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Iodine Deficiency Disorders

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Foreword

The following two research papers focus on a health problem, iodine-deficiency disorders (IDD), which affects hundreds of millions of people, primarily in developing countries. INCLEN-trained physicians and health social scientists are working to develop efficient, low-cost, national health interventions which will dramatically reduce the number of people afflicted with the debilitating symptoms of IDD, as well as other infectious and chronic diseases. The primary author of the first paper, on iodine content in salt in Northern India, Dr. C. S. Pandav, an INCLEN-trained researcher at the All India Institute of Medical Sciences in New Delhi, also served as a co-author for the second paper on IDDs in Bangladesh.

According to the United Nations Children's Fund (UNICEF), approximately 30% of the world's population is at risk for iodine deficiency, an estimated 120,000 children are born each year with severe mental retardation, and an additional 60,000 fetal and infant deaths are directly attributable to iodine deficiency. UNICEF further estimates that the worldwide toll from iodine deficiency includes an estimated 26 million children and adults with significant brain damage, and of that number 5.7 million suffer from cretinism.

There are 94 countries worldwide where IDDs pose significant health problems. The majority of these countries are now implementing national plans for the iodization of salt to directly combat IDD. The efficacy of these national plans will depend greatly on good planning, vigilant monitoring and careful analysis of health statistics. The following two research papers on IDDs in India and Bangladesh illustrate the importance of effective iodization programs, and the challenges many countries face in designing and maintaining effective programs.

INCLEN, INC. EXECUTIVE OFFICE 3600 MARKET STREET SUITE 380 PHILADELPHIA PA 19104-2644 USA
PHONE: 215.222.7700 FAX: 215.222.7741 EMAIL: INCLEN@MCIMAIL.COM

A ROLE FOR NON-GOVERNMENTAL ORGANIZATIONS IN MONITORING THE IODINE CONTENT OF SALT IN NORTHERN INDIA

C.S. Pandav,[1] S. Pandav,[2] K. Anand,[3] S.A. Wajih,[4] S. Prakash,[5] J. Singh,[6] & M.G. Karmarkar[7]

Introduction

Iodine-deficiency disorders (IDDs) are a major public health problem in India. Approximately 150 million people are at risk, of whom 54 million have goiters, 2.2 million suffer from cretinism, and 6.6 million have other, milder neurological deficits *(1)*. Regardless of whether the cause of IDDs is environmental deficiency or the presence of goiter-causing elements in the diet, the easiest way of eliminating the problem is to fortify dietary salt with iodine.

The Indian National Iodine Deficiency Disorders Control Program, which is organized by the Ministry of Health and Family Welfare, is responsible for carrying out initial surveys to identify areas where goiter is endemic, monitoring the production and supply of iodized salt, and conducting additional surveys after five years of continuous supply of iodized salt to assess its impact. The Indian Salt Commissioner's Office at Jaipur, in Rajasthan State, is responsible for ensuring the supply of iodized salt.

Iodization of salt is a simple process that can be easily implemented by salt manufacturers and small-scale entrepreneurs. Manufacturers control the level of iodization by controlled spraying of salt with a solution of potassium iodate.

[1] Associate Professor, Centre for Community Medicine, All India Institute of Medical Sciences (AIIMS), New Delhi- 110 029, India. Requests for reprints should be sent to this author.
[2] Research Officer, Centre for Community Medicine, AIIMS, New Delhi, India.
[3] Senior Resident, Centre for Community Medicine, AIIMS, New Delhi, India
[4] Secretary, Gorakhpur Environmental Action Group, Gorakhpur, Uttar Pradesh, India.
[5] Regional Programme Officer, Uttar Pradesh Voluntary Health Association, Varanasi, Uttar Pradesh, India.
[6] Regional Programme Officer, Uttar Pradesh Voluntary Health Association, Varanasi, Uttar Pradesh, India.
[7] Professor, Department of Laboratory Medicine, AIIMS, New Delhi, India.

Government regulations require salt to be iodized to a level of 50 milligrams of iodine per one kilogram (2.2 pounds) of salt, or 50 parts per million, so that, after making allowance for losses of iodine during storage and distribution, the salt contains not less than 15 milligrams of iodine per kilogram of salt. In India, the average per capita consumption of salt is 10 grams per day. Consequently, salt with an iodine content of 15 milligrams per kilogram would satisfy the recommended daily requirement of 150 µg of iodine.

Consistent monitoring of the iodine content of salt at the production, storage, sale and consumption levels, and prevention of the sale of uniodized salt, are vital components of salt iodization programs. Monitoring must also be adjusted to meet local conditions. The information generated by the monitoring mechanism should be directly linked to decision-making, and there should be a feedback system allowing necessary changes to be made.

In India, salt is iodized in approximately 350 production centers. Over 90% of the centers are in the states of Gujarat, Rajasthan, and Maharashtra in the western portion of the country, and in Tamil Nadu and Andhra Pradesh in the south. Iodized salt is largely transported by rail to the areas where IDDs are endemic, mainly in northern, northeastern and central India.

The Salt Commissioner's Office periodically checks the iodine content of salt at the production level. At the consumer level, the Prevention of Food Adulteration Act applies to salt intended for human consumption in districts where IDDs are endemic, i.e. where the prevalence of goiter exceeds 10%; however, the monitoring system at this level still requires to be streamlined. The Act prohibits the sale of non-iodized salt in areas where IDDs are endemic.

Since there is no effective, consistent monitoring mechanism, and because non-iodized salt, which is cheaper than the iodized product, is available for animals, improving consumer awareness about IDDs is essential. Non-governmental organizations (NGOs) could play a critical role in monitoring the iodine content of salt at household and retail levels. Consequently the objectives of this study were to assess the iodine content of salt at the household and retail levels in selected districts in the Dehradun, Gorakhpur and Varanasi regions of Uttar Pradesh, where IDDs are endemic, and to study the feasibility of using NGOs to monitor the iodine content of salt in selected districts at the consumer levels.

Methods

The feasibility of using NGOs to monitor the iodine content of salt was studied in five districts in Gorakhpur, five in Varanasi, and six in Dehradun regions. One agency was identified in each of the three regions to coordinate the work of NGOs at the village level. The selection of districts, villages, and NGOs depended on their willingness to participate in the study. All the NGOs had already been active in the health, development, and environmental fields over the previous 20 years.

A detailed protocol of activities and methodology was worked out on the basis of discussions held between the Centre for Community Medicine at the All India Institute of Medical Sciences, a university hospital in Delhi, and the coordinators of the NGOs. Laboratory technicians and others were then trained in the collection, transportation, and analysis of salt samples. Regional iodine-monitoring laboratories were established by the three coordinating agencies. Progress was reviewed six months after the start of the study.

During the course of the study salt samples were collected every month for six months from one household in the poorer section of the community, and from one shop selling salt in each village. Gathering salt samples from households was problematical in some instances because families refused to give samples regularly, perhaps because of a fear that salt, which in Indian culture is associated with loyalty and prestige, might be used for black magic purposes. In those cases, nearby households that were willing to participate were chosen and followed up.

All of the samples collected were sent to the regional laboratories, in accordance with a uniform transportation protocol. The iodine content of the samples was then tested. Of the samples received, 10% were selected at random and sent to the central laboratory at the All India Institute of Medical Sciences, New Delhi, for external quality control. Regular feedback on this was provided to the regional laboratories. Information on the iodine content of the salt was sent from the regional laboratories to the participating NGOs on a regular basis, and also to the district, state, and national authorities.

Results

The number of samples obtained in the Gorakhpur, Varanasi, and Dehradun regions were 992, 1397, and 1612 respectively (Table 1). In Varanasi only 6.7% of samples were from shops, compared with 28.6% in Gorakhpur and 22.1% in Dehradun. In Dehradun all the salt collected was unpacked, whereas only 5% and 20%, respectively, was unpacked in Gorakhpur and Varanasi. Packed salt was sold under more than fifteen brand names, of which Tata, Taza and Tara were the most common.

Table 1: **Sources of the salt samples in the study**

Region	No. of districts	No. of samples	No. of samples from: Households	Shops
Dehradun	6	1,612	1,256 (77.9)[a]	356 (22.1)
Gorakhpur	5	992	708 (71.4)	284 (28.6)
Varanasi	5	1,397	1,303 (93.3)	94 (6.7)
Total	16	4,001	3,267 (81.7)	734 (18.3)

[a] Figures in parentheses are percentages

Table 2 shows the iodine contents of the salt samples, as determined at the regional headquarters within a month of collection. In Gorakhpur, 85.9% of the samples had less than 15 milligrams of iodine per kilogram of salt. In Varanasi, 80.7% were in this category, and in Dehradun the corresponding value was 37.4%. A few samples in Dehradun and Varanasi, and 175 (18%) in Gorakhpur, contained no iodine at all. Some samples contained more than 80 milligrams of iodine per kilogram of salt, the maximum being 95 milligrams per kilogram in Dehradun. Iodization thus seemed to be extremely variable in the study areas. Samples taken from packets of salt had higher and more uniform iodine content than those of loose salt.

Table 2: **Iodine content of the salt samples in the study**

	No. of districts	% of samples with iodine content of: <15mg/kg	15-30 mg/kg	30-45 mg/kg	>45 mg/kg
Region:					
Dehradun	1,612	37.4	35.8	16.3	10.5
Gorakhpur	992	85.9	11.3	1.9	.9
Varanasi	1,397	80.7	9.7	1.7	7.9
Packing:					
Loose	3,627	69.0	19.0	7.4	4.7
Packed	374	21.7	36.4	10.4	31.8
Source:					
Households	3,267	65.4	20.3	7.2	7.1
Shops	734	60.5	22.2	9.4	7.9
Total	4,001	64.5	20.6	7.7	7.2

There was no significant difference in the iodine content of salt samples from households and shops. This may have arisen because in shops most samples were of loose salt stored in open sacks, with the result that significant losses of iodine occurred. Furthermore, a higher proportion of samples from shops were of loose salt than was the case with household samples. When the data were analyzed by month, there was very little variation in iodine content.

A total of 381 salt samples were received at the central laboratory, and the results of analyses performed there were comparable to those carried out in the regional laboratories.

Discussion

The study villages lie in the sub-Himalayan belt, where IDDs are highly endemic. Previous surveys in this area indicated that the prevalence of goiter was 16-40%. The iodine content of the salt available in the study area is very low, despite an official ban on the entry of non-iodized salt since October, 1986. Iodized salt supplies were introduced in Dehradun in 1986 and in Gorakhput and Varanasi in 1987.

There was a wide variation in the iodine content of the salt. Some samples had 95 milligrams of iodine per kilogram of salt, primarily in Dehradun, while 175 samples in Gorakhpur and 10 in Varanasi had no iodine at all. This study illustrates an urgent need for proper monitoring of the iodine content at the production, distribution, storage, wholesale, and retail levels in order to ensure a minimum of 15 milligrams of iodine per kilogram of salt used in Indian households.

The NGOs reported poor awareness of the causes, consequences and preventive measures associated with IDDs, even among district officials. However, during the course of the study, the awareness levels of these officials increased, as did their understanding of the problems faced by the NGOs.

The study demonstrates that it is practical and feasible to involve NGOs in monitoring the iodine content of the salt, particularly in hilly and tribal regions, where government outreach is limited. However, some special, specific problems need to be addressed in a study of this kind. Some of the problems encountered in this study included the following:

* Shopkeepers and villagers are reluctant to provide salt samples.
* Shopkeepers store salt primarily in large open sacks, although some salt is available in packed form. Manufacturing dates could not be determined from samples from open sacks, and it is usually impossible to take samples from packed salt.
* In many places, mainly in hilly areas, bartering is used to obtain supplies of salt for a year at a time, making it difficult to determine details of price, manufacturing date, etc.
* Households were advised of the iodine content of local salt and the consequences of consuming non-iodized salt, and this led shopkeepers to fear that their businesses would be adversely affected by IDD sensitization programs.

* A demand for iodized salt needs to be generated. Shopkeepers are willing to sell any salt, since there is very little difference in the profit margin.

In order to implement a plan wherein Indian NGOs have responsibility for monitoring the presence and levels of iodine in salt, a number of recommendations should be considered by the government, manufacturers of salt, traders, universities, and the NGOs themselves. First, an information, education and communication campaign should be conducted in villages before monitoring is undertaken, with a view to helping people to realize the importance of consuming iodized salt and, therefore, increasing the demand for it. Second, shopkeepers should be reassured that these measures are educational and that a lack of iodine in salt does not mean that they are at fault. Third, a workshop or training module for district officers should be provided at the onset of programs.

This study's findings clearly show that the levels of iodine consumed by the villagers in the study area are often deficient or entirely absent. This may be due to one or more possibilities.   The current, official monitoring of iodine levels in salt, as it leaves the manufacturer, is deficient; non-iodized salt is being illegally distributed and sold in these areas; and/or salt, adequately iodized by a local manufacturer, is being subsequently improperly stored so as to lose its iodine content.   It is important that NGOs play a part, in monitoring iodine levels, even after a government plan has been put in place. The role of the NGOs should be fostered particularly in districts where IDDs are highly endemic. India has an extensive network of NGOs whose infrastructure makes it possible for them to carry out such work, as has been amply demonstrated, for example, with immunization.

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THE CURRENT STATUS OF IODINE-DEFICIENCY DISORDERS IN BANGLADESH

H.K. M. Yusuf, S. Quazi, M.N. Islam, T. Hoque, K.M. Rahman, M. Mohiduzzaman, B. Nahar, M.M. Rahman, M.A. Khan, M. Shahidullah, M. Baquer, C.S. Pandav.

Iodine-deficiency disorders (IDDs) are a global public health problem. According to the most recent estimates, 1.57 billion people worldwide are at risk of iodine deficiency, 655 million suffer from goiters, and about 20 million have varying degrees of mental retardation, e.g. cretinism. *(1)* Southeast Asia shares the greatest rates of prevalence of IDD (486 million at risk and 176 million with goiters) with Bangladesh and Bhutan. India, Indonesia, Myanmar, Nepal, and Thailand have hyperendemic iodine deficiency. Two surveys, the East Pakistan Nutrition Survey of 1962-64 *(2)*, and the National Goiter Prevalence Study of 1981-82 *(3)*, showed prevalence rates of goiter in Bangladesh of 10-28%. In view of repeated annual flooding, heavy rains, and the continued risk of IDD, we have conducted an extensive survey of the country to assess the latest status *(4)*.

This study of the current status of iodine-deficiencies in Bangladesh focuses on the two primary clinical expressions of iodine deficiency, goiter and cretinism. Urinary iodine was considered the chief biochemical variable, and was measured in 15% of the study population. The IDD variables were assessed by trained physicians and expert faculty members, with supervision and internal as well as external quality assurance tests. The "EPI-30 cluster" sampling methodology, recommended by the Joint World Health Organization-UNICEF-ICCIDD Consultation on IDD Indicators *(5)*, was followed for selecting the survey sites. Thirty *mauzas*, an area generally equivalent to a village, were selected from both the plain and the flood-prone zones according to probability proportional to population size. From the small hilly zone, 18 *mauzas* were selected at random. Consequently, the number of survey sites totaled 78. In each *mauza*, the study population consisted of boys and girls, aged 5-11 years, and men and women, aged 15-44 years, in about equal proportions. The total number of respondents was 30,072; 7320 from the hilly zone, 11,445 from the flood-prone zone, and 11,307 from the plain zone. The total number of urine samples was 4512. Each survey questionnaire was manually edited and coded. Data entry was done by use of software dBase III Plus with range checking and appropriate correction.

The study revealed that the current total goiter rate in Bangladesh is 47.1%; 44.4% in the hilly zone, 50.7% in the flood-prone zone, and 45.6% in the plain zone. The prevalence of cretinism in the country is 0.5%; 0.8% in the hilly zone, 0.5% in the flood-prone zone, and 0.3% in the plain zone. Nearly 69% of the Bangladeshi population have biochemical iodine deficiency, with a urinary iodine excretion rate of <10 µg/dL. Consequently, all of these people are at risk for iodine deficiency disorders.

These findings show that IDDs have increased throughout Bangladesh over the past three decades and now pose a severe threat to the health of a sizable majority of the population. In fact, the widespread iodine deficiency in all ecological zones indicates that the country as whole is an iodine-deficient region and 100% of the population are feared to be at risk of iodine deficiency. The government of Bangladesh, with assistance of UNICEF, has initiated a universal salt iodization program that had as its original goal to provide iodized salt to every household by the middle of 1994.

References

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