sodium in unprocessed foods contributes approximately 10% of total sodium intake. In some developed countries (the UK, Ireland, Australia and New Zealand), due to adventitious sources of dietary iodine (mainly through use of iodine containing disinfectants in dairy industry), populations received adequate dietary iodine and iodine deficiency has not been a problem for several decades. However, mild-to-moderate iodine deficiency re-emerged over the past 10-15 years in several industrialized countries [1].

In some countries (Russia and Ukraine are the best examples), despite clear iodine deficiency, governments are reluctant to introduce mandatory iodization of table salt as this could allegedly "violate consumer's right for choice and freedom of entrepreneurial activities" [2].

Table 1: Summary of Greater Europe Legislative Picture Regarding Use of Iodized salt in Processed Foods (2007)* [3]

Compulsory	Voluntary	Not Permitted	No Legislation
Armenia	Austria	France	Albania
Azerbaijan	Belgium	Poland	Estonia
Belarus	Czech Republic		Ireland
Bosnia & Herzeg.	Finland		Latvia
Bulgaria	Germany		Lithuania
Croatia	Greece		
Denmark	Hungary		
Georgia	Italy		
Kazakhstan	Netherlands		
Kyrgyzstan	Norway		
Macedonia	Portugal		
Moldova	Slovenia		
Romania	Spain		
Serbia	Sweden		
Slovakia	Switzerland		
Taijikistan	Turkey		
Turkmenistan	United Kingdom		
Uzbekistan	Russia		
	Ukraine		

Moreover, national laws mandating salt iodization tend to focus on table salt. Recently, the Iodine Network conducted a review of use of iodized salt in processed foods. In only 18 out of 43 countries in the WHO European Region is the use of iodized salt compulsory in the food industry. In two countries (France and Poland) iodized salt was forbidden in the food industry while in 23 countries use of iodized salt was either voluntary or not regulated at all (Table 1). Thus, iodization efforts in most of the countries of West/Central Europe are not focused on salt used in processed foods. In many of these countries, food processors are reluctant to use iodized salt due to concerns about the imagined effects on their food products and/or national trade barriers due to varying legislation [3].

Among processed foods, use of iodized salt in bread baking seems the most feasible delivery strategy for iodine. From the Australian National Nutrition Survey, approximately 50% of salt in processed foods came from bread and cereal products [4]. There are several reasons why use of iodized salt in bread and some other cereal products could be an effective strategy:

- Salt is already an essential component for baking a good bread; in most cases no technological changes or upgrades of equipment are needed for switching to use of iodized salt.
- Bread and other cereal products are consumed by the majority of population and in sufficient quantity to provide adequate amount of iodine with no risk of iodine overload.
- Switching to iodized salt will not result in substantial extra costs for producers and consumers alike.
- Salt fortified with potassium iodate can even improve quality of bread; there is sufficient experience using potassium iodate as bread conditioner in the United States.
- Iodine losses are negligible due to high retention and stability of iodine in bread.
- Bread is typically consumed near the place of production (no international trade barriers).
- There is a positive experience of iodized salt use in bread baking in several industrialized countries.

In the **Netherlands,** bread salt is iodized since 1942. Though compulsory use of iodized salt in bread baking was repealed by high court in 1984, still 90-95% of the bread producers are using iodized salt. In 1997 Dutch authorities increased the level of iodine in bread salt from 45 to 70-85 mg/kg due to a decline in bread consumption. Iodized salt is also permitted for processing of other grain based products. In the new Dutch iodine policy effective July 2009, the number of foods that may contain iodized salt was extended and the concentration of iodine in salt was decreased. Currently iodized salt with maximum iodine levels of 65 mg/kg may be applied to bread, bread-replacing products and other bakery products. Salt with a maximum iodine level of 25 mg/kg may be applied in all other industrially processed foods (excluding drinks containing more than 1.2% volume of alcohol). Currently up to 50% of dietary iodine in Netherlands is consumed through bread and other cereal-based products [5]. Iodine deficiency in this country is considered to have been eliminated.

In **Denmark,** salt iodization became mandatory in 2000 for table salt and for salt used in commercial bread production. Salt is fortified with potassium iodate at the level of only 13 mg iodine/kg. Approximately 98% of the rye breads and 90% of the wheat breads were iodized. The mean iodine level of iodine in bread produced with common (non-iodized salt) was 6 µg/100 g and in bread baked with iodized salt was 21 µg/100 g. The median iodine intake from bread increased by 25 (13-43) µg/day and the total median iodine intake increased by 63 (36-104) µg/day (also due to mandatory iodization of table salt). The authors conclude that fortification of bread with iodized salt and mandatory use of table iodized salt resulted in desirable increase in iodine intake, and the current fortification level of salt (13 mg/kg) seems reasonable [6].

In **Belarus,** the government decree (2001) requires mandatory use of iodized salt in all industrially processed foods (except salt water fish and other seafood) and for public catering. Iodization of table salt is voluntary, but 70% of salt in the retail trade is iodized. Table and food industry salt is fortified with potassium iodate at 40±15 mg of iodine/kg. Compulsory use of iodized salt resulted in significant increase of iodine level in different brands of bread, on average by 10 to 20 µg/100 g (Figure 1).

Iodine intake from bread only increased by 30-60 µg /day (estimated; based on average bread consumption of 250 g/day). Results of recent survey indicated that iodine deficiency in Belarus population has been eliminated, including in pregnant women [7].

Starting in October 2009, all bakers in **Australia and New Zealand** will be required to replace the salt that they currently use in bread making with iodized salt according to new mandatory regulation by Food Standards Australia New Zealand (FSANZ). FSANZ has developed a mandatory iodine fortification standard to help address iodine deficiency that has re-emerged in these countries. The new standard requires the replacement of non-iodized salt in all bread, where salt is added, with iodized salt with a range of 25 to 65 mg/kg. It also applies to the small amount of bread imported into Australia, usually as frozen dough. However, bread described as organic is exempt. This regulation applies to all products made from bread dough that contain yeast and salt. It is estimated that mandatory fortification will increase iodine intakes of adults by 30 - 70 µg, the amount of iodine provided by approximately three slices of bread or the equivalent of a large glass of milk (300 ml) [8].

Due to a lack of coherent policy to adopt and enforce mandatory USI, introduction of iodized salt in some industrialized countries has been difficult despite clear iodine deficiency in the population. As an alternative, sustainable optimal iodine nutrition in these countries may be achieved through "tailor made" salt iodization strategies and programs that could include mandatory use of iodized salt in processed foods, and particularly in bread baking. Advocating for use of iodized salt in processed foods requires a dedicated approach on the national level with involvement of all stakeholders. The additional costs of switching from non iodized to iodized salt are minimal: iodized salt is roughly 10% more expensive than non iodized salt, which is already quite inexpensive [4]. The challenges and benefits of the expanded use of iodized salt in bread baking are shown in Table 2. Experience in several industrialized countries, including Netherlands and Denmark, illustrate that using bread as vehicle for iodine can be an effective approach to improve iodine nutrition of populations, avoiding many obstacles and barriers.

Figure 1: **Iodine levels in bread (µg/100 g) produced with and without iodized salt in Belarus [7].**

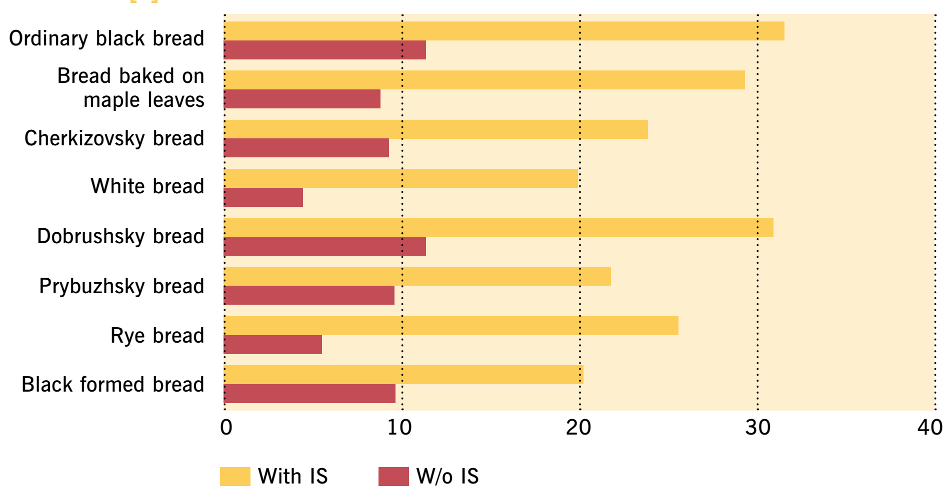

Table 2: **Barriers and opportunities for use of iodized salt in bread baking**

Barriers	Opportunities
• Lack of awareness concerning effects of iodine deficiency among policy makers and bread bakers • Suspected adverse effects of iodine on food quality and acceptance • Dietary customs, habits and myths • Costs of replacing non iodized salt by iodized salt • Confrontation with government strategies to reduce overall salt consumption • Differences in legislation affecting business, opportunities for salt producers and bread makers.	• Bread and cereal products are uniformly consumed by majority of population in industrialized countries • Iodization of bread at production level is simple and inexpensive • Absence of any negative effects of iodine on product quality • Minimal loss of iodine in bread at production and storage • Proved effectiveness of iodized bread for elimination or reduction of iodine deficiency • Interference with perceived consumer's "freedom of choice" can be easily avoided by production of special brands of bread (such as "organic") with common salt

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Salt iodization in Ethiopia: New partnerships give children a brighter future

The Micronutrient Initiative has begun centralizing salt iodization with the financial support of the Government of Canada.

Severe iodine deficiency in Ethiopian women leads to 50,000 stillbirths annually and the country's goitre rate has increased from 26% in 1980 to almost 40% today. Adding iodine to salt provides protection from brain damage due to iodine deficiency for whole populations, helping people and Ethiopia reach their full potential. But less than 5% of Ethiopian households are currently consuming iodized salt. Ensuring that all edible salt is iodized is an investment that makes sense. For just a few cents per year, a child can be saved from the permanently damaging effects of iodine deficiency.

Spearheading the Return of Iodized Salt

After almost achieving Universal Salt Iodization in the early 1990s, after Eretria seceded from Ethiopia, iodized salt consumption in Ethiopia dropped to as low as 5% and much of the country's salt was being imported. In response to this, government began to explore the indigenous sources for salt production, including the salt deposits at Lake Afdera in Afar Regional State. Today, the salt supply in the country has dramatically changed; Ethiopia has successfully developed new sites in this part of the country to meet the salt needs of the country.

However, during the transition period, iodization efforts were sidelined. Currently, less than one per cent of the salt produced in the country is iodized. With raw salt production now firmly established, the Federal Government and the Regional Government of Afar are working to re-establish USI in the country.

Centralizing Salt Iodization: Establishing a Central Iodization Facility

Over the past two years, Afdera landowners, salt harvesters, community leaders, regional government officials, federal government officials and experts in salt iodization have been working tirelessly to determine the most effective way to provide Ethiopians with their daily requirements of iodine, a micronutrient essential to cognitive brain development in children. Working with partners such as the Micronutrient Initiative and UNICEF, they launched an ambitious project – the establishment of a Central Iodization Facility (CIF).

The CIF, to be located in Afdera, will be a modern streamlined facility equipped with salt iodization machines and material handling facilities to receive and process raw salt, ensure iodization and repack salt in bags for distribution across the country. The facility will be supported by a quality control laboratory and all material inputs including potassium iodate. It is expected to be fully operational by 2010 and process an estimated 300,000 tons of a salt per year.

An Efficient, Mechanized Process to Bring Adequately Iodized Salt to Market

Small salt producers and traders will now bring their harvested salt to the CIF, where they can process and package it more quickly and assure that it's adequately iodized. Using its experience in other countries, the Micronutrient Initiative will help establish the CIF as an independent cost centre that will operate the facility and process the salt for a specified fee payable by the salt producer/trader bringing the salt to the facility. The fee charged will cover operating expenses and ensure the maintenance of equipment and the long-term purchasing capacity for potassium iodate. As a second phase, the CIF will offer upgrading facilities to improve the quality of the raw salt before it is iodized, thereby increasing its value and marketability.

Ensuring that all salt producers and traders iodize their salt is key to the success of achieving Universal Salt Iodization in Ethiopia. The federal and provincial governments, with support from international agencies, will undertake to educate salt producers and traders about the contributions they will make to the development of Ethiopia's children by iodizing their salt, as well undertaking education for all Ethiopians about the health benefits of iodized salt.

Investing in the future: a united call to action on vitamin and mineral deficiencies

"The sustainable elimination of iodine deficiency disorders is within the world's grasp. When it is achieved, it will be a major public health triumph, eliminating the primary cause of preventable mental retardation in the world."

These inspiring lines are from a 2009 Global Report funded by the Micronutrient Initiative, with the financial support of the Government of Canada through the Canadian International Development Agency (CIDA). The sections related to iodine deficiency and its control are summarized in the following article.

Micronutrient deficiencies affect billions

In no small way, the quality of every human life is determined very early on by nutrition. Without access to simple but vital micronutrients, either through diet, fortification or supplementation, an individual can suffer tremendous – otherwise avoidable – lifelong hardship.

Around the world, billions of people live with vitamin and mineral deficiencies. For instance, approximately one third of the developing world's children under the age of five are vitamin A-deficient, and therefore ill-equipped for survival. Iron deficiency anaemia during pregnancy is associated with 115,000 deaths each year, accounting for one fifth of total maternal deaths. Children, whose mothers died giving birth, may be neglected. Children who themselves have insufficient micronutrient intake and absorption can suffer serious lifelong repercussions. If they survive infancy, their bodies may be weak and prone to disease. They may have birth defects or become blind. They may not go far in school.

When whole populations suffer from malnutrition, including a lack of critical vitamins and minerals, nations likewise cannot fulfill their potential. Health-care costs rise, education efforts are thwarted, the workforce is less capable and productive, and economic activity is curtailed. Human capital overall is significantly diminished. Yet there is encouraging news from many corners. Working together, national governments, donors, science and industry have made huge strides in delivering cost-effective solutions to vulnerable populations. These successes, if further scaled-up, present exciting opportunities to improve the lives of those who have thus far not been reached.

Specifically regarding salt iodization, when the power of iodine is unleashed through intake of iodized salt, the results are impressive. In communities where iodine intake is sufficient, IQ is on average 13 points higher than in iodine deficient communities. Between 1993 and 2007, the number of countries in which iodine-deficiency disorders were a public health concern was reduced by more than half, from 110 to 47.

The Best Investment in the World

As the global financial crisis unfolds and available funds from all sources are shrinking, the need for development assistance is expanding at an alarming pace. It is more important than ever that priority for investments goes to measures that yield the highest rates of return. Micronutrients are inexpensive commodities.

With the low cost of interventions and their high returns in improved capacity, the benefit:cost ratio of micronutrient programming is unmatched by any other large-scale health or economic intervention.

This simple truth has been endorsed by a panel of eight of the world's most distinguished economists. In May 2008, the Copenhagen Consensus panel considered 30 options and ranked salt iodization number 3 on the list of the world's best investments for development. Salt iodization has been a major international success, reaping great benefits for the intellectual health of nations that have embraced it. While several regions have held back progress toward the goal of universal salt iodization, the investment required to close the gap within five years and put these regions on track is relatively small. Each dollar invested in salt iodization returns US$30 in benefits (see Table 1).

Iodine is fundamental for the intelligence of the next generation

Iodine is one of the most important elements required by a developing fetus because of its effect on brain development. While the link between iodine and goitre – the most visible effect of severe iodine deficiency – has been known since the early 20th century, it was not until the 1970s and 1980s that the links between iodine and fetal cognitive development began to be understood. When the intake of iodine is increased through the consumption of iodized salt, the results are impressive.

The Essential Role of Partnerships

Delivering vitamins and minerals to large populations involves commitment, coordination and cooperation – all held together by strong and durable partnerships. Key partners in micronutrient interventions include national governments, donors, aid agencies, foundations,

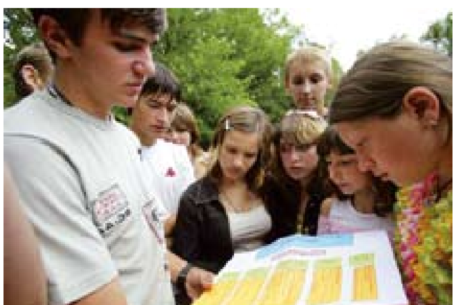
Table 1: Cost effectiveness data for micronutrient interventions

Intervention	Region	Cost/Person/Year (US Dollars)	Benefit: Cost Ratio
Salt iodization		0.05	30:1
Vitamin A supplementation	South and East Asia, Sub-Saharan Africa	1.20	17:1
Zinc supplementation	South and East Asia, Sub-Saharan Africa	1.00	14:1
Flour fortification		0.12	8:1

Source: *Copenhagen Consensus best practices paper on Micronutrient supplements for child survival (Vitamin A and Zinc), Horton et al., 2008; and Copenhagen Consensus best practices paper on Food fortification (Iron and Iodine). Horton et al., in press.*

industry, community leaders and the agricultural sector.

The story of salt iodization in developing countries is one where the private sector has come to play an especially strong role, working in close partnership with national governments as well as with other development partners. Building on the initial capital and other investments provided by international donors and groups such as Kiwanis, most of the salt industry and their consumers are already absorbing the minimal additional costs of iodization. National governments, agencies, civil society and other partners are also now working with processors of all sizes to enable them to iodize their salt, so as to complete universal coverage.



A young man shares a poster about the effects on the thyroid gland of iodine deficiency disorders (IDD) with a group of adolescents. They are part of a peer-to-peer education programme at a UNICEF-supported summer camp for vulnerable children in the village of Vasyshchevo, Urkraine. *© UNICEF*

Salt Iodization

The greatest story of progress in food fortification has been that of salt iodization, demonstrating how well government commitment, market opportunity and social responsibility can be combined for improved health. With iodization initiatives dating back to the early years of the 20th century in the industrialized world and more than two decades of expansion in developing countries, the technology for large-scale salt iodization has been long proven. Models of legislative frameworks, industrial standards, shipping and handling guidelines, monitoring systems and social marketing campaigns all exist to guide the way for achieving universal salt iodization.

A salt processor shovels salt that has been iodized using a mobile machine on the shore of Senegal's Lac Rose.More than one third of Senegal's salt is produced by tens of thousands of small-scale harvesters, presenting a challenge for iodization programmes. *© MI*

Salt is consumed throughout the world in small, fairly consistent amounts on a daily basis. Because of this, it is an ideal vehicle for fortification with micronutrients. In most countries, potassium iodate is added to salt after it is refined and dried and before it is packed. There are numerous methods of adding the compound to the salt. The most appropriate method depends on the quality of the salt, and on local conditions and resources. The amount of iodine added to salt can be varied to suit local consumption patterns – allowing changing diets to be taken into account.

Packaging and storage are important to the quality of the iodized salt because humidity and temperature affect the retention of the iodine in the salt. Like most industrial procedures, large-scale salt iodization is the most efficient. However, even very small-scale iodization at the village level is possible with tried-and-tested processes, and in some countries, small processers are the ones producing the majority of the salt.

Between 1993 and 2007, the number of countries in which iodine deficiency disorders were a public health concern reduced by more than half – from 110 countries to 47. These striking public health results are clearly linked to expanded salt iodization. In 1990, less than 20% of households in the developing world were consuming iodized salt. Today that figure has increased to 70%. Thirty-four developing countries have achieved the universal salt iodization goal, and an additional 38 countries are considered 'on track' for elimination of iodine deficiency disorders. These are countries that have either shown increases in coverage of at least 20% over the previous decade or that have reached between 80% and 89% coverage with no indication of possible decline.

Despite this progress, many countries are lagging far behind. Twenty-four countries have experienced no growth in coverage rates or have even experienced a decline since the mid 1990s. In 12 countries, less than 20% of the population is consuming adequately iodized salt. Around the world, approximately 38 million children are born every year unprotected against the risk of iodine deficiency.

What more needs to be done to correct iodine deficiency

Priority actions include the need to:

- Enact mandatory legislation and ensure adequate resources are made available to enforce it.
- Build financial sustainability to transition from a donor-supported to a market-supported supply of iodate.
- Undertake strategic advocacy and communication efforts through media, health systems, and schools.
- Strengthen population monitoring systems so that programme adjustments can be made as habits and diets change over time.
- Create incentives for processors to iodize their salt.

Macedonia begins to monitor IDD in pregnant and lactating women along with school-age children

Borislav Karanfilski, Vukosava Bogdanova, Olivija Vaskova, Svetlana Miceva-Ristevska, Suzana Loparska, Sonja Kuzmanovska

Historically Macedonia was an iodine deficient area, with a high incidence of goiter, which, in certain regions, was endemic (1). Research on IDD initiated in 1995/96 included the entire country and applied the assessment methods recommended by WHO/UNICEF/ICCIDD, which included palpation of the thyroid gland to assess goiter, determination of the thyroid gland volume by ultrasound and measurement of urinary iodine (UI) concentration (2). Inspection and palpation of the thyroid showed the general prevalence of goiter among school age children was 18.7%, thyroid gland volumes were higher than the norms established by WHO/UNICEF/ICCIDD, and the median UI was 117μg/L.

These findings were discussed with the Ministry of Health and a National Committee for Iodine Deficiency (NCID) was formed to correct iodine deficiency and its consequences in Macedonia. The NCID was formally established by the Minister of Health on 26.12.1997. Subsequently, continuous and coordinated activities aimed at correcting IDD were initiated. The annual programs of the Committee included monitoring the IDD status of the population, monitoring and control of salt iodination, as well as activities aimed at educating and informing the population on purchase, storage and utilization of salt in households. A new rule book on mandatory iodination of salt for human use became effective in October 1999. It stipulated that all salt for human use, including salt used in the food industry, must be iodinated with 20 to 30 mg of iodine per kg using only potassium iodate.

The incidence of the goiter fell from 18.7% before the introduction of these new measures to 5% in 2000, 5.8% in 2002, 4.7% in 2003, 2.05% in 2005 and 0.99% in 2007, indicating elimination of IDD as a public health problem in school children (3).

The serial assessments of thyroid volume by ultrasound showed a continuous reduction in thyroid size after the enforcement of the new salt iodination regulations. The median UI, that was 117μg/L in 1995/96 before the enactment of the new regulations, increased to 154.1 μg/L in 2000, 164.5μg/L in 2001, 198.5μg/L in 2002, 191μg/L in 2003, 228μg/L in 2005 and 241 μg/L in 2007 (4).

Neonatal TSH screening in Macedonia was first introduced in 2002 in the Clinic for Disorders of Children at the Medical Faculty in Skopje (Prof. M Kochova). If IDD is present in a population, more than 3% of newborns will have TSH values greater than 5 mU/L. Surveys implemented by the clinic found the percentage of elevated values in newborns to be 4.3% in 2002, 5.9% in 2003, 2.8% in 2004, 0.8% in 2005, 1.8% in 2006 and 1.5% in 2007.

In 2001, the National Committee judged that IDD had been corrected and asked WHO/UNICEF/ICCIDD for an international expert evaluation of the achievements of the program to correct iodine deficiency in Macedonia. A team of experts visited Macedonia from 19th to 23rd of March 2003 and performed a thorough assessment of the program and its achievements. The team reported a very positive assessment of the program (5).

However, it was uncertain if IDD control among the general population, assessed by goiter frequency and the median UI in school children, meant that iodine deficiency had been corrected in pregnant and lactating women as well. Therefore, the studies of iodine status in Macedonia conducted in 2006/2007 used a wider spectrum of parameters to provide a more comprehensive picture of the iodine status of pregnant and lactating women (6). One of them was the median UI, and the results showed the median value in all trimesters of pregnancy ranged between 150 μg/L – 249 μg/L, corresponding to an adequate iodine intake in this group. For the first and second trimesters it was 199.7μg/L, and the value for the third trimester was slightly lower (174.9μg/L).

However, looking at individual values, a significant number of subjects had a concentration less than 150μg/L: 29.6% of the samples in the first, 37% in the second and 39.1% in the third trimester. The frequency of samples in the 20 μg/L to 49 μg/L range was very low (2.2% to 3.1%). Values between 50-100 μg/L were found in 12.2% of the samples in the first trimester, 13% in the second and 19.6% in the third trimester. These results suggest some pregnant women may have low intakes of dietary iodine, although the overall median is adequate.

Iodine concentration in the urine and breast milk of lactating women was also determined. The median UI was 157.9 μg/L, lower than the median found in pregnant women, but within the recommended range (100-200 μg/L). Looking at the individual values, 20.4% of the women had a UI less than 100 μg/L, 49% had a UI between 100 and 200 μg/L, and 16.3% had a UI greater than 200 μg/L. The median value for breast milk iodine concentration (BMIC) was 89.7μg/L.

TSH was measured in pregnant women, and compared to values for the general population, analyzed using the same method during the same time interval. The median TSH in pregnant women was 1.3 mU/L; for the first trimester the median was 1.22 mU/L and in the second and the third trimester, the median was higher (1.6 mU/L). This median is higher than the respective average value for the general population, suggesting increased thyroid stimulation during this period. After delivery, the TSH values in pregnant women return to the level of the general population, with a median of 1.4 mU/L.

Free thyroxine (FT4) concentrations were also measured in pregnant women in all trimesters as well as after delivery, and the results were compared to the reference values for the general population (8.4 pmol/L – 18 pmol/L); the median was 12.6 pmol/L. The results showed a gradual reduction of the median FT4 value as the pregnancy progressed; the median FT4 after delivery was identical to the median for the general population.

The thyroglobulin values of pregnant women were determined in each of the trimesters. The median thyroglobulin was 6.05 μg/L, and there were no statistically significant differences between trimesters. The median in pregnancy was slightly higher than the median for the general population (5.55μg/L), and the median thyroglobulin postpartum was also higher (6.55μg/L).
Anti-thyroid antibodies (anti-thyroperoxidase (TPO) and anti-thyroglobulin (Tg) in the pregnant women during their first examination as well as the subsequent examinations throughout the gestation periods. Overall, for all 185 pregnant women, the prevalence of anti-TPO antibodies was 8.6% and the prevalence of anti-Tg antibodies was 3.8%. According to data from the literature, the usual prevalence of anti-TPO antibodies during pregnancy is between 8% and 11.3%.

Among the pregnant women receiving 100 μg of iodine daily as supplements there was a higher median UI compared to those not supplementing, but no differences in median TSH or FT4; however, Tg values tended to be lower in the supplemented women, suggesting reduced thyroid stimulation. Comparing UI values between supplemented and non-supplemented women, in the second trimester, 37% of women without iodine substitution had low iodine intake, compared to 12.5% of women who received iodine supplements. In the third trimester, 39.1% of pregnant women without supplements had low iodine intake compared to 21.4% of pregnant women with supplements. After the delivery, the frequencies were 20.4% without supplements and 14.3% with supplements.

The volume of the thyroid gland in the pregnant women was determined using ultrasound. Expressed as a median, there was an increase during pregnancy, from 7.8 ml in the first trimester to 7.86 in the second trimester and 8.75 ml in the third trimester; this then falls to 7.5 ml after delivery. The women receiving iodine supplementation had smaller median values for thyroid gland volume in comparison to the women who did not receive iodine supplementation.

The results from these studies in pregnant and lactating women suggest that the Macedonian USI program, in place since October 1999, is overall providing adequate iodine to these vulnerable groups. However, some women may not have adequate intakes and may benefit from supplementation.

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Meetings and Announcements

Eduardo Pretell receives PAHO's prestigious Horwitz award

ICCIDD's regional coordinator for the Americas is the recipient of the 2009 Pan American Health and Education Foundation (PAHEF) and Pan American Health Organization's Abraham Horwitz Award for Leadership in Inter-American Health.

Created in 1975, the award recognizes public health leaders for their leadership. PAHO stated:

The work of Professor Pretell includes pioneering contributions in the study of the effects of iodine deficiency on the quality of life, investigations of new methods for the prevention, diagnosis and monitoring of iodine deficiency, and the application of his research results on public health programs, aimed to reach the goal of the sustained elimination of iodine deficiency disorders (IDD).

E. Pretell examinning a goitrous woman during an iodine survey in 1988

His research studies represent an important contribution to the understanding of both the physiopathology and the prevention and treatment of iodine deficiency. Three studies were of particular importance: 1) the effect of iodine deficiency on the maternal-fetal unit, which demonstrated its deleterious effect on the mental and neurofunctional development of the fetus; 2) the use of iodized oil in the prophylaxis and treatment of iodine deficiency, a new method now approved by WHO, and 3) the validity of the analysis of iodine concentration in casual urine samples as an indicator for the diagnosis and monitoring of iodine nutrition.

Professor Pretell has been more recently involved in two other important studies: 1) The Thyroid Mobil Project in Latin America; he organized a mobile van, which travelled around various Latin American countries documenting iodine deficiency as well as encouraging public advocacy for the sustained elimination of iodine deficiency, and 2) International reference values for thyroid volume by ultrasonography

Professor Pretell's most important contribution at the continental level has been his endless journeys around all the Latin American countries, in connection to his effort and personal commitment to the cause of the eradication of iodine deficiency as a public health problem. Professor Pretell has contributed in the development, assessment, quality assurance and sustainability of country programs, and the preparation of country's reports.

Abstracts

Selenium and iodine supplementation: effect on thyroid function of older New Zealanders.
The New Zealand population has both marginal selenium status and mild iodine deficiency. He authors investigated the effects of selenium and iodine supplementation in a double-blind, randomized, placebo-controlled trial in 100 volunteers aged 60-80 y. Participants received daily: 100 µg Se/d, 80 µg I, both or neither for 3 mo. Plasma selenium and whole-blood GPx activity increased significantly in the selenium groups. Median urinary iodine (UI) at baseline was 48 µg/L, which is indicative of moderate iodine deficiency. UI increased significantly only in the iodine groups. Thyroglobulin concentration decreased by 24% and 13% of baseline in the iodine groups, but no effects were found for thyroid hormones. Thus, although iodine supplementation alleviated the moderate iodine deficiency and reduced elevated thyroglobulin concentrations, no synergistic action of selenium and iodine was observed.
Thomson CD et al. Am J Clin Nutr. Epub 2009 Aug 19.

Iodine stability and sensory quality of fermented fish and fish sauce produced with the use of iodated salt.
The study assessed iodine loss during fermentation of fermented fish and fish sauces produced by using iodated salt and the effect on product sensory quality. Fermented fish and fish sauces were produced with iodated rock and grain sea salts (approximately 30 ppm iodine). Fermented fish was prepared from freshwater fish mixed with salt and rice bran and fermented for 6 months at room temperature. Fish sauces were prepared by mixing anchovy with salt and fermenting either exposed to sunlight or in the shade for 12 months. After fermentation, the products were tested for sensory acceptability by Laotian and Thai panelists. After fermentation, the level of residual iodine was 7.61 ppm (16% loss) in fermented fish, 5.57 ppm (55% loss) in fish sauce prepared with exposure to sunlight, and 9.52 ppm (13% loss) in fish sauce prepared in the shade. Sensory qualities of the products were not affected. Thus, it appears feasible to produce fermented fish and fish sauces with iodated salt and maintain acceptable iodine levels.
Chanthilath B et al. Food Nutr Bull. 2009;30(2):183-8

Iodine nutrition in upper socioeconomic school children of Delhi.
The authors assessed the iodine nutrition of upper socioeconomic strata school children from Delhi to identify its association with goiter, thyroid autoimmunity or thyroid function. Students (n=997) from from five private schools representing all the zones of Delhi were evaluated. Median urinary iodine was 353 µg/L. Goiter was present in 12.3% and positive anti-TPO antibodies in 2.6%. Excess urinary iodine was associated with thyroid dysfunction, though not with goiter.
Marwaha RK et al. Indian Pediatr. Epub 2009 Jul 1

Effect of iodine prophylaxis during pregnancy on neurocognitive development of children during the first two years of life.
The study objective was to evaluate the psychological development of infants aged 3 to 18 months whose mothers had received 300 µg of KI during the first trimester of their pregnancy. The study included 133 women who received iodine and 61 women who had received no iodine supplements. Those children whose mothers had received an iodine supplement had a more favorable psychometric assessment than those of the other group of mothers. They had higher scores on the Psychomotor Development Index and the Behavior Rating Scale. But given the possible presence of confounding variables not controlled for in this study, these findings should be considered as preliminary.
Velasco I et al. J Clin Endocrinol Metab. Epub 2009 Jun 30.

Thyroglobulin as a marker of iodine nutrition status in the general population.
In this prospective study of a mandatory iodization program, the authors aimed to evaluate serum thyroglobulin (Tg) as a marker of iodine status in the population. Two identical cross-sectional studies were performed before (1997-1998, n=4649) and after (2004-2005, n=3570) the initiation of the Danish iodization programme in two areas with mild and moderate iodine deficiency. Before iodization, the median serum Tg was considerably higher in moderate than in mild iodine deficiency. Iodization led to a lower serum Tg in all examined age groups. The marked pre-iodization difference in Tg level between the regions was eliminated. The prevalence of Tg above the suggested reference limit (40 µg/l) decreased from 11.3 to 3.7%. Thus, serum Tg was a suitable marker of iodine nutrition status in the population. The results may suggest that the Danish iodization program has led to a sufficient iodine intake, even if the median UI excretion is still marginally low according to WHO criteria.
Vejbjerg P et al. Eur J Endocrinol. 2009; 161(3):475-81.

Improved salt iodation methods for small-scale salt producers in low-resource settings in Tanzania.
Since many salt producers in low-income countries are small-scale, the authors examined and improved the performance of hand and knapsack-sprayers used locally in Tanzania. Different concentrations of solution were prepared and tested using different iodation methods, with the aim of attaining correct and homogeneous iodine levels under real-life conditions. Levels achieved by manual mixing were compared to those achieved by machine mixing. The results showed that supervised, standardized salt iodation procedures adapted to local circumstances can yield homogeneous iodine levels within the required range, overcoming a major obstacle to universal salt iodation.
Assey VD et al. BMC Public Health. 2009;9:187

Iodine treatment in children with subclinical hypothyroidism due to chronic iodine deficiency decreases thyrotropin and C-peptide concentrations and improves the lipid profile.
Chronic iodine deficiency (ID) often produces a thyroid hormone pattern consistent with subclinical hypothyroidism (ScH). ScH may be associated with cardiovascular disease risk factors. Thus, the study aim was to determine if iodine treatment of children with elevated TSH concentrations due to ID would affect their lipid profile, insulin (C-peptide) levels, and/or subclinical inflammation. In controlled intervention trials of oral iodized oil or iodized salt, 5-14-year-old children from Morocco, Albania, and South Africa with TSH concentrations ≥2.5 mU/L (n = 262) received 400 mg iodine as oral iodized oil or household distribution of iodized salt containing 25 mug iodine/g salt. Median (range) UI at baseline was 46 (2-601) µg/L. Compared to the control group, iodine treatment significantly increased UI and total thyroxine and decreased TSH, C-peptide, and total and low-density lipoprotein cholesterol. The mean low-density lipoprotein/high-density lipoprotein cholesterol ratio fell from 3.3 to 2.4 after iodine treatment. Thus, correction of ID-associated ScH improves the insulin and lipid profile and may thereby reduce risk for cardiovascular disease. This previously unrecognized benefit of iodine prophylaxis may be important because ID remains common in rapidly developing countries with increasing rates of obesity and cardiovascular disease.
Zimmermann MB et al. Thyroid. Epub 2009 Jun 17.

Evidence of endemic goiter and iodine deficiency in a mountainous area of Haiti.
This cross-sectional study was performed in a mountainous area of Haiti. Eighty-eight individuals aged 2 to 72 years participated in the study. Median urinary iodine concentration was 39 µg/L. Of the 88 participants, 82 (93%) were iodine deficient (18 [20%] were severely deficient), and 45 (51%) had goiter on physical examination, including 27 with grade 1 goiters and 18 with grade 2 goiters. The study indicates iodine deficiency with associated endemic goiter in this previously uninvestigated Haitian population.
Tenpenny KE et al. Endocr Pract. 2009; 15(4):298-301

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For further details about the IDD Newsletter, please contact:
Michael B. Zimmermann, M.D., the editor of the Newsletter, at the Human Nutrition Laboratory, Swiss Federal Institute of Technology Zürich, ETH Zentrum, Schmelzbergstrasse 7, LFW E19, CH-8092 Zürich, Switzerland, phone: +41 44 632 8657, fax: +41 44 632 1470, iccidd.newsletter@ilw.agrl.ethz.ch.

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