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IDD NEWSLETTER

IODINE GLOBAL NETWORK is a nongovernmental organization dedicated to sustained optimal iodine nutrition and the elimination of iodine deficiency throughout the world.

Iodized oil to combat severe IDD and cretinism in Papua New Guinea

Prof. Victor Temple, *Iodine Global Network National Coordinator for Papua New Guinea and the Solomon Islands;* **Prof. Michael Zimmermann,** *ETH Zurich, Switzerland;* **Mr. Wilson Karoke** *and* **Ms. Eileen Dogimab,** *Technical Officers, National Department of Health (NDOH) PNG; and* **Dr. Hanifa Namusoke,** *Nutrition specialist UNICEF PNG.*

From Feb 16-24, 2020, Michael Zimmermann, Chair of the Iodine Global Network (IGN), visited Papua New Guinea on the invitation of Victor Temple, IGN National Coordinator, to assess the current status of the iodine program with a focus on urgent distribution of iodized oil in areas affected by severe iodine deficiency.

Salt iodization has been implemented in Papua New Guinea (PNG) since June 1995, with legislation banning the importation and sale of non-iodized salt. Findings of the National Nutrition Survey in PNG in 2005 indicated that 92.5% of salt samples taken from households with salt were adequately iodized. The Survey also reported that iodine status was adequate among non-pregnant women of childbearing age (n = 690), with median urinary iodine concentration (UIC) of 170μg/L. However, on the day of data collection, 38% of the households had no salt, and women in these households had lower iodine status than those from households with salt (median UIC of 114μg/L and 203μg/L, respectively).

Two small surveys on iodine status carried out afterwards found adequate iodine status of non-pregnant women around Port Moresby, an urban area; a median UIC of 163μg/L in non-pregnant women in a 2006 study and a median UIC of 125μg/L in lactating women in a 2009 study. By contrast, a small survey undertaken in 2015 in a remote and mountainous rural area of Kerema district, Gulf province, reported a median UIC of 32μg/L and 36μg/L in school-aged children and in non-pregnant women, respectively. Over 80% of the population of Papua New Guinea live in remote rural areas.

At the scientific meetings of the Pediatric Society of PNG in 2014 and 2015 troubling reports were presented by the Chief Pediatrician in Simbu Province, Dr. G. Kiagi. He described cretinism and dwarfism in infants and children in Karimui-Nomane district in Simbu Province. Both reports included cases of severe mental retardation, deaf-mutism, inability to walk, and in some affected children, clinical evidence of hypothyroidism.

Many communities in the Papua New Guinea Highlands do not have access to commercial iodized salt.

This prompted Prof. Victor Temple, IGN National Coordinator for Papua New Guinea, to conduct an investigation of the iodine status of school children (n=545, age 6 to 12 years) in the district of concern, as well as in Sina-Sina Yonggomugl, a comparison district in the same province. This project was supported by UNICEF PNG and the National Department of Health (NDOH). The results showed that 82.4% and 63.8% of salt samples from Karimui-Nomane and Sina-Sina Yonggomugl respectively were adequately iodized above the national standard of 30ppm. Despite this, for children in Karimui-Nomane the median UIC was 17.5μg/L and in Sina-Sina Yonggomugl, the median UIC was 57.5μg/L. These apparently conflicting findings were explained by the fact that only 34% of households in Karimui-Nomane and 72% of households in Sina-Sina Yonggomugl had salt on the day of the survey. The results indicate that iodine deficiency is a significant public health problem in these areas, possibly because of lack of access to commercial salt, rather than due to inadequate implementation of salt iodization.

Iodine intakes are low in rural populations in Papua New Guinea

Two neurological cretins in Simbu Province, Papua New Guinea. Credit: Dr. G. Kiagi.

Recent studies have suggested that severe iodine deficiency in remote areas of PNG may be more widespread than previously recognized. Studies in school age children (n=289) and women of reproductive age (n=284) were carried out in Kerema district in Gulf province, Papua New Guinea. In the first study, only 64% of households had salt on the day of data collection. Mean iodine content in household salt samples was 29ppm. Mean per capita discretionary intake of household salt was 2.9 g/day. Overall, median UIC was 25.5μg/L and median UIC was 34.3μg/L for children in households with salt, compared to 15.5 μg/L for children in households without salt. In the second study, salt was available on the interview day in 51.6% of households. Mean iodine content in household salt samples was 37.8ppm. Mean discretionary intake of salt per capita per day was 3.9g. Median UIC was 34μg/L, indicating moderate iodine deficiency. For women with salt in the household, median UIC was 39.5μg/L, compared to median UIC of 29μg/L for those without salt. Like the reports above from Simbu province, this community had low consumption of iodized salt, likely due to limited access to commercial salt. This is highlighted in a recent survey of access to iodized salt in four areas of rural PNG.

These recent findings were presented at the relevant sessions of the PNG Medical Symposium in 2016, 2017 and 2018. These concerning findings were also discussed with the Nutrition Division of the NDOH, the Nutrition specialists in UNCEF PNG and the Regional Coordinator of Iodine Global Network (IGN). UNICEF PNG subsequently purchased in 2017 over 400,000 iodized oil capsules (200mg per capsule) for distribution in the severely affected districts in Simbu and Gulf provinces. The plan was for 7-24 month-old children to receive one capsule, and for children over 24 months of age and women to receive two capsules, as per WHO recommendations. The plan also included advocacy work to increase use of iodized salt in the communities.

The Nutrition Division of the NDOH was planning to supervise distribution of the capsules in 2018 with funding from UNICEF PNG, with support from School of Medicine and Health Sciences (SMHS), University of PNG (UPNG), but the polio outbreak in PNG in 2018 diverted attention away from the distribution. In 2019, a successful appeal was made to IGN for funding to carry out a limited distribution of the capsules.

The distribution began in early 2020, supported by the IGN, the Nutrition Division of NDOH, UNICEF PNG and the University of PNG. The distribution of more than 7500 iodized oil capsules to women and children in Karimui-Nomane district of Simbu province was done in January 2020 by members of the Simbu Medical Students Association (SMSA), which is made up of medical, dental and health sciences students from Simbu province who attend the University of PNG. They distributed iodine capsules, together with vitamin A capsules and deworming tablets, with the objective of achieving 80% coverage in the area. This was supported by the IGN, NDOH and UNICEF PNG. The SMSA also plans to distribute in the districts of Sina-Sina Yonggomugl and Kerowagi in July 2020.

The distribution of 1500 capsules to women and children in Huon district, Morobe province, began in February 2020 under the guidance of Prof. Michael Zimmermann, Chair IGN and Prof. Sakarepe Kamene, School of Humanities and Social Sciences (SHSS UPNG). In Gulf Province, Kerema District, the PNG Corporate Mission with support from IGN and NDOH is planning distribution of capsules in Kotidanga area in April 2020.

On February 24, at Grand Rounds at the University of PNG, Michael Zimmermann spoke to packed auditorium on the essential role of iodine in human growth and cognitive development. In a meeting on February 24, 2020 in Port Moresby with the Nutrition Division of NDOH and UNICEF PNG, Victor Temple and Michael Zimmermann encouraged the Nutrition Division to develop an action plan of rapid assessment surveys to better define which rural areas are most severely affected and could benefit from iodized oil distribution.

The red stars show areas of distribution of iodized oil capsules in Papua New Guinea.

Prof. Michael Zimmermann, IGN Chair, supervised iodized oil capsule distribution in Huon district, Morobe province, in February 2020.

In summary, although the iodized salt program in PNG has been successful in achieving good coverage in urban and accessible rural areas, there is increasing awareness that many remote rural areas are at high risk of moderate-to-severe IDD, including mental retardation and cretinism.

The following measures are being considered:

- Improving penetration and coverage with iodized salt in remote areas where ever possible, and increasing awareness of the benefits of iodized salt among the population are critical.
- Subsidizing iodized salt distribution costs is a viable and effective way that government can help control and eliminate IDD in PNG.
- Producing smaller (25 to 50 g) packages of commercial iodized salt may also make salt more affordable to people in remote communities.
- Mass distribution of iodized oil capsules in severely affected areas in PNG is an important adjunct measure to control IDD in the short-term.
- The urgent need for a comprehensive plan of action to tackle IDD in PNG by government and all the stakeholders cannot be overemphasized.

Prof. Victor Temple: fighting IDD in Papua New Guinea

Can you tell us a bit about yourself?
I am a Sierra Leonean by birth, and studied biochemistry at the Moscow State University. Currently, I am a Professor in Biochemistry at the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG). I have over 30 years of teaching and research experience in medical schools in Africa, Europe, and the South Pacific. My main research focus has been the impact of micronutrient deficiencies on maternal and child health in resource limited countries. I am the Iodine Global Network National Coordinator for Papua New Guinea (PNG) and the Solomon Islands and supervise the iodine laboratory in the Division of Basic Medical Sciences, SMHS UPNG.

How did you first get interested in iodine deficiency?
I worked in the Medical Faculty, the University of Jos in Plateau State, Nigeria, for 16 years, and my research work there was focused on micronutrient deficiencies, including monitoring IDD and testing salt for iodine. When I came to PNG, I came across a 2003 UNICEF report that suggested there was no IDD left in PNG because rapid test kits found iodine in most household salt. I was surprised and skeptical! I was familiar with the history of severe IDD in the region, and I subsequently read an ICCIDD report that stated there was no recent information on urinary iodine concentrations (UIC) available for PNG. This inspired me to start investigating IDD, and I set up a laboratory to measure UICs. In one of my first research projects, I found that iodine deficiency continued to affect people in rural PNG. I wrote to Professor François Delange in Brussels about my findings, and I was very surprised that he took the time to write back to me! He gave me guidance and became a mentor to me. I have photo of François on the wall of my iodine laboratory, and I even refer to my lab as the Delange iodine laboratory.

Why are you so enthusiastic about fighting iodine deficiency and your role as IGN National Coordinator for PNG?
Because it is such a powerful and cost-effective way to contribute to education and national development in the country. Iodine deficiency is devastating in affected populations. I also enjoy teaching and motivating medical students in SMHS UPNG to go back home and get involved in fighting IDD in their local communities.

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Iodine Symposium at the 2019 American Thyroid Association Annual Meeting

Elizabeth N. Pearce, *IGN Regional Coordinator for North America*

A symposium, "Iodine and Health," was jointly sponsored by IGN and the American Thyroid Association (ATA) at the ATA's annual meeting in Chicago on October 31, 2019.

Eliminating Iodine Deficiency – The EUthyroid project

Prof. Henry Volzke (University of Greifswald) reviewed some of the work of the recently-completed EUthyroid Project. This three-year project was begun in June of 2015. It included 30 partners from 22 European Union member states and from Macedonia, Iceland, Israel, Norway, and Switzerland. Objectives included the development of a map of iodine status across Europe and building the capacity of national studies to perform well-harmonized urinary iodine measurements. Additional aims included work to refine the use of thyroglobulin as a biomarker for chronic iodine status, and work to provide evidence for the effectiveness of IDD prevention efforts.

Dr. Volzke reported that in Europe there is currently a great deal of variation in IDD prevention programs. Salt iodization programs exist in some, but not all countries, and where they do exist in some cases they are voluntary rather than mandatory. Salt is iodized at different concentrations in different regions, and iodized salt reaches proportions of the population which vary from 5-80%. In many European countries there is currently no monitoring or no systematic monitoring of population iodine status. Only eight European Union member states are regularly monitoring their iodine supply. There is only very limited information available about iodine status across different socioeconomic groups. As part of this project, inter-lab differences in urinary iodine concentration measurements were explored. Results from lab to lab, when measuring the same samples, were found to be highly variable, even for many of those labs which had previously received EQUIP certification from the U.S. CDC. This lack of precision may impair the usefulness of UIC measurements for public health assessments. These data suggest that there is currently an urgent need to improve the quality of laboratory UIC measurement in many regions.

A lively discussion at the symposium, "Iodine and Health," at the American Thyroid Association Meeting in Chicago, USA.

Dr. Volzke concluded by noting the need for European policymakers and regulators to harmonize universal salt iodization in order to ensure free international trade of fortified foodstuffs. Standards for iodized animal feed also need to be harmonized. Monitoring and evaluation of fortification programs needs to be performed at regular intervals, and could also be harmonized across counties. Finally, scientists, the medical community, patient organizations, and industry need to work together to ensure that IDD prevention programs are appropriate and to further public awareness of this issue.

New Insights into the Mechanism of NIS

Dr. Nancy Carrasco (Vanderbilt University) discussed the role of the sodium/iodide symporter (NIS) and its relevance to iodine nutrition and thyroid health. Iodine is a scarce element in nature and must be acquired in the diet in order to make thyroid hormone. Although the thyroid's ability to concentrate iodine had been known since the nineteenth century, Dr. Carrasco's laboratory first cloned NIS in 1996. She has gone on to extensively characterize this protein and its actions in different tissues.

NIS can concentrate iodine in the thyroid at levels 30-60 times higher than in other tissues. In the placenta NIS transports iodine from the maternal circulation to the fetus. It is also expressed in lactating breast tissue, where it serves to secrete iodine into breast milk. NIS also is expressed in tissues including the stomach, small intestine, salivary glands, and kidneys.

NIS can mediate the transport of substances other than iodine. Perchlorate is an industrial pollutant which is found ubiquitously at low levels in many foods and in drinking water in many communities. It is a competitive inhibitor of NIS, meaning that when present in high levels it may decrease transport of iodine into the thyroid gland and into breast milk. Governments in some regions are considering the regulation of perchlorate exposure to prevent adverse thyroidal effects and adverse effects on fetal and infant development which might be mediated by decreased iodine availability.

Iodine from breastmilk is critical for newborns

Iodine Status in Lactation

Dr. Tim Korevaar (Erasmus University Medical Center) was the third speaker. He noted that adequate iodine availability is critical for the optimal growth and development of newborns, and that breast milk iodine content is the most important determinant of iodine status in early life. Prior research had found a wide variation in breast milk iodine concentrations across different regions. However, a recent balance study has demonstrated that the minimum adequate newborn iodine intake is 80ug/day, corresponding to an infant urinary iodine excretion of 125 ug/L and a minimal breast milk iodine content of 92 ug/day.

The mammary glands include complex mechanisms to concentrate and excrete iodine into breast milk. Low maternal iodine intake, maternal smoking, and exposure to iodine uptake inhibitors such as perchlorate are all risk factors for low breast milk iodine content and thus for inadequate infant iodine nutrition. Maternal iodine supplementation has been found to be more effective at providing iodine to the newborn than direct supplementation of the infants themselves. Iodine supplementation at typical dosages is not associated with any adverse effects in the mother or child. In spite of the growing body of evidence regarding the importance of adequate iodine intakes for lactating women, in most regions there is limited public awareness. Most women are not advised to use iodine containing supplements and many multivitamins include inadequate iodine to support the needs of nursing mothers and their infants.

Ensuring iodine lab capacity and performance in Africa: the role of the Tanzania Food and Nutrition Centre

Dr Fatma Abdallah, *National Focal Point, Iodine Deficiency Control program;* **Michael Maganga,** *Iodine Laboratory Manager at Tanzania Food and Nutrition Centre; and* **Dr Vincent Assey,** *Iodine Global Network Regional Coordinator for East Africa*

Tanzania is among the few countries in Africa that has received training to build capacity of monitoring and assessing impact of interventions towards reduction and/or elimination of micronutrient malnutrition. The training was coordinated by the then Program Against Micronutrient Malnutrition (PAMM) at CDC in Atlanta in early 1990s and Tanzania was represented by multi-disciplinary team from ministries, departments and agencies under the coordination of Tanzania Food and Nutrition Centre (TFNC) which is an arm of the MOH in addressing the national nutrition issues.

Through the iodine nutrition laboratory located at TFNC, the iodine analyses of both salt and urine samples have been carried out to support national IDD control programs within countries in the Africa continent and partially in the Middle East. In 2019, the laboratory supported national IDD surveys for Burundi and Angola by providing technical support for the national surveys and in carrying out the iodine analyses from salt and urine samples collected during the survey.

Tanzania Food and Nutrition Centre

Demand for such support from Tanzania's laboratory is increasing; TFNC's laboratory has extended its support by training technicians from other countries in order build capacity for monitoring progress of USI interventions against IDD.

Training iodine lab technicians from Rwanda and Angola at the TFNC in Dar es Salaam, Tanzania

Thanks to partnership support from UNICEF, GAIN, the International Atomic Energy Agency and the National Bureau of Statistics of Tanzania, the laboratory built capacity in terms of laboratory equipment to enable TFNC to support nutrition research/surveys within and outside the country.

Ghana and Ethiopia are examples of countries in which TFNC has built capacity, and now they are operational and supporting their countries national surveys. The trainings were supported by Regional Iodine Global Network (IGN) and UNICEF country offices. The same efforts have been extended to Madagascar for capacity to determine iodine content in salt samples.

New training for scientists in Rwanda and Angola

In 2019, trainings have been extended to Rwanda and Angola where a total of five laboratory scientists were trained on various topics including the importance of iodine, etiology of IDD, interventions, and importantly, procedures for assessing the iodine nutrition status in the population, iodine content in salt samples and aspects of quality assurance/control. The trainees were: from Rwanda, Dr Murerwa Lambarte and Ms Clarisse Murebwayire, and from Angola, Dr Odeth Camarada, Ms Nelma Pontes Jose and Mr Eduardo Panguila. The training will enable them to establish their iodine monitoring laboratories in their country and reduce workload at TFNC reference laboratory in the future. All trainees were awarded Certificates of Recognition for the training received.

Iodine fortification of foods and condiments, other than salt, for preventing iodine deficiency disorders

Cochrane Systematic Review – Intervention Version published: 12 February 2019
➔ **https://doi.org/10.1002/14651858.CD010734.pub2**

Joseph Alvin R Santos, Anthea Christoforou, Kathy Trieu, Briar L McKenzie, Shauna Downs, Laurent Billot, Jacqui Webster, Mu Li

Iodine deficiency disorders (IDD) affect close to 1.9 billion people worldwide, and are a major public health concern in many countries. Among children, iodine deficiency is the main cause of potentially preventable deficits of central nervous system development and impairment of cognitive function, as well as goiter and hypothyroidism in people of all ages. Salt iodization is the preferred strategy for IDD prevention and control, however, in some instances where salt is not the major condiment, alternate vehicles for iodine fortification have been considered.

The objective of this review was to assess the effects of fortifying foods, beverages, condiments, or seasonings other than salt with iodine alone or in conjunction with other micronutrients, on iodine status and health-related outcomes in all populations.

Studies were eligible if they:

- were randomized or quasi-randomized controlled trials (RCT), non-randomized RCTs, or prospective observational studies with a control group, such as cohort studies, controlled before-and-after studies, and interrupted time series
- examined the effects of fortification of food, beverage, condiment, or seasoning with iodine alone, or in combination with other micronutrients versus the same unfortified food, or no intervention
- included populations, including pregnant women, from any country

Main results

Eleven studies met the criteria, providing 14 comparisons, and capturing data on 4317 participants. Seven studies were RCTs, three were cluster non-RCTs, and one was a randomized cross-over design. Seven studies were carried out among school children (N = 3636), three among women of reproductive age (N = 648), and one among infants (N = 33). The studies used diverse types of food as vehicle for iodine delivery: biscuits, milk, fish sauce, drinking water, yoghourt, fruit beverage, seasoning powder, and infant formula milk. Daily amounts of iodine provided ranged from 35 µg/day to 220 µg/day; trial duration ranged from 11 days to 48 weeks.

Five studies examined the effect of iodine fortification alone, two against the same unfortified food, and three against no intervention. Six studies evaluated the effect of cofortification of iodine with other micronutrients versus the same food without iodine but with different levels of other micronutrients.

Two studies reported the effects on goiter, one on physical development measures, and one on adverse effects. All studies assessed urinary iodine concentration.

Pooled results from RCTs showed that urinary iodine concentration significantly increased following iodine fortification; equivalent to an increase of 38 µg/L (95% CI 24 to 53 µg/L). The effects of iodine fortification compared to control on goiter prevalence, and five physical development measures were uncertain. One study reported that there were no adverse events observed during a cross-over trial.

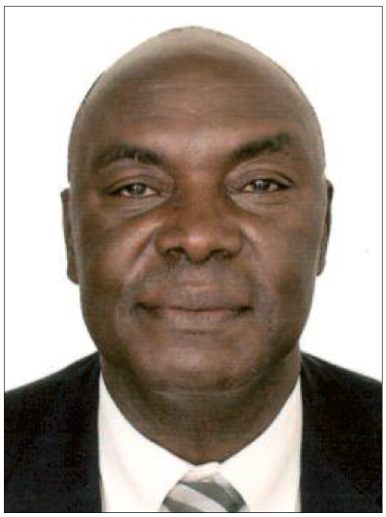
Conclusions

The evidence on the effect of iodine fortification of foods, beverages, condiments, or seasonings other than salt on reducing goiter, improving physical development measures, and any adverse effects is uncertain.

However, the findings suggest that the intervention likely increases urinary iodine concentration. Additional, adequately powered, high-quality studies on the effects of iodine fortification of foods on these, and other important outcomes, as well as its efficacy and safety, are required.

Establishing salt iodization in Kenya: personal reminiscences of Mr. Wilfred Kimiri

Mr. Kimiri was interviewed by Carole Tom in Nairobi, in February 2020. Here are his words:



Wilfred Kimiri: iodized salt champion in Kenya

“I joined KENSALT in 1999 as a chief accountant and gradually rose through the ranks to become the General Manager. At the time, KENSALT was the only company refining salt in Kenya.

There were many challenges at the time. The Kenya Government imposed price controls on all commodities sold in the country including salt. Despite the production cost being very high, increasing the selling price even by small margins required approval by the Price Controller which was a long and laborious procedure. Salt distribution and marketing was done only by a government-owned organization, The Kenya National Trading Corporation, from which the distributors and traders would buy their salt stock. After refining and iodizing Salt, KENSALT would sell the processed and packaged salt to the Kenya National Trading Corporation for distribution, which was highly inefficient.

A rapid distribution analysis would show huge amounts of salt stacked up in various stores in Nairobi and other towns while some regions could not receive their salt supply on time.

The cost of salt production was also very high. The salt harvesting area was very small and not sufficient to produce adequate raw salt. This was due to low acreage of the salt drying pans because of lack of funds to support expansion, and sometimes due to prolonged rains in the Salt Belt. In the above circumstances, local raw salt would be supplemented with imported raw salt, that was very expensive.

Potassium iodate for iodizing salt was also imported at a very high price. The potassium iodate required to be added as per Kenya Bureau Standards was 168ppm, which was also very high. This meant iodization had high costs. Based on these challenges and coupled with the need to minimize the cost of production, it was not surprising that the salt manufacturers were not able to meet the Kenya Bureau Standards for iodization.

However, a study carried out by Ministry of Health established that there were various diseases caused by iodine deficiency in the Rift Valley and other regions. Research established that the only way to eliminate the iodine deficiency was to enforce consumption of iodized salt. Although I had no nutrition or food science knowledge, I got interested and felt KENSALT may have the very solution to eliminate iodine deficiency, not only in the Rift Valley but in all the other parts of the country.

This health problem caught the attention of Government, but the MOH did not have adequate funds to support salt iodization. In 2001, UNICEF approached KENSALT and asked us how we could help in creating awareness. I then got interested in eradicating iodine deficiency! The government had identified 11 districts during that time (now counties) which had a high prevalence of iodine deficiency. A quick budget was done which indicated that creating awareness about iodized salt in these districts would require about Ksh. 6-7 million. With much conviction and aspiration, I tabled the budget to our Directors and they kindly approved a budget of about Ksh. 8Million (about US$ 700,000) to support the initiative.

Armed with the good news, I sat with UNICEF to plan the kind of awareness campaigns or sessions we would carry out. It was proposed that in each of the 11 districts that were marked as having iodine deficiency, we should select strategic groupings, i.e., 5 primary schools, 5 public barasas and 5 women's groups. It took us about 2 months to go around the country to create awareness. The campaign group consisted of experts in Nutrition and Public Health from MOH, UNICEF and a representative from salt industry (me!).

Iodized salt ensures iodine intakes in Kenyan women

I wish to thank our Directors and particularly our Chairman Mr. M.S. Patel and Mr. P. Kansagra for approving the funds for supporting the iodization campaign. I also thank UNICEF and Mrs Pam Malebe, the then Nutrition-in-charge from the MOH, because if it wasn't for their dedication, we wouldn't have achieved the successful iodization of salt in Kenya.

Going around the 11 districts to sensitize the public was very tiring and sometimes scary! One day, in one of the towns we visited, we couldn't find a hotel to sleep in and ended up all sleeping in the car. On a trip to one of the remote districts (Turkana), we got scared because on the way, we saw residents carrying guns. They looked very unfriendly and we didn't know what they were going to do with the guns! Despite these adventures, we continued with our mission until we completed the exercise of educating the public.

At the primary schools, the pupils were provided with basic information on the benefits of consuming iodized salt. KENSALT provided each of them with packets of iodized salt and asked them to always tell their parents to buy that brand which was iodized as per KEBS Standards from the market. The women's groups were more receptive and seemed to have some knowledge on the benefits of consuming iodized salt from their antenatal visits. In the public barasas, the most difficult group to handle and less interested were men. As soon as one of our experts would introduce the issue of salt iodization, the men would slowly disappear, leaving only the women and the campaign group at the venue.

After these sensitization meetings on the benefits of consuming iodized salt, the next challenge was how to make salt cheaper so that manufacturers could iodize the salt and consumers could afford to buy iodized salt. The salt production environment was changing. After many meetings and consultations with the government (over 10 years!), price controls were removed; and the manufacturers began to fully market and distribute their salt without going through Kenya National Trading Corporation. At least we could make some profits to sustain operations. The other problem was the cost of potassium iodate which remained very high (US$ 42 per kilo); import duty was also high at 25%; and the standards continued to require high iodization levels. Despite these challenges, we continued to produce iodized salt because there was demand for the salt and the salt business was able to earn some profit. I eventually convinced the government to reduce the level of iodization from 168 ppm to 50-85ppm and to remove customs duty on potassium iodate, which made the cost of iodization cheaper.

Looking back, is there anything we would have done differently? No! Did all these efforts pay off? Yes, a great deal! I am personally proud of the success. It wasn't easy to convince a private company to put in so much money to sponsor this kind of program. We as a company also learned a lot and are proud of being one of the champions of the success in salt iodization in Kenya. The latest report (2014) by Ministry of Health on consumption of iodized salt at the household level showed that Kenya has reached 98%. I hope this coverage reaches 100% and it is sustained. But we need stronger partnerships and more engagement.

I thank God for favoring my company and myself to champion salt iodization to try and eliminate iodine deficiency in Kenya, the East Africa Community and the entire region. What was my drive? I understood the need and had the solution with our company's commitment. More importantly, we at KENSALT were driven by the need to eliminate iodine deficiency in Kenya and make our citizens healthy! ”

China's universal salt iodization program boosted school enrollment

Excerpted from: Huang Q et al. Farewell to the God of Plague: Estimating the effects of China's Universal Salt Iodization on educational outcomes. Journal of Comparative Economics. 2020; 48: 20-36.
→ **https://www.ign.org/cm_data/2020-China-Farewell_to_the_God_of_Plague_Estimating_the_effects_of_Chinas_USI_educational_outcome.pdf**

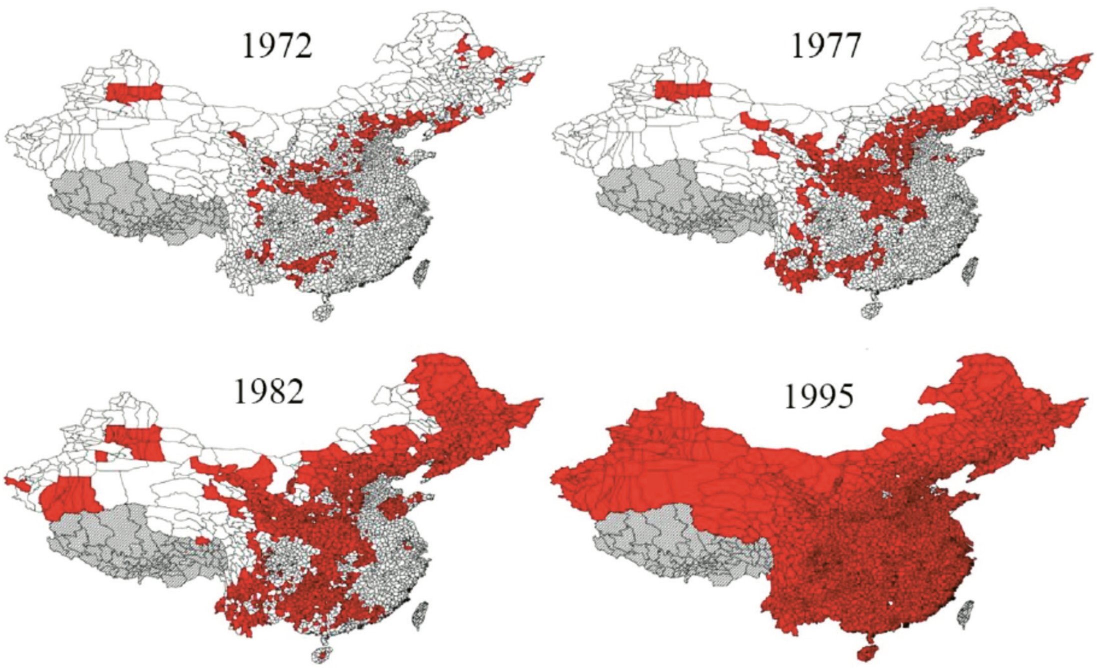


FIGURE 1 Countries with salt iodization in China, by year. Salt-iodized counties are shaded in red. In 1995, high iodine counties not supplying iodized salt are left blank.

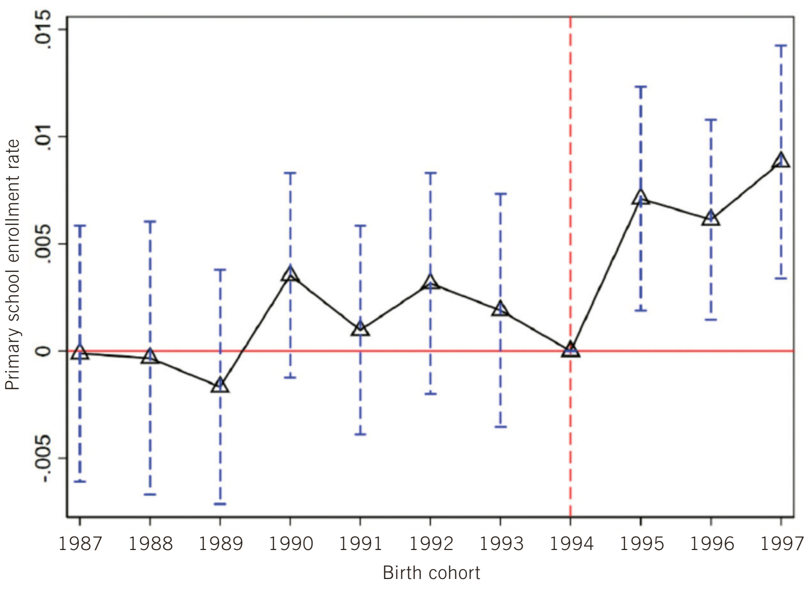
For many years, iodine deficiency disorders have been a leading cause of preventable mental retardation worldwide. Iodine deficiency in utero has irreversible detrimental impacts on the development of the infant nervous system, which ultimately limits the development of cognitive ability and hinders human capital formation. This important new paper estimates the effect of China's USI policy – the largest nutrition intervention policy in human history – on children's later-life educational outcomes.

China had over 700 million people living in areas suffering from IDD in the early 1990s. To eliminate IDD by 2000, the Chinese government initiated a USI policy on October 1, 1994, which mandated the iodization of edible salt throughout the country. Using China's 2005 population mini-census data combined with county-level information, the authors compared the outcomes of children born before and after the USI policy in 1994 across counties with different IDD prevalence levels.They found that the USI policy significantly increased primary school enrollment for the policy-affected cohorts in high goiter counties by 0.6 percentage points. The costs of USI almost evenly fell on the iodized salt consumers through an in-price tax levied by China's central government. Therefore, their findings yield clear redistribution implications.

The authors found that the beneficial USI effect almost exclusively shows up in rural areas rather than in urban areas and girls benefit more.

USI in China boosted school attendance.

FIGURE 2 Time pattern of primary school enrollment in China. The estimates in the pre-USI period are statistically indistinguishable from zero in stark contrast with a statistically significant and drastic increase beginning in 1995.



China's USI policy serves as an ideal natural experiment to examine the causal effects of salt iodization for two reasons. First, a state monopoly on salt in China ensured strict nationwide enforcement of USI and ruled out the potential endogeneity of producing or consuming iodized salt, which may threaten a causal analysis of the policy effect. China instituted state monopolization of salt production, distribution, and sales beginning in 1990. Specifically, China's central government authorized China Salt Industry Corporation, a central state-owned enterprise, other local state-owned enterprises in the salt industry, and local branches of these enterprises throughout the country to monopolize the production, distribution, and sales of edible salt. Second, before the enactment of USI, China had the largest population in the world exposed to IDD and exhibited rich regional heterogeneity in IDD levels. The Chinese government conducted an iodine deficiency census in the 1980s, which furnished the authors with a comprehensive dataset with rich county-level information, including IDD prevalence and water iodine content.

The effect of the USI policy on primary school enrollment in China was heterogeneous across several important socioeconomic dimensions. The authors found that the USI policy effect almost exclusively showed up in rural areas rather than in urban areas and girls benefitted more from the USI policy. These findings forcefully suggest that the USI policy is desirable not only on efficiency terms but also on social justice grounds. To the best of the authors' knowledge, these are among the first empirical studies to investigate the causal effect of China's nationwide USI intervention on educational outcomes.

Iodine – essential for mothers to be in the UK

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The United Kingdom (UK) National Diet and Nutrition Survey (NDNS) is designed to assess the diet, nutrient intake, and nutritional status of the general population living in private households in the UK. The most recent survey (1) published in 2018, related to the years 2014–15. The data indicated that the median urinary iodine concentration for women aged 16–49 years from 2014–15 was 102 µg/L. Although this median value met the WHO criterion for adequate intake for the general population, it does not meet the criterion for iodine sufficiency in pregnant and lactating women (ie, median urinary iodine concentration within 150–249 µg/L). This finding suggests a substantial public health issue affecting neonates, which urgently requires corrective strategies.

The UK has started the implementation process for mandatory fortification of flour with folic acid. Spina bifida due to folate deficiency is well recognized and has a clearly visible consequence, but the effect of iodine deficiency on fetal brain development is not so visible. Maternal iodine intake should be adequate before conception, through gestation (particularly the first trimester), and during lactation. Even mild iodine deficiency in pregnancy might lead to a lower intelligence quotient (IQ), as well as cognitive and behavioral problems in childhood. UK data have confirmed that a significant reduction in IQ of between 2 and 6 points is associated with suboptimal iodine status in pregnancy (2). Uncorrected, this issue will have substantial negative economic and social consequences.

Pregnant women in the UK are iodine deficient

What is the current dietary iodine status in the UK? The non-pregnant population requires 150 µg iodine per day, but in pregnancy this requirement rises to around 250 µg. The UK Iodine Group (a committee of experts in thyroid, nutrition, and public health with the aim of ensuring that iodine deficiency is eradicated in the UK) emphasizes that dietary sources of iodine are very important. In the UK, cows' milk is an important source of iodine. Milk-alternatives (eg, soya or almond), which have a very low iodine concentration, are not suitable as a milk substitute for mothers to be. White fish are a rich source of iodine. However, data from the NDNS show that fish intake is low, particularly among young women, and is more expensive than milk and other dairy products. Although some pregnancy vitamin supplements contain an adequate amount of iodine, many do not.

Universal salt iodization (USI) both helps to provide iodine for the general population and to achieve the necessary increased iodine requirement in gestation. This results in positive effects on population IQ, yet, according to the Iodine Global Network, the UK has still not achieved adequate iodine intakes in pregnant women.

Household consumption of salt, as the main source of salt intake, is reducing worldwide. In the UK, the main source of salt is from processed food, manufactured outside the home. In some countries (Australia and New Zealand) where USI has not been implemented, use of iodized salt in factory bread production has resulted in adequate iodine nutrition in all population groups. We do, however, also understand the paradox of advocating USI at the same time as reducing salt intake in the general population. The associated concerns have been appropriately addressed by statements from WHO and other authorities. The introduction of USI is not a barrier to achieving the reduction of salt consumption in the UK population from 8 g per day to 6 g per day.

Unfortunately, current knowledge of iodine requirements in pregnancy in the UK is very low. We suggest that efforts should be made to raise awareness of the importance of adequate iodine nutrition, especially in pregnant women and women of childbearing age. As the consumption of processed food is increasing, introduction of iodized salt in manufactured food and adding iodine to household salt should be advised. We support that the Department for International Development is aiding salt iodization in some developing countries, but it is surely time the UK itself recognized international standards of iodization to protect the IQ of our future generations.

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Uzbekistan: Low iodine intakes in pregnant women reflect poor coverage with iodized salt

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Excepted from Uzbekistan Nutrition Survey Report, UNICEF, Tashkent 2019

Results of 2017 Uzbekistan Nutrition Survey (UNS 2017) were recently published by UNICEF (1) and provide an important update on the use of iodized salt and iodine status of women of reproductive age (WRA) and pregnant women (PW) in this country. The objective of the UNS 2017 was to obtain updated and reliable information on the nutrition and micronutrient status of children 0-59 months of age, non-pregnant women 15-49 years of age, and pregnant women in Uzbekistan, and to formulate evidence-based recommendations to improve the nutritional status of vulnerable groups.

The UNS 2017 was a cross-sectional stratified household survey based on a probability sample to produce estimates that have acceptable precision for priority indicators of nutritional status in children 0-59 months of age and non-pregnant women in each of the 14 regions of the country which were defined as different strata. For pregnant women, the UNS 2017 was designed to produce national estimates only. This publication focuses specifically on salt iodization and iodine status data obtained in this survey.

Although pregnant women in Uzbekistan in general had low iodine intakes, those from households with adequately iodized salt had optimal iodine nutrition.

Use of iodized salt

Salt was collected from participating households for subsequent quantitative testing for iodine content at the central laboratory. Over 96% of respondents at the household level reported using iodized salt, and this information was also confirmed by the label on the salt packages: 80% were labeled as iodized. However, laboratory testing revealed a different picture: only 40% of salt samples were adequately iodized and salt samples labelled as "iodized" were less often adequately iodized than those that did not claim this or where the salt was not in its original package. The median iodine concentration was 6.9 mg/ kg salt. As shown in Figure 1 in total, almost half of households had non-iodized salt (iodine concentration <5ppm), about one-fifth had insufficiently iodized salt (iodine concentration 5-14.9ppm) and only just over one third had adequately iodized salt (iodine concentration ≥ 15ppm).

The proportion of adequately iodized salt was higher in urban households compared to rural, and significant differences were detected between the regions (*Figure 2*). The highest median iodine concentration and the largest proportion of households using iodized salt were found in Khorazm region. The lowest median iodine concentration was detected in Namangan region where median iodine concentration and proportion of households using adequately iodized salt were more than six-time lower.

FIGURE 1 Salt iodine concentration by categories: non-iodized (0-<5 ppm), inadequately iodized (5-14.9 ppm) and adequately iodized (≥ 15 ppm), UNS 2017 Report

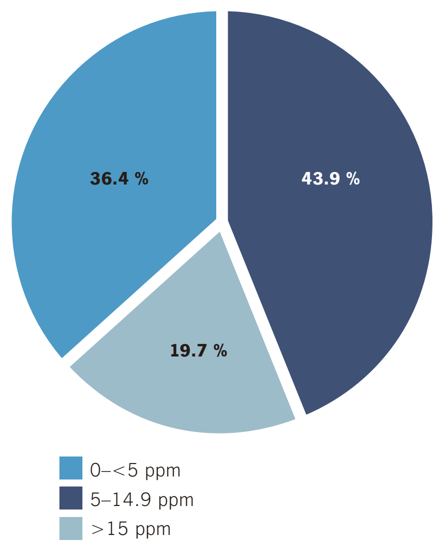
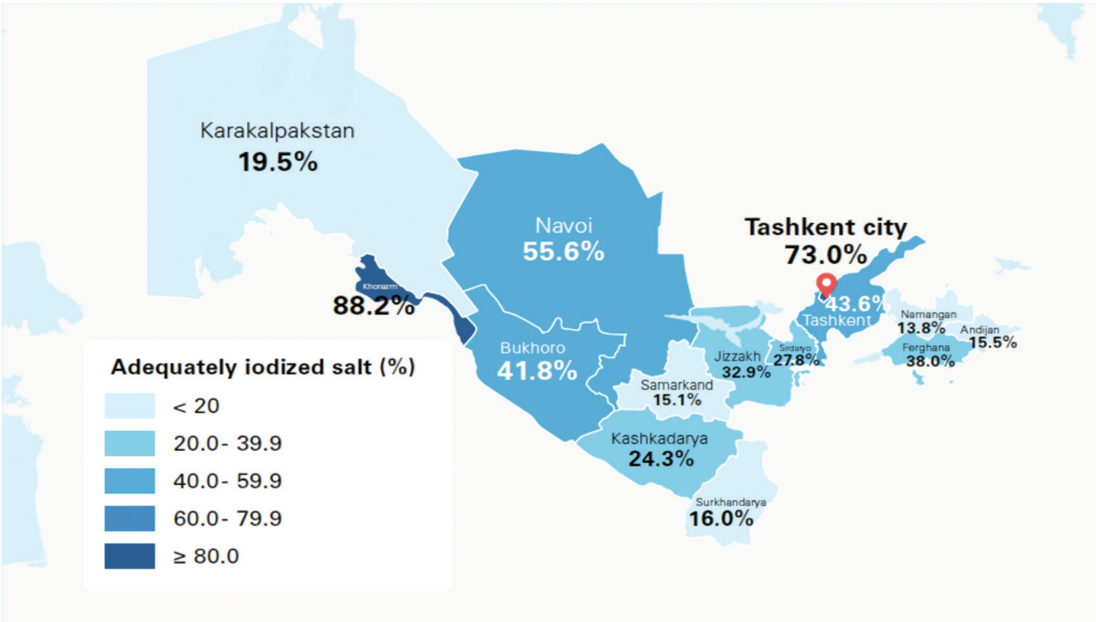


FIGURE 2 Proportion of households with adequate salt iodization (≥15 ppm), by regions, UNS 2017 Report



The lowest proportion of households with adequately iodized salt was found in the poorest households, whereas the highest proportion was found in households in the fourth and highest wealth quintile where adequately iodized salt was more than twice as common.

Iodine status of women of reproductive age (WRA)

Urinary iodine concentration (UIC) was assessed in 2085 women aged 15 to 49 years residing in urban (586) and rural (1499) areas of Uzbekistan. Median UIC (mUIC) in all non-pregnant women (135.3 μg/l) was above the cut-off level of 100 μg/l which defines an iodine-sufficient status in the population (*Table 1*). Median UIC was higher in women from urban (148.2 μg/l) than rural (129.3 μg/l) areas. The region-specific estimates indicate that in some districts, such as Namangan and Samarkand, mUIC in WRA was well below the cut-off defining population iodine sufficiency. WRA from the poorest households had borderline mUIC. No difference was found between women with different educational levels, while the mUIC was substantially higher in women from households with adequately iodized salt.

Iodized salt should be used in food preparation in Uzbekistan to ensure adequate iodine status

TABLE 1 Median urinary iodine concentration in non-pregnant women 15–49 years, UNS 2017 report

Characteristic	Total number of non-pregnant women per sub-group	Median UIC	(95% CI)	P Value
TOTAL	2085	135.3	(128.4, 143.2)	–
Urban/rural				
Urban	586	148.2	(137.0, 159.0)	<0.05
Rural	1499	129.3	(120.9, 137.1)	
Wealth quintile				
Poorest	431	99.3	(90.8, 113.4)	<0.001
Second	406	126.9	(118.4, 141.3)	
Middle	430	160.0	(142.7, 174.4)	
Fourth	383	143.3	(125.4, 165.4)	
Wealthiest	422	163.0	(152.7, 180.5)	
Educational level				
Secondary or less	911	133.6	(122.5, 144.3)	0.74
Special secondary or more	1176	136.3	(127.2, 146.4)	
Level of iodization of household salt				
None (<5 ppm)	812	89.9	(84.0, 98.1)	<0.001
Insufficient (5-14.9 ppm)	372	139.1	(125.5, 150.7)	
Adequate (15+ ppm)	710	208.9	(193.7, 229.8)	

TABLE 2 Median urinary iodine concentration in pregnant women, UNS 2017 Report

Characteristic	Total number of pregnant women per sub-group	Median UIC	(95% CI)	P Value
TOTAL	227	117.3	(101.8,139.9)	–
Urban/rural				
Urban	54	123.6	(89.1, 152.8)	0.85
Rural	173	117.3	(98.6, 144.1)	
Age (in years)				
15–19	14	106.9	(24.8, 212.9)	0.45
20–29	168	110.9	(88.6, 139.2)	
30–39	43	126.5	(92.4, 177.1)	
40–49	2	50.9	(27.9, 73.8)	
Educational level				
Secondary or less	62	112.5	(86.4, 151)	0.69
Special secondary or more	165	117.6	(96.7, 143.7)	
Trimester of pregnancy				
1	58	109.7	(74.3, 164)	0.25
2	91	136.8	(94.5, 191.9)	
3	72	106.5	(86.0, 134.0)	
Level of iodization of household salt				
None (<5 ppm)	96	78.4	(54.3, 97.7)	<0.001
Insufficient (5-14.9 ppm)	36	106.9	(51.4, 161.2)	
Adequate (15+ ppm)	72	205.8	(176.1, 253.4)	

Iodine status of pregnant women (PW)

The median UIC (117.3 μg/l) in a total of 227 PW indicates inadequate status of iodine nutrition in this population group without significant differences between urban and rural settings, and also among age groups, wealth status, educational levels and trimester of pregnancy. However, mUIC (205.8 μg/l) was adequate in PW from households with adequately iodized salt (*Table 2*).

Results of the 2017 UNS showed significantly lower coverage of Uzbekistan population with adequately iodized salt compared to previous assessments. For example, the Uzbekistan Multiple Indicator Cluster Survey (MICS) conducted in 2006 reported that 53% of salt samples were adequately iodized (2) with a different pattern of household coverage with iodized salt by regions of the country. However, the rapid test kits (RTK) that were used in MICS in 2006 could not accurately distinguish between adequately and inadequate iodized salt. Results of the 2017 UNS that employed quantitative assay of iodine in salt provide more accurate and precise data on use of iodized salt in Uzbekistan.

Overall, the 2017 UNS indicated adequate iodine intake among WRA in Uzbekistan with exception of women from Namangan and Samarkand regions. Another important finding of the 2017 UNS is that that WRA from the poorest quintile of population and from households with non-iodized salt had inadequate iodine status in comparison with women who used adequate and even poorly iodized salt. While PW in Uzbekistan in general had inadequate iodine status, those from households with adequately iodized salt (15 ppm and more) had mUIC (205.8 μg/l) suggesting optimum iodine nutrition. This report calls for strengthening of enforcement of USI legislation on production, importation and distribution levels.

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Iodine status in Tunisia two decades after universal salt iodization

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Introduction

Tunisia is a North African country located between Algeria and Libya with a population of about eleven million inhabitants of which about two third live in urban areas. The first national cross-sectional assessment was conducted in 1973-75 among 9940 individuals from all age classes, and revealed that the goiter rate was 9.3% in the inland mountainous areas, mostly rural and poorly developed, of North-Western region (1). In the same survey, the urinary iodine concentration (UIC) among a national random sample (n=1688) showed mild iodine deficiency, with a median UIC below 50 μg/L (1). To address iodine deficiency disorders, in 1984, the Tunisian government regulated the commercialization of iodized salt (with a compulsory iodization at 15-25 ppm, either with KIO3 or KI) in the North Western region (3). Due to the unsatisfactory impact of this first local legislation, along with the recommendation of the World Health Organization, universal salt iodization (USI) was adopted in 1995. During 1995, a second national survey, conducted among school-age children (8-11 y), showed an optimal iodine intake with a median UIC of 158 μg/L (3).

In 1996, a new decree added more specifications as regard to the quality of the salt packaging to prevent iodine losses during storage and transportation. In order to assess the USI impact at national level, iodine status was assessed in the framework of the National Nutrition Survey conducted by the Tunisian National Institute of Nutrition and Food Technology in 1996-97: it revealed a significant increase of iodine intake among school-age children (6-12 y, n=473), with a median UIC of 127 μg/L (4). In 2000, the coverage of adequately iodized salt was found to be satisfactory as 96.6% of the household were reported to consume adequately iodized salt (>25 ppm of KIO3) (5).

Tunisian salt production near Zarzis

After a gap of seventeen years, a fourth national survey was conducted in 2012 among 1560 school-age children (6-12 y) (6). At the national level, optimal iodine intake was found with a median UIC of 220 μg/L (95% CI, 199–241). But there was high variability in iodine status, and a quarter of the children assessed had a UIC≥300 μg/L, much higher than in 1996 (8.3%). This survey highlighted a north-south gradient of iodine excess which was paradoxically more prevalent in the semi-arid South-Eastern region (339 μg/L, 95% CI, 309-369) than in the much more urbanized and developed northern coastal regions (e.g. 159 μg/L, 95% CI, 140–178 for the North-Eastern region). However, in the southern region a significant amount of iodine intake is hypothesized to come from drinking water based on a local study. In the 2012 national survey, mean UIC was higher for boys vs. girls (241 μg/L vs. 200 μg/L P=0.014).

In 2012, over 78% of Tunisian households were using iodized salt, but updated data are needed to ensure sustainability of the 25 year-old program

This 2012 national survey also included measures of the adequacy of salt iodization at the different levels of the distribution chain: households (n=1560), retailers (n=1440) and wholesalers (n=635). According to the Tunisian standards (25-45 ppm of potassium iodate), only 55.8% of consumed salt was adequately iodized and an excess of iodine was found in 22.4% of samples. However, based on the international cut-off of 15 ppm, 78.2% of households were found to use adequate iodized salt: this was found to be relatively stable along the distribution chain, with 65% for the retailers and 67.3% for the wholesalers.

Key challenges and recommendations

No concrete actions have been taken since the last iodine survey in 2012. Therefore, advocacy on the issue of iodine nutrition should be set as a top priority not only to eradicate iodine deficiency but also to tackle the issue of iodine excess. The reactivation of the national platform for the monitoring of the iodine status among the population and the external quality control of the distributed salt is crucial and urgent.

Of note, the Tunisian Ministry of Health has launched a national strategy to prevent and control non-communicable diseases: the reduction of salt intake is one of the approaches. This strategy should be coordinated with the USI program to both mitigate the adverse effects of the nutrition transition and prevent inadequate iodine intake. The lessons learned will be of interest to many countries in the region which also face this double challenge.

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ABSTRACTS

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Low habitual iodine intake in Norwegian pregnant women predicted poorer child language, school performance, and increased likelihood of special educational services.

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