IODINE DEFICIENCY DISORDER SURVEY, 2002
REPUBLIC OF MALDIVES

Report Prepared by
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CONTENTS

List of Figures

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ABBREVIATIONS

CDR	Crude Death Rate
CS	Crystalline Salt
FGD	Focus group discussion
ICCIDD	International Council for Control of Iodine Deficiency Disorders
IDD	Iodine Deficiency Disorders
IEC	Information, Education and Communication
IMR	Infant Mortality Rate
MICS	Multiple Indicator Cluster Survey
MIS	Management information system
MOE	Ministry of Education
MOH	Ministry of Health
NIDDCP	National Iodine Deficiency Disorders Control Programme
PHL	Public Health Laboratory
PPS	Probability Proportionate to Size
SAARC	South Asian Association for Regional Cooperation
STO	State Trading Organization
TBA	Traditional birth attendant
TGR	Total Goiter Rate
TSH	Thyroid Stimulating Hormone
UIE	Urinary Iodine Excretion
UNICEF	United Nations Children's Fund
WHO	World Health Organization

EXECUTIVE SUMMARY

Iodine deficiency is a public health problem in the Republic of Maldives. A study conducted in 1995 documented a prevalence of goiter in school-aged children (6-12 years) as 23.6% and median Urinary Iodine Excretion (UIE) of 67 mcg/l. The present study was conducted after a gap of 6 years to re-assess the prevalence of iodine deficiency disorder (IDD) and improvements made thereafter to facilitate the Government of Maldives to strengthen intervention activities towards elimination of IDD.

The objectives of the study were i) to assess the prevalence of IDD and ii) to estimate the iodine content of salt consumed by population. The "30 cluster" sampling methodology and indicators for assessment of IDD as recommended by the WHO/ UNICEF/ICCIDD were utilized for the survey. Children in the age group of 6-12 years were considered for assessment of iodine deficiency. Since the primary school enrollment rate is more than 90% in the country, the school approach was adopted.

The sample size was calculated with a presumption that the prevalence of goiter at the time of the survey was 10%. The confidence level of 95%, relative precision of 20% and design effect of 3 was considered for calculation of sample size. Utilizing these parameters a sample size of 2592 was obtained. In each identified school unit (cluster) the detailed survey was conducted and a minimum of 90 children were surveyed. If the sample could not be covered in one school, the adjoining school was included to complete the sample of a cluster. The clinical examination for goiter was performed by investigators specially trained for the survey. On the spot urine samples were collected from a minimum 30 children in screw capped plastic bottles. Salt samples were also collected from the homes of the same children from whom urine samples were collected.

A total of 3510 school children in the age group of 6-12 years were included for the study. The male: female ratio of the study samples was 1:1. Moderate goiter was found in 25. 7% of the study population. 0.1% had severe goiter. It was found that a total of 43.1% of the children had UIE level less than 100 mcg/l. (l5.5, 12.5 and 25.1 percent of the children had urinary UIE of <20.0, 20.0-49.9 and 50.0-99.9 mcg/l, respectively). One hundred(100) mcg/l is considered to be an adequate level. The median UIE of the children studied was found to be 115 mcg/l. Salt with inadequate iodine content was consumed by 38% of the children.

The finding of a total goiter prevalence of 25.7% indicates that the population of the Maldives has moderate iodine deficiency, while the observation of a median UIE of 115 mcg/l indicates that there was no overall biochemical iodine deficiency in the population studied. However, out of 30 clusters surveyed, 12 clusters had median UIE levels <100 mcg/l indicating biochemical iodine deficiency in those clusters. In addition, of these clusters more than 20% of the urine samples had UIE levels less than 50 mcg/l, indicating moderate to severe biochemical iodine deficiency. The clusters with the highest percentage of samples with a UIE level <50 mcg/l were located in the far north of the country. However, the highest percentages of householdsusing salt with less than the

recommended 15ppm of iodine were found in the south

The findings of the present study indicate that the population of the Maldives is going through a transition phase from iodine deficient to iodine sufficient. Yet, there exists a large inequality for the various IDD parameters across the country showing an urgent need for more awareness on IDD and ensuring universal salt iodization in the country so that the IDD can be eliminated from the Maldives.

IODINE DEFICIENCY AND ITS HEALTH CONSEQUENCES

About 1.5 billion people, or nearly one-third of the earth's population, live in iodine deficient areas. Eliminating iodine deficiency was recognized as one of the most achievable of the goals by the World Summit for Children held in 1990.

Healthy humans require iodine, an essential component of the thyroid hormones, thyroxin and triiodothyronine. Failure to have adequate iodine leads to insufficient production of these hormones, which affect many different parts of the body, particularly muscle, heart, liver, kidney, and the developing brain. Inadequate hormone production adversely affects these tissues, resulting in the disease states known collectively as iodine deficiency disorders, or IDD. These consequences include: (i) mental retardation; (ii) defects in development of the nervous system; (iii) goiter; (iv) physical sluggishness; (v) growth retardation; (vi) reproductive failure, (vii) increased childhood mortality, together often resulting in economic stagnation. The most devastating of these consequences are the ones on the developing human brain. IDD has been identified as the world's most important single major cause of preventable mental retardation. Its severity can vary from mild intellectual blunting to frank cretinism, a condition that includes gross mental retardation, deaf autism, short stature, and various other defects. In areas of severe iodine deficiency, the majority of individuals risk some degree of mental impairment. In addition to mental retardation, goiter is an important consequence of iodine deficiency. Thyroid enlargement can be viewed as an attempt to compensate for inadequate hormone production by the thyroid, as a consequence of insufficient iodine for hormone synthesis. The pituitary gland at the base of the brain secretes TSH (thyroid stimulating hormone) in response to the levels of thyroid hormone circulating in the blood. When thyroid hormone production is low, the pituitary secretes more TSH. This increased stimulation causes thyroid enlargement. The resulting goiter is a marker for iodine deficiency, and is particularly useful because it is easily assessed.

IDD has been identified as the world's most important single major cause of preventable mental retardation

Unlike other nutrients such as iron, calcium or the vitamins, iodine does not occur naturally in specific foods; rather, it is present in the soil and is ingested through foods grown on that soil. IDD results from an uneven distribution of iodine on the earth's crust. Soils from mountain ranges, such as the Himalayas, Alps, and Andes, and from areas with frequent flooding, are particularly likely to be iodine deficient. The problem is aggravated by accelerated deforestation and soil erosion. This deficiency in the soil cannot be corrected. The food grown in iodine deficient regions can never provide enough iodine to the

population and livestock living there. Living on the seacoast does not guarantee iodine sufficiency, and significant numbers of IDD have been reported from the Azores, Bombay, Bangkok and Manila for example. IDD thus results mainly from geological rather than social and economic conditions. It cannot be eliminated by changing diet habits or by eating specific kinds of foods grown in the same area. Rather the correction has to be achieved by supplying iodine from an external source. This can be done in two ways: by periodic supplementation of deficient populations with iodized oil or by fortifying a commonly eaten food with iodine. While both strategies are effective, the iodinization of salt is the most common, long term and sustainable solution that will ensure that iodine reaches the entire population. Salt is ingested on a regular basis by all segments of the population in almost equal amounts. Fortification of salt has been extremely successful in eliminating iodine deficiencies in North America and many parts of Europe.

Checking for goiter

SOCIODEMOGRAPHIC PROFILE OF MALDIVES

The Republic of Maldives is a small archipelago consisting of 1,190 coral islands, each surrounded by sea. The country is situated in the Indian Ocean, approximately on 7° Northern to 0° Southern latitude and between 72° to 73° Eastern longitudes. The low-lying islands do not have any mountains or rivers. The Republic of Maldives has a very humid climate with an average annual rainfall of about 2000 mm. The mean temperature lies between 25°C to 31°C. The recorded lowest temperature in the Maldives was 17.2°C (Male' in 1978) and the recorded highest temperature (Laamu atoll Kadhoo in 1991) was 36.8°C.

Among the islands, 200 are inhabited (administrative), 111 are non-administrative islands (which include tourist resorts, industrial islands, and islands for other purposes), and the rest are uninhabited. Most of the islands are less than two square kilometers and the total area (including sea) is approximately 115,300 square kilometers. The Maldives has 27 natural atolls. However, for easy administration the country is divided into 20 atolls, each headed by an Atoll Chief, while each inhabited island is headed by an Island Chief. The Maldives has always been a sovereign and an independent state. The people of the Maldives embrace the noble religion of Islam and converse in a common language called Dhivehi.

The first population data recorded in 1911 showed that the population was only 72,237 in the country. It took 55 years to add 28,000 people and reached the 100,000 mark in the year 1965. After 1965 when the health services were extended to the atolls, the mortality rate was sharply reduced while the birth rate continued to be high. As a result, a significant population growth rate averaging above 3 percent, with a doubling time of 23 years was witnessed in the last 30 years. The 200,000 mark was reached just in 25 years after the first 100,000. But with efforts of the population control program, the trends started to change and the growth rate dropped and was sustained. The last population and housing census in the year 2000 revealed that today's population of the Maldives stands at 270,101 with a population growth rate of 1.9 percent. By the year 2000, the population of Male' had reached to 74,069 with a population density of about 37,035 people per square kilometer. Life expectancy has significantly increased from 50 years in 1980 to 70 years in 1995.

The Crude Death Rate (CDR) has declined sharply from 14 per thousand in 1978 to 4 per thousand in 2000, as result of improved health services and the control of communicable diseases. During the '70s, there was a marked difference between the mortality rates in the atolls and Male'. However, this difference has reduced to just a few percentage points by year 2000 due to improved services in the atolls. Childhood deaths contribute to a large proportion of the overall mortality. The Infant Mortality Rate (IMR) declined from 120 per thousand live births in 1977, to 30 per thousand live births in 1994. Thereafter, during the five years, it has further declined, though the rate of decline is slow. In the year 2000 the IMR stands at 21 per thousand live births.

Grade 2 (visible) goiter

STATUS OF IDD IN MALDIVES

IDD is a public health problem in the Maldives. An earlier study conducted in 1995 in school-aged children documented a prevalence of goiter as 23.6% and median UIE of 67 mcg per liter. The UIE data indicated mild iodine deficiency while total goiter rate (TGR) data indicated moderate iodine deficiency in the country.

A recent Multiple Indicator Cluster Survey (MICS) data collected in 2001 revealed that only 44% of the total population surveyed was consuming iodized salt with the adequate iodine content of 15 ppm and more.

ASSESMENT OF IDD IN MALDIVES

The present study was conducted to collect the data after a gap of 6 years on the prevalence of IDD in the country to facilitate the Maldives to assess the status of IDD and initiate intervention activities to prevent IDD if required.

OBJECTIVES

The objectives of the study were:

1. To assess the prevalence of IDD utilizing the 30 cluster approach
2. To estimate the iodine content of salt consumed by population

METHODOLOGY

The "EPI-30 cluster" sampling methodology and IDD indicators as recommended by the joint WHO/UNICEF/ICCIDD were utilized for the survey.

Children in the age group of 6-12 years were considered for the present study. School children in this age group are recommended for the assessment of IDD because of their combined high vulnerability to disease, representativeness of their age group in community and easy accessibility. The school enrollment in primary classes was more than 90% and hence the school approach was adopted. The sample size of children to be surveyed was calculated with a presumption that the prevalence of goiter at the time of the survey was 10%. The confidence level of 95%, relative precision of 20% and design effect of 3 was considered for calculation of sample size. Utilizing these parameters, a sample size of 2592 was obtained. The country has a total of 232 primary schools. All the primary schools with their respective enrollment were enlisted. A total of 30 clusters (school units) were selected using probability proportionate to size cluster sampling procedure.

Salt and urine collection for testing iodine content

In each identified school unit (cluster) at least 90 children were surveyed. If the sample could not be covered in one school, the adjoining school was included to complete the sample of a cluster. In each class, the children were briefed about the study objectives. Verbal consent of parents was taken for the participation in the study. Subsequently, the

Among the study population the prevalence of goiter was found to be 25.6% moderate (grade 1) and 0.1% severe (grade 2) goiter, resulting in a TGR of 25.7%.

children between 6-12 yrs of age were identified with the help of school records for inclusion in the study. An attempt was made to study an equal number of children in each age of 6 to 12 years. The clinical examination for goiter was done by investigators specially trained for the survey. Grading of goiter was done according to the criteria recommended by the joint WHO/UNICEF/ICCIDD (grade 0= no goiter; grade 1= thyroid palpable but not visible; and grade 2 = thyroid visible with neck in normal position). When in doubt, investigators were asked to record the immediate lower grade. The results were recorded in a pre-designed questionnaire. The sum of grades 1 and 2 provided the TGR in the study population.

Table 1a: Age-wise distribution of children

Age	No. of children	Percentage
6	474	13.5
7	523	14.9
8	219	14.8
9	624	17.8
10	567	16.2
11	803	22.9
Total		

On the spot urine samples were collected from a minimum of 30 children in each cluster in screw capped plastic bottles. Iodine was determined by the wet digestion method. The results were expressed as mcg iodine/ liter. The severity of IDD based on the median UIE levels was done according to the criteria of WHO/UNICEF/ICCIDD.

In each cluster, a minimum of 30 salt samples were collected from the same children who provided the urine sample. The subjects were asked to bring about 20g of salt in auto seal polythene pouches, which was routinely consumed in their respective homes. The iodine content of the salt was estimated by the idometric titration method.

Table 1b: Sex-wise distribution of children

Age	Male	Female
6-7	500	497
8-9	555	588
10-11	688	682
Total	1743	1767

In each of the cluster, one focus group discussion (FGD) was conducted with the women on different aspects of use of iodized salt.

Discussions were also held with officials of the State Trading Organization (STO) and the salt importers to assess the procurement and distribution system of salt in the country.

RESULTS

A total of 3510 school children in the age group of 6-12 years were included for the study. The children were evenly distributed among age groups. The male:female ratio was nearly 1:1 (Table 1a and 1b).

Among the study population the prevalence of goiter was found to be 25.6% moderate (grade 1) and 0.1% severe (grade 2) goiter, resulting in a TGR of 25.7%. There is however a large difference between the different clusters ranging from 10% to 46% (Table 2). No significant difference was found in goiter prevalence amongst the male and female children .

Table 2: Total Goiter Rate (TGR) in each of the selected clusters

Cluster	No. of children surveyed	Grade 0		Grade 1		Grade 2		Total Rate	Goiter
		n	%	n	%	n	%	n	%
1	116	92	79.0	24	20.7	0	0.0	24	20.7
2	124	84	68.0	40	32.3	0	0.0	40	32.3
3	146	111	76.0	35	24.0	0	0.0	35	24.0
4	151	120	79.0	31	20.5	0	0.0	31	20.5
5	177	143	81.0	34	19.2	0	0.0	34	19.2
6	151	120	79.0	31	20.5	0	0.0	31	20.5
7	93	73	78.0	20	21.5	0	0.0	20	21.5
8	90	71	79.0	19	21.1	0	0.0	19	21.1
9	95	65	68.0	30	31.6	0	0.0	30	31.6
10	111	74	67.0	37	33.3	0	0.0	37	33.3
11	100	77	77.0	23	23.0	0	0.0	23	23.0
12	108	70	65.0	37	34.3	1	0.9	38	35.2
13	90	81	90.0	9	10.0	0	0.0	9	10.0
14	120	95	79.0	25	20.8	0	0.0	25	20.8
15	91	73	80.0	18	19.8	0	0.0	18	19.8
16	106	57	54.0	47	44.3	2	1.9	49	46.2
17	139	94	68.0	45	32.4	0	0.0	45	32.4
18	284	251	88.0	33	11.6	0	0.0	33	11.6
19	99	76	77.0	23	23.2	0	0.0	23	23.2
20	90	65	72.0	25	27.8	0	0.0	25	27.8
21	109	65	60.0	44	40.4	0	0.0	44	40.4
22	113	83	73.0	30	26.5	0	0.0	30	26.5
23	90	62	69.0	28	31.1	0	0.0	28	31.1
24	114	79	69.0	35	30.7	0	0.0	35	30.7
25	107	68	64.0	38	35.5	1	0.9	39	36.4
26	103	72	70.0	31	30.1	0	0.0	31	30.1
27	104	78	75.0	26	25.0	0	0.0	26	25.0
28	96	68	71.0	28	29.2	0	0.0	28	29.2
29	101	74	73.0	27	26.7	0	0.0	27	26.7
30	92	65	71.0	27	29.3	0	0.0	27	29.3
Total	**3510**	**2606**	**74.0**	**900**	**25.6**	**4**	**0.1**	**904**	**25.7**

The age wise goiter prevalence has been depicted in table 3, and depicted in Figure 1. The TGR is slightly lower among the 6-year-old children compared to the other age groups.

The results of the analyses of the iodine content of the salt samples taken to school by the study population are shown in Table 4. Out of all the salt samples collected 67.3% had iodine content above15 ppm (28.4% nil and 4.2% <15). Again a large difference between the various clusters was observed: In some clusters only 3% of the samples did not contain iodine, whereas in other clusters this percentage was as high as 68.

The results of the two types of analytical methods used for determination of the iodine content of the salt samples are shown in Table 5. Samples brought to school by almost all of the children were tested with the help of spot testing kit in the school premises. An extra salt sample from the children whose urine was tested was taken and analyzed with the help of idometric titration in the Public Health Laboratory (PHL). The table shows that using the spot testing kit resulted in a higher percentage of samples with no iodine compared to analysis at the PHL (28.4% vs 9.8%).

The median UIE was 115 ppm, but ranged from 52.5 to 210 mcg/l (Table 6). One hundred mcg/l is considered to be an adequate level. A closer look at the UIE levels in

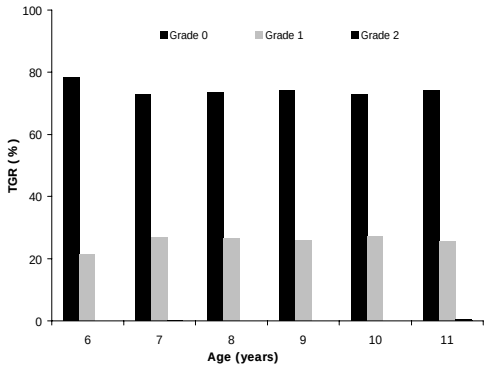
children shows that 5.5% of the children had UIE levels of < 20.0, 12.5% between 20.0 - 49.9 and 25.1% of the children had UIE levels between 50.0 - 99.9 mcg/l. About 56.9% samples had UIE levels 100 mcg/l and more (Figure 2).

Table 3: Age-wise prevalence of goiter (%)

Goiter Grade	Age (years)					
	6	7	8	9	10	11
0	78.5	72.8	73.4	74.2	72.8	74.2
1	21.5	27.0	26.6	25.8	27.2	25.4
2	0.0	0.2	0.0	0.0	0.0	0.4

To get a better insight into IDD prevalence in the different clusters the data on TGR, iodine content of salt used by the study population and UIE for the different clusters were combined. Table 7 depicts the TGR, iodine content of salt and median UIE and percentage samples with UIE levels above 50 mcg/l in each of the 30 clusters. Sorting the data according to percentage of samples with a UIE <50 mcg/l shows that the three clusters with the highest percentage of very low UIE output are nr. 11, 8 and 10, all located in the northern region. Figure 3 depicts the distribution of the three IDD parameters in the different regions. It shows that although the TGR is not very different between the regions, the use of salt with low iodine content and the percentage of urine samples with low iodine content vary widely. The use of salt with less than 15 ppm iodine is the lowest in the south central region and the highest in the south. UIE with less than 50 mcg/l of iodine is the highest in the North and the lowest in Male' region. Table 7 also shows that the three different IDD parameters (TGR, iodine content of salt used and UIE) are not closely linked. Indeed in most of the clusters where the percentage of samples with a UIE <50 mcg/l is high, also TGR and percentage of salt samples with <15 ppm is high, but a high TGR (32%) was observed in a cluster (no.2) with a rather low percentage (5.9) of samples with a UIE <50 mcg/l.

Figure 1: Prevalence of goiter according to age



Comparison between the present survey and the MICS 2 shows that in the present survey a lower percentage of salt samples with nil iodine was found (Table 8). The present study was also compared with the IDD survey of 1995. The 1995 study covered only 7 Atolls (2834 children), compared to 16 in the present one (3510 children). Age and sex distribution was similar between the 2 studies. Also age and sex wise TGR were nearly the same. In the 1995 study no UIE levels were measured.

Results of FGD

Table 4: Iodine content of salt samples, expressed as % of total samples

	Iodine content (ppm)		
Cluster	Nil	<15	>15
1	14.0	19.0	67.0
2	20.0	2.0	78.0
3	21.0	4.0	75.0
4	15.0	11.0	74.0
5	27.0	1.0	71.0
6	14.0	4.0	82.0
7	4.0	0.0	96.0
8	32.0	3.0	65.0
9	13.0	2.0	86.0
10	68.0	0.0	32.0
11	67.0	0.0	33.0
12	26.0	0.0	74.0
13	11.0	0.0	89.0
14	14.0	1.0	85.0
15	49.0	1.0	50.0
16	33.0	0.0	67.0
17	44.0	7.0	49.0
18	18.0	0.0	82.0
19	45.0	9.0	45.0
20	9.0	6.0	85.0
21	38.0	2.0	60.0
22	4.0	4.0	93.0
23	73.0	17.0	14.0
24	50.0	14.0	36.0
25	50.0	11.0	39.0
26	35.0	5.0	60.0
27	3.0	3.0	93.0
28	3.0	2.0	95.0
29	25.0	0.0	75.0
30	25.0	4.0	71.0
Total	28.4	4.2	67.3

The results of the FGD have been described in Table 9. The major findings were as follows:

1. The majority of women were aware about iodized salt.
2. The majority of women were aware about the advantages of iodized salt particularly the role iodine in IQ development.
3. The majority of women were using both types of salt. Powdered salt was used for recipes in which small quantities of salt were used while crystalline salt was used in recipes requiring large quantities of salt, like fish cooking.
4. The main reason for using crystalline salt by women was because it was cheap.
5. The majority of women mentioned that they would use only powdered salt if it were made available at the same price as crystalline salt.
6. The majority of women mentioned that the source of information about the use of iodized salt was Radio followed by Health workers.
7. The findings of FGD indicated that the women were aware about the benefits of Powdered Iodized Salt, however they continued to use both the powdered salt and crystalline salt.
8. There was no resistance for use of iodized salt by women in all the clusters.

Status of Procurement and Distribution of Salt

It was found that no salt was produced in the country and there is only one port through which all salt for the country is imported. The salt was only used for either human consumption or in fish processing industries. There was no other industrial use of salt in the country.

Table 5: Iodine content of salt as measured with spot testing kit & idometric titration

Iodine content	Spot Testing Kit		Idometric Titration	
(ppm)	n	%	n	%
Nil	659	28.4	93	9.8
<15	97	4.2	265	27.9
>15	1562	67.4	591	62.3
Total	2318	100	949	100

There were only two types of salt which were imported by the traders namely 1) refined powdered salt (iodized) packed in the LDPE pouch in 500g and 750 g packaging and 2) crystalline salt (non iodized) in HDPE bag in 50 kg packaging.

Table 6: Median Urine Iodine Excretion (UIE)

Cluster	UIE (mcg/l) median
1	187.5
2	210
3	210
4	197.5
5	210
6	127.5
7	200
8	52.5
9	115
10	57.5
11	60
12	90
13	100
14	190
15	82.5
16	92.5
17	92.5
18	137.5
19	112.5
20	132.5
21	75
22	100
23	55
24	71
25	67.5
26	160
27	140
28	85
29	122.5
30	120

The whole sale price of crystalline salt was about Rf 35 per 50 kg i.e. Rf 0.75 per kg and for powdered salt (table salt) was about Rf 2.5 per 500 g i.e. Rf 5 per kg, which means that powdered salt is around 6.5 times as expensive as crystalline salt.

The STO was earlier importing salt and selling it to the consumer. However, since year 2000, STO has stopped the importation of salt due to administrative reasons.

It was found that at the island level, there were no storage depots for salt and other food commodities. The private traders procured salt and other commodities as per their requirements from Male'. Generally each of the retail traders stored a supply of 3-4 weeks with them.

It was found that there were 6 major importers of iodized salt in the country. Each importer procured both type of salt i.e. crystalline salt and powdered salt. The major countries from which crystalline salt was imported were India, Singapore, UAE, Australia and Thailand. The major countries from which powdered salt was imported were Singapore, Thailand, India, and UAE.

The total quantity of crystalline salt imported during 1998, 1999 and 2000 was 57,35,327 kg while only 6,02,046 kg of table salt/ powdered salt was imported. This finding indicates that more quantity of crystalline salt was imported to the country as compared to powdered salt. Looking at the totals over the different years reveal that although the import of crystalline salt has not changedmuch, the import of powdered salt has almost tripled over these 3 years (from 94,965 kg in 1998 to 279,884 kg in 2000).

Focus group discussion

Information, Education and Communication (IEC) Activities

Ministry of Health (MoH) conducted IEC activities on IDD through following channels:

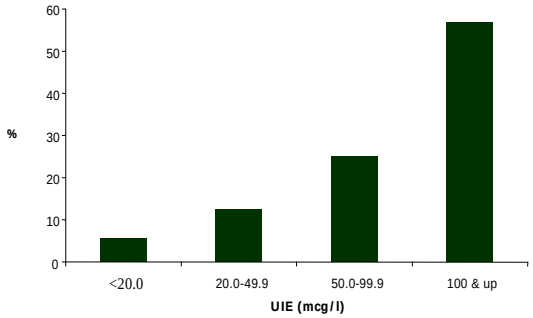
1. Posters
2. Leaflets
3. Radio talk/clips/songs/drama

4. Messages on TV
5. Advocacy meetings

Public Health Laboratory

It was found that PHL in Male' is well equipped to undertake the estiomation iodine content in salt by idometric titration method. However, although the staff at PHL were found to be comeptent to undertake these tests, a lack of adequate training was found to exist.

Figure 2: UIE levels among the study population



Faculty of Health Sciences

It was found that faculty of health sciences provided orientation and training on IDD to the functionaries service providers during the job training course and in service upgrading courses organized for community health worker, family health worker, traditional birth attendants (TBA) and primary health care workers.

Table 7: TGR of the children, iodine content of salt used in the households & UIE levels of the surveyed children, arranged according to severity (low levels) of UIE

Cluster		TGR (%)	% of households using salt with iodine content < 15 ppm	Median UIE of children in that cluster	% of children with UIE <50 mcg/l
Island	Atoll				
Kanditheemu	Sh	23		60	
Thakandhoo	Ha	21	67	52.5	45.2
Kumundhoo	HDh	33	35	57.5	43.8
Dhiyamigili	Th	31	68	55	43.3
Dhiggaru	M	40	90	75	36.7
Maavah	L	31	40	71	30
Maakandoodhoo	Sh	35	64	90	30
Fuvahmulah	Gn	29	26	85	29
Kunahandhoo	L	36	5	67.5	28.1
Kulhudhufushi	HDh	32	61	115	23.3
Dharavandhoo	B	46	15	92.5	22.6
Thinadhoo	GDh	25	33	140	21.9
Inguraidhoo	R	20	6	82.5	21.9
Kudarikilu, Maalhos	B	32	50	92.5	20
Male'	Male'	19	51	210	20
Kudahuvadhoo	Dh	27	28	100	16.7
Maamigili	ADh	28	8	132.5	16.7
Hanbadhoo	N	10	15	100	14.3
Maafushi	K	23	11	112.5	13.3
Male'	Male'	21	54	127.5	13.3
Hithadoo	S	27	18	122.5	10
Naifaru	Lh	12	25	137.5	9.4
Dhidhdhoo	Ha	22	18	200	7.5
Male'	Male'	32	4	210	7.1
Male'	Male'	21	22	187.5	5.9
Hithadoo	S	29	33	120	3.3
Kanduhulhudhoo	Ga	30	29	160	3.2
Male'	Male'	24	40	210	3
Male'	Male'	21	25	197.5	0
Kandholhudhoo	R	21	26	190	0
			15		0

Discussion

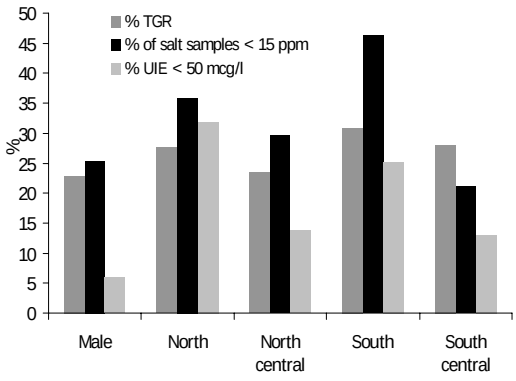
It has been recommended that if more than 5% school age children (6-12 yrs) are suffering from goiter, the area should be classified as endemic to iodine deficiency. In the present study, a total goiter prevalence rate of 25.7% was found, indicating that moderate iodine deficiency exists in the country. An earlier study conducted in Republic of Maldives in 1995 revealed a goiter prevalence of 23.6%, showing that the TGR has not changed over the last 7 years. It should however be noted that goiter takes a while to

Table 8: Percent distribution of households by iodine content of salt used for cooking, according to region for the MICS 2001 and IDD 2002 surveys

Region	MICS II Survey 2001			IDD Survey 2002		
	Iodized		Not Iodized	Iodized		Not Iodized
	<15 ppm	>15 ppm		<15 ppm	>15 ppm	
Male	5.7	68.7	19.7	7.2	74.3	18.5
North	2.4	30.5	63.3	0.7	63.5	35.8
North central	2.2	36.6	58	1.4	72.7	25.8
South	1.5	58.3	26.7	2.5	80.4	17.2
South central	2.4	33.5	54.3	9	52.1	39.4
Total	**2.7**	**44.1**	**45.7**	**4.2**	**67.3**	**28.4**

disappear, which means that although biochemical iodine deficiency might be on the decrease, TGR will follow only later. This phenomena indeed seems to be the case in the Maldives since the median UIE level of the children studied was found to be 115 mcg/l, indicating that there was no overall biochemical iodine deficiency in the population studied. Although on a national level no biochemical IDD was found it should be noted that 43% of the children had UIE levels below the borderline of 100 mcg/l. Moreover, one-third of the households were using salt with iodine content below the recommended amount of 15 ppm, indicating that IDD is far from eradicated from the Maldives.

Figure 3: IDD parameters in different regions



Large differences concerning the different parameters were observed between the clusters and regions. The 3 clusters with the highest percentage of urine samples with UIE < 50 mcg/l (above 40%) were located in the north. However, the highest percentages of households using salt with less than 15 ppm of iodine were found in the south (fig. 3). This again indicates that the different IDD parameters show different results concerning 'Iodine status' of the population. Yet, looking at figure 3 and considering elimination of IDD from the country, special attention should be paid to the south and north of the country, the areas the most far away from the capital Male'.

Comparing the present study with the IDD survey of 1995 shows that the recent one is more representative as compared to earlier study, since it included more atolls and the number of children studied was larger. The discrepancy observed for the iodine content of salt used among the population between the MICS 2001 and the present report (not iodized 45.7% in the MICS and 28.4% in the IDD survey) might possibly be explained by the fact that the MICS was a household survey, while in the IDD 2002 survey the salt samples were collected from schoolchildren, who probably were biased to what type of salt to bring (see section 'constraints of the study').

The results of the FGD show that most of the women were aware about the benefits of iodized salt compared to crystalline salt, but that one of the reasons not to use it all the time was the higher price compared to crystalline salt. Indeed powdered salt is around 6.5 times as expensive as crystalline salt. It was said that powdered salt would be bought if it were available at the same price as crystalline salt. On the other hand looking at all the other expenditures made by a family, the amount spend on salt will be very small, even if powdered salt would be purchased. Therefore future action should rather be taken in the field of IEC activities, compared to reduction of the price of powdered salt. If people are really convinced of the benefits of powdered salt (e.g. better performance, especially of their children) they are most probably very willing to spend just a little bit more money on salt. Yet, it seems that IEC activities have borne fruit over the last couple of years, which may be concluded from the fact that the import of iodized salt has tripled over the period 1998-2000. On the other hand one may wonder if this salt has reached the Maldivian population or that is has gone to the resorts. Another way to eliminate IDD across the country is the universal iodisation of salt, meaning that only iodized salt is available to the public.

CONCLUSIONS

In the present study, a moderate goiter rate of 25.6% was found, indicating a moderate iodine deficiency among the population of the Republic of Maldives. However, no overall biochemical iodine deficiency was observed since the median UIE of the children studied was found to be 115 mcg/l, indicating that the population of Republic of Maldives is possibly going through a transition phase from iodine deficient to iodine sufficient. Yet, there exist a large inequality for the various IDD parameters across the country showing an urgent need for more awareness on IDD and ensuring universal salt iodisation in the country so that the IDD can be eliminated.

Constraints Of The Study

The study population was informed in advance by Ministry of Education (MoE) through Radio, TV, Newspapers and by the island/cluster level health workers about the IDD survey to be conducted. As the study was school based, there is a possibility that higher percentage of children might have brought the powdered salt for the testing in schools (and not the crystalline salt, although both the type of salt were available in the family). The families could have adopted a biased approach by bringing powdered salt and getting it tested. This may be because mothers were aware about the IDD survey and

about the benefits of iodized salt. However, it is very unlikely that UIE was affected because the children would just have consumed more of the powdered salt compared to crystalline salt than usual, and goiter grade definitely will not have been affected by short-term changes in the consumption of the type of salt.

Since only school children were enrolled in the present study, the small percentage of children who are not attending school were left out. They may however be the most vulnerable group and if these children had been included TGR might have been higher and median UIE level lower.

RECOMMENDATIONS

Immediate Measures

1. Government should develop a National Plan of Action (NPA) for elimination of IDD from the country and it should be incorporated in the health master plan.

2. No salt is produced in the country and there is only one port through which all salt for the country is imported. The Maldives should immediately notify through a legislation that for human consumption only iodized will be permitted in the country with a minimum level of 30 ppm iodine at the point of entry in to the country (This level of iodine has been suggested keeping in view of scientific evidence and the climatic conditions of the country and with presumption that even after the 50% losses of iodine during transportation and storage, between point of import to the point of consumption, the beneficiary would receive the salt with at least 15 ppm of iodine). The customs official should also be issued the instruction that all consignments of POWDERED SALT for human consumption should be accompanied with a certificate from the manufacturers that the imported salt is iodized salt and have minimum of 30 ppm of iodine at the port of entry. A-select samples from the imported needs to be tested at the PHL.

Short term Measures

1. There is no industrial use of salt except for the salt used in fish industry. Ideally this salt should also be iodized. However, if the technical constraints do not permit the use of iodized salt in the fish industry then an official regulation

should also be passed that the salt for fish industry would be permitted to be imported in a specific color bag so that beneficiaries from salt for the human consumption can identify it separately.

2. Conducting orientation and training on health consequences of IDD at the national and regional level to create awareness amongst the different sectors and agencies who have a role in the IDD prevention activities like Health, Education, Information, Customs, Women Affairs & Social Security etc, voluntary organizations, salt traders, salt importers, transporters etc.

3. Establishment of regular management information system (MIS) to monitor quality of iodized salt. At present the salt samples are collected and sent to PHL by Department of Public Health, however this system is not regular. This system needs to be further streamlined.

4. Implementation of intensive IEC activities to create awareness about benefits of iodized salt. The main thrust should be on IDD and it's impact on loss of IQ amongst the school age children. Radio talks were found to be one of the most common source of information for the women as revealed in the FGD conducted during the survey. Hence radio talks should be more frequently utilized for advocating consumption and use of powdered salt and to avoid the use of crystalline salt for the cooking, as it does not contain any iodine. There is a need for dubbing or producing videocassettes on IDD in Dhivehi. A number of IEC materials on IDD have been developed by the SAARC countries. These may be brought in and adapted for use in the country.

5. Strengthening PHL to undertake the assessment of UIE level.

6. Development of national technical expertise in the field of IDD by deputing the senior health scientists to short-term international training courses organized by agencies.

7. Developing an inventory of salt importers in the country and interact with them regularly to motivate them to bring only iodized salt to the country.

8. Study procurement and distribution of iodized salt, so that the areas requiring strengthening can be identified to ensure that an adequate quantity of iodized salt is imported for human consumption.

9. Study the possible impact of use of iodized salt on the change of color of fish during processing if any. The findings can further help to increase the importation of iodized salt to a 100% in the country.

Long term Measures

Regular monitoring of UIE levels in the country amongst school age children every three to five years to monitor the progress achieved towards elimination of IDD from the country.

Exploring the possibility of import of the salt for human consumption through STO under Maldives to ensure availability of iodized salt to population at an economical price.

REFERENCES

1. Vir S. Universal Iodisation of salt: a mid decade goal. In: Nutrition in Children Developing country concerns. Eds. Sachdev HPS and Choudhary P. Cambridge Press, New Delhi, 1994, pp 525-535.

2. Pandav CS. Iodine deficiency disorders in Maldives - a report 1995. Department of Public Health, Ministry of Health, Republic of Maldives and UNICEF, Maldives

3. Multiple Indicator Cluster Survey (MICS 2) Maldives, Ministry of Health, Republic of Maldives, September 2001

4. Assessment of IDD and monitoring their elimination: a guide to the programme managers. Second edition ICCIDD/UNICEF/WHO. World Health Organisation, Geneva, 2001.

5. Dunn JT, Crutchfield HE, Gutekunst R, Dunn D. Methods for measuring iodine in urine. A joint publication of WHO/UNICEF/ICCIDD 1993, 18-23.

6. Kapil Umesh, Bhanti T,Saxena N, Nayar D, Dwivedi SN. Comparision of spot testing kit with iodometric titration method in the estimation of iodine content of salt. Indian J Physiology Pharmcol 1996,40: 279-280

7. Mary Manandhar UNICEF Consultancy Trip Report. Republic of Maldives.

APPENDICES

APPENDIX 1

Criteria for selection of study population for IDD survey

The WHO-UNICEF-ICCIDD group has critically reviewed the advantages and disadvantages of undertaking an IDD survey in potential target groups.

Keeping in view the operational feasibility and vulnerability to the clinical manifestations of iodine deficiency, the group recommended that children in the age group of 6-12 yrs should be included.

Framework for considering target groups for IDD surveillance

	Vulnerability	Representativesness*	Accessibility
Newborns	High	Intermediate	
Preschool children in MCH clinics	High	Intermediate	High
Preschool children in households	High	High	Intermediate
Children in schools	High	Intermediate	High
Pregnant women in MCH clinics	High	Intermediate	High
Adult women in households	Intermediate	Intermediate	Intermediate
Adult men	Intermediate	Low	Low

* Level of representativeness depends on access or coverage

APPENDIX 2

Criteria used for Calculation of Sample Size

i) Prevalence of goiter 10%

ii) Confidence level 95%

iii) Relative precision 20%

Sample to be covered = 864

iv) For goiter assessment by PPS 30 cluster sampling methodology, a design effect 3 has been recommended

864 x 3 = 2592

Therefore number of subjects per cluster was = 2592/30 = 86

APPENDIX 3

PPS Sampling Methodology

The sample population to be studied were selected using probability proportional to size cluster method, which was as follows:

i) All the primary schools in Maldives were enlisted. This information was obtained from the Ministry of Education, Maldives.

ii) Against the name of each Primary school the corresponding enrollment was written and also the cumulative population was calculated.

iii) The sampling interval was calculated using the following formula.

Sampling interval = Total cumulative population /Number of clusters to be studied

(i.e.30) In Maldives, the total primary schools population was 59,418

The sampling interval was = 59,418/30 = 1981

A random number of was selected between 00001 and 1981, It was 86 in present case

Cluster 1: The first cluster was selected where 86th individual was found, based on the cumulative population column. In the present case, it was in the school number two with cumulative population 2067. This primary school was identified as cluster 1.

Cluster 2: 2067 + sampling interval (i.e. = 2067 + 1981 = 4048).The second cluster was identified where the 4048th individual was found in the cumulative population column. In the present case it was in the school number three. This primary school was identified as cluster 2

Cluster 3: Subsequent cluster were selected using the above procedure

APPENDIX 4

Method of Examination of Thyroid size/Goiter

The thyroid size was assessed by palpation method, which was conducted as below: -

Palpation method: -

For examination of goiter, the examiner should stand or sit facing the subject, placed his two thumbs on either side of the subject's windpipe several centimeters below the notch of thyroid cartilage (the "Adam's Apple") and roll his thumb gently over the thyroid, which lies next to windpipe.

If each lobe of the thyroid is smaller than the part of the subject's thumb beyond the last joint (the "terminal phalanx"), the thyroid will be classified as grade 0, no goiter. If each lobe is larger than the terminal phalanx of the subject's then, he or she has goiter.

Classification of Goiter

Grade 0: No palpable or visible goiter

Grade 1: A mass in the neck that is consistent with an enlarged thyroid that is palpable but not visible when the neck is in the normal position. It moves upward in the neck as the subject swallows. Nodular alteration(s) can occur even when the thyroid is not enlarged.

Grade 2: A swelling in the neck that is visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated.

APPENDIX 5

Epidemiological criteria for assessing the severity of IDD based on median urinary iodine levels.

Median value (mcg/l)	Stage of IDD
< 20	Severe
20-49	Moderate
50-99	Mild
> 100	No deficiency

Epidemiological criteria for assessing the severity of IDD based on the prevalence of goiter in school-aged children.

Prevalence of goiter (TGR)	IDD
5-19.9%	Mild
20-29.9%	Moderate
>30%	Severe

APPENDIX 6

Points for focused group discussions

Are you aware about the iodized salt?

What are the advantages of iodized salt?

Which type of salt do you use

Crystalline type

Powdered

If CS is used

4. Why do you prefer crystalline salt : enlist the reasons

Cost

Availability

Traditional

Any other specify

Will you buy the Powdered salt if it is made available at the same price as crystalline salt?

What was the source of information about the use iodized salt to you

TV/Radio/News paper/Health workers/doctors/IEC Pamphlets, Posters on IDD

APPENDIX 7

Major Brands of Salt Available with Retail Traders

1. Name Moon Star
   Cost Rf 3.5
   Packaging 500g
   Country of Import Singapore
   Iodine content Not mentioned

2. Name Moon Star
   Cost Rf 3.5
   Packaging 500g
   Country of Import Singapore
   Iodine content Not mentioned

3. Name Al Jameel
   Cost Rf 7
   Packaging 750g
   Country of Import Sharjah
   Iodine content Not mentioned

4. Name Refina
   Cost Rf 3
   Packaging 500g
   Country of Import Indonesia
   Iodine content 30- 80 ppm

5. Name Santa Cook
Cost Rf 3
Packaging 500g
Country of Import Singapore
Iodine content 50 ppm

6. Name Diamond
Cost Rf 3
Packaging 500g
Country of Import Not mentioned
Iodine content 30 ppm

7. Name Kapal
Cost Rf 3
Packaging 500g
Country of Import Indonesia
Iodine content 30–80 ppm

APPENDIX X

List of senior officials with whom scientific discussions were conducted:

1. Mr. Ibrahim Ismail Ali
HURBERT H. HUMPHREY FELLOW
Director General, Educational Management
Secretary general, National Olympic Committee
Secretary Football Association of Maldives
Ministry of Education
Male'
Republic of Maldives

2. Mr. MOOSA ANVER
DIRECTOR
PUBLIC HEALTH LABORATORY
MINISTRY OF HEALTH
Male'
Republic of Maldives

3. DR. ABDUL AZEEZ YOOSUF
Director General of Health Services
Ministry of Health, Male', Republic of Maldives

4. Dr. Sheena Moosa, House Officer
MINISTRY OF HEALTH
Planning, Information, & Research
Ameenee Magu,
20-03, Male'
Republic of Maldives