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# GUIDELINES FOR A NATIONAL PROGRAMME FOR THE CONTROL OF IODINE DEFICIENCY DISORDERS IN THE EASTERN MEDITERRANEAN REGION

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In the Name of God, the Compassionate, the Merciful

## FOREWORD

by

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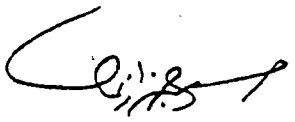
Although endemic goitre and cretinism have been known for decades, the true nature of the ravages effected in the human body by iodine deficiency has been revealed only recently. Disorders due to environmental iodine deficiency include a spectrum of conditions, from goitre, through a broad range of mental and physical disabilities, to cretinism. It is ironic that, in spite of the availability of cheap, relatively simple and tested control technologies, the problem of iodine deficiency disorders continues unabated in the world.

It is a matter of particularly grave concern to me that at least seven countries in the Eastern Mediterranean Region have areas with alarming prevalence of iodine deficiency disorders. Urgent, concerted action is needed to reverse this tragic situation yet not one country has undertaken a national prevalence survey to define the precise extent and magnitude of the problem.

WHO has given high priority to national activities for the control of iodine deficiency disorders within the framework of the Global Strategy of Health for All by the Year 2000. In December 1987 an Intercountry Consultation on the Control of Iodine Deficiency Disorders, with experts from seven countries, was convened at the Regional Office for the Eastern Mediterranean in Alexandria in order to exchange experiences and develop guidelines that might assist countries in mounting national control programmes. This booklet is the outcome of that consultation and I am confident that it will be of considerable help to those Member States who are plagued with this problem and seek to undertake corrective measures.



# PREFACE

There are a number of countries in the Eastern Mediterranean Region in which iodine deficiency disorders pose a major public health problem in certain localized areas. The problem of endemic goitre at least has been known for decades in these countries but, unfortunately, not one has a functioning national programme for the control of goitre or of iodine deficiency disorders in general.

The sinister effects of iodine deficiency have been recognized only in recent years, leading to renewed interest in their control and in correcting the imbalance caused in the body by lack of iodine in the environment. The Intercountry Consultation on the Control of Iodine Deficiency Disorders, held in December 1987 at the Regional Office in Alexandria, had as its main objective the development of simple guidelines to assist policy-makers, senior health administrators and technical managers in developing and implementing a national programme for the control of iodine deficiency disorders. This publication is the outcome of the collective thinking that resulted from the Consultation. Wherever necessary, background information, required for decision-making and for technical management, has been included. In general, the booklet provides information which will acquaint governments with the precise nature of the problem, its causes and the steps that can be undertaken to tackle it, including possible sources of external support.

The booklet was prepared by Dr Kalyan Bagchi, WHO Consultant in Nutrition, and Dr Habib Rejeb, Regional Adviser, Nutrition, WHO Regional Office for the Eastern Mediterranean, both of whom also participated in the Consultation.

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## Chapter I

## THE PROBLEM

### I – 1. DANGERS OF IODINE DEFICIENCY DISORDERS

The term Iodine Deficiency Disorders (IDD) covers a wide variety of clinical conditions affecting the health and well-being of man, starting in early foetal life and continuing through adulthood. At the relatively benign end of the spectrum is the widely prevalent condition of goitre, while at the opposite end is the relatively uncommon syndrome of cretinism. These conditions are caused by a deficiency of iodine, a trace element essential for the formation of thyroxine, the hormone of the thyroid gland. The daily requirement of iodine is, really, extremely small, ranging between 120 and 150 micrograms (ug) per day (1000 microgram = 1 milligram); nevertheless there are many areas of the world which are environmentally deficient in iodine and this deficiency is passed on through soil and water and, consequently, all local foodstuffs (see §I – 3). Table 1 shows the major manifestations of iodine deficiency at different stages of life.

TABLE 1. IODINE DEFICIENCY DISORDERS AT DIFFERENT STAGES OF LIFE

| LIFE STAGE | MAJOR DISORDERS |
|---|---|
| Foetal and infancy | Abortion, still birth, congenital anomalies, increased infant and perinatal mortality, psycho-motor defects, deaf mutism, neurological and myxoedematous cretinism, dwarfism, spastic diplegia. |
| Childhood and adolescence | Goitre, retarded physical development, impaired mental function. |
| Adult | Goitre, hypothyroidism, impaired mental function. |

Goitre, an enlargement of the thyroid gland, is the most commonly known manifestation of iodine deficiency. Indeed, even now, iodine deficiency disorders are equated with goitre and, to many, goitre is a cosmetic, not a clinical, problem. Cretinism, the most severe and dramatic manifestation of iodine deficiency, is comparatively rare in its occurrence. Cretinism is characterized by severe mental and physical growth retardation and other neurological and motor disturbances. Deaf-mutism is a common feature of cretinism.

Endemic goitre and cretinism are the two commonly known and visible manifestations of iodine deficiency. However, the number of victims of less well-known and recognized manifestations of iodine deficiency, such as varying degrees of spasticity and mental and growth retardation, spontaneous abortion or still birth, far surpass those with goitre and cretinism; even now this fact is not recognized by political decision-makers and administrators. It is for this reason that a goitre control programme is frequently postponed in many developing countries; it is regarded as a low priority problem. In the Eastern Mediterranean Region, where at least seven countries have high to alarming prevalence, not one country has so far fully implemented a national programme for its control. Efforts so far have been restricted to sporadic ad hoc pilot projects with no follow-up action. Recently Pakistan developed a national iodine deficiency disorder control programme and this is in the process of being implemented in the endemic areas.

## I–2. PREVALENCE IN THE EASTERN MEDITERRANEAN REGION

In many countries of the Eastern Mediterranean Region, endemic goitre has been a familiar contition for decades and yet it has never attracted the particular attention of health administrators, with the result that the alarming prevalence rates in certain regions have continued unchecked. The prevalence of goitre in the Gilgit and Chitral districts of Pakistan was reported by McCarrison as long ago as 1908 [1] and continues unabated to this day.

Results of surveys, published and unpublished, indicate that the Eastern Mediterranean Region may have the largest number of countries (approximately 11 out of 23) in which iodine deficiency disorders pose a public health problem, although the precise extent of the problem in each of these countries is not yet known (Fig.1). Ad hoc surveys in a number of countries indicate high and, in some cases, alarming prevalence of endemic goitre, but no organized national surveys have yet been carried out in any of these countries. It goes without saying that **the absence of any report regarding prevalence of iodine deficiency disorders in a particular country does not presuppose its absence.** It merely confirms that the subject has neither attracted the attention of researchers in that country, nor has it aroused the "nutritional curiosity" of epidemiologists.

A recent review of the prevalence of iodine deficiency disorders in countries of the Eastern Mediterranean Region [2], indicates high rates in regions of Afghanistan, Iran (Islamic Republic of), Iraq, Lebanon and Pakistan. These disorders are also found in restricted areas of Egypt, Libyan Arab Jamahiriya, Morocco, Sudan and

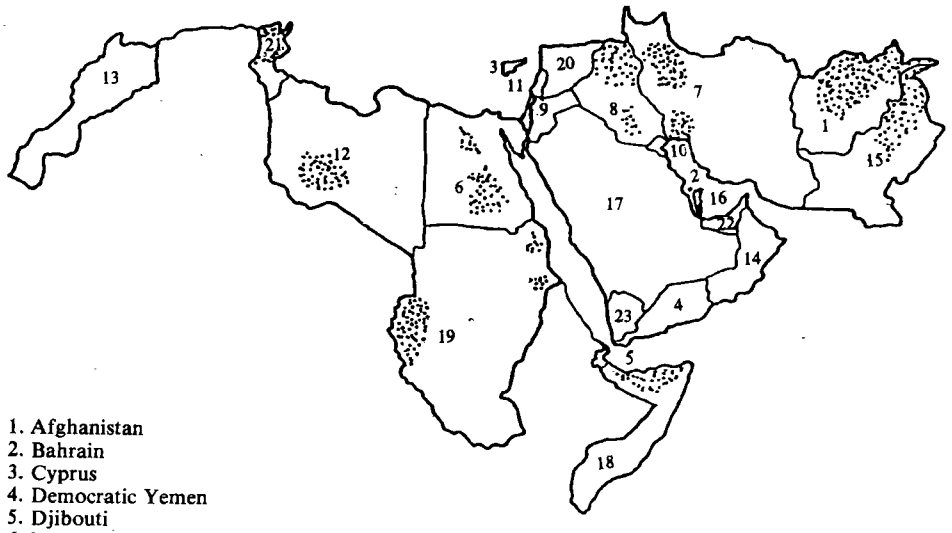


FIG.1. Eastern Mediterranean Region countries and areas reporting prevalence of iodine deficiency disorders.

Tunisia with moderate to high prevalence rates. By a rough assessment, not less than 12 million people are affected by various types and degrees of iodine deficiency disorder in this Region.

The surveys conducted so far in these countries were based on clinical manifestations of iodine deficiency i.e. enlargement of the thyroid gland. They did not take into consideration conditions of sub-clinical hypothyroidism, a mechanism by which the thyroid gland adapts itself to a marginally deficient iodine intake with no manifestation of goitre. Very few studies have been undertaken in these countries to detect neo-natal hypothyroidism. Yet if all these conditions were taken into consideration, the problem of iodine deficiency disorders in the Eastern Mediterranean Region would be seen to be of serious concern requiring the urgent attention of WHO, other international organizations and the Member States concerned.Table 2 summarizes the situation regarding prevalence, areas of endemicity and control measures undertaken in some countries of the Eastern Mediterranean Region.

TABLE 2. SUMMARY OF IDD PREVALENCE, AREAS OF ENDEMICITY AND CONTROL MEASURES IN SOME COUNTRIES OF THE EASTERN MEDITERRANEAN REGION

| Countries | Year of problem recognition | Nature of surveys | Endemic region of the country | Prevalence data | National survey | Measures taken | National control programme |
|---|---|---|---|---|---|---|---|
| Afghanistan | 1966 | Ad hoc surveys planned on data from clinical sources | North-east and south-west regions and along the mountain and banks of Oxus river | 10 – 60% High prevalence – in some regions to about 80% | None | None | None |
| Egypt | 1968 | Ad hoc surveys in several oases | Oases in south-west Egypt | Average of 26% in these areas | None | None | None |
| Iran (Islamic Republic of) | 1960 | Ad hoc surveys among school-children | Highly endemic area south-west of Teheran (Shahryar) | 80% prevalence among school-children in Shahryar | None | None Proposal for salt iodination not implemented | None |
| Iraq | 1965 | Ad hoc surveys in northern region and in Baghdad and Basrah | Northern mountain region bordering Turkey (Mosul) and areas around Baghdad | 60 – 85% in hyperendemic northern area About 30% around Baghdad | None | None Proposal for iodine fortification of sugar and later salt. | None |
| Lebanon | 1960 | Number of surveys among school-children in different regions | Throughout Lebanon | Average 40 – 75% in moutain and hilly regions and about 12% in coastal areas | Planned national survey not done | None | None |

| Countries | Year of problem recognition | Nature of surveys | Endemic region of the country | Prevalence data | National survey | Measures taken | National control programme |
|---|---|---|---|---|---|---|---|
| Libyan Arab Jamahiriya | 1973 | Ad hoc surveys in littoral areas and in southern desert areas. | Endemicity in Fezzan province | 20 – 55% in most areas of Fezzan province | None | Proposals for salt iodination partially implemented in 1980 | Partial |
| Pakistan | 1958 | A large number of surveys in north-east mountain areas and a few in other areas | Alarming prevalence in Gilgit and Chitral. Multan in the riverine plains has high level | 80 – 90% in Gilgit and Chitral. High endemicity in Multan. | None | Two salt iodination plants with limited output Proposal for iodinated oil injection | A national programme being implemented |
| Sudan | 1968 | Ad hoc surveys based on clinical data and impressions | Darfur in Western Sudan. Patches in other areas | 40 – 65% | None | Proposal for salt iodination and iodinated oil injection not implemented | None |
| Tunisia | 1972 | Ad hoc surveys in three geograph-ical regions | North-west mountainous region | 14 – 51% Average of 36% in this region | None | None | None |

## I – 3. MAJOR UNDERLYING CAUSES

### I – 3.1. Iodine deficient soil

Iodine is, in general, naturally present in both foods and water, sea foods are particularly good sources of iodine. However, if the quantity of iodine in the foodstuffs entering the human body is less than the body's requirement, then the result is iodine deficiency in the body itself and high potential for a series of physiological, pathological and clinical disorders.

What makes iodine deficiency different from other nutrient deficiencies (e.g. vitamin deficiency) is that when iodine deficiency disorders are found in a region, then all foods grown and all sources of water in that area are deficient in iodine. In other words, no amount of dietary manipulation will correct the deficiency. Diets consumed by people of different socio-economic levels in that area will all be equally deficient in iodine.

The basic underlying cause of iodine deficiency in foods is a lack of iodine in the soil. Foods grown on such soil are unable to extract adequate quantities of iodine and in turn pass the deficiency on to livestock and humans who live on these. Thus, all vegetable and animal foods are deficient in iodine and water passing through that soil will also be deficient in iodine. What causes such an environmental deficiency?

Usually the upper layers of soil are rich in iodine. As the soil is exposed over thousand of years to ice, snow and heavy rains, the iodine is gradually and continually washed away ("leached out"), into rivers and, ultimately, to the sea which is regarded as the world's store-house of iodine. As a result, all areas on the slopes of hills and mountains have soil that is highly deficient in iodine, and are usually highly endemic areas for iodine deficiency disorders. The iodine cycle in nature explains the distribution of iodine in the environment. Iodine evaporates from the ocean, is concentrated in the rain, falls on the earth, and returns with the rivers back to the ocean. On average, sea water contains 50 ug per litre, rain and river water contain 5 ug per litre, and the soil contains 500 – 9000 ug per kg.

Recent field studies have shown that even plains and riverine areas exposed to recurrent floodings, with or without excessive rainfall, also have iodine deficient soil with moderate to high prevalence of iodine deficiency disorders (e.g. in Bangladesh, India and Sri Lanka). Similarly, some of the oases in Egypt and Libyan Arab Jamahiriya, and possibly desert areas of other countries, which have almost no

rainfall have soil which is extremely poor in iodine. The population in these areas lives on locally produced food with negligible amounts of food brought from elsewhere and iodine deficiency disorders are of moderate prevalence in such areas. Endemic areas have also been identified in coastal regions. The effect of water pollution and other soil characteristics on iodine content of water has yet to be clearly understood, but there are some indications that polluted drinking water is associated with endemic goitre. Fig.2 shows areas of the Eastern Mediterranean Region which are at risk from iodine deficiency disorders.

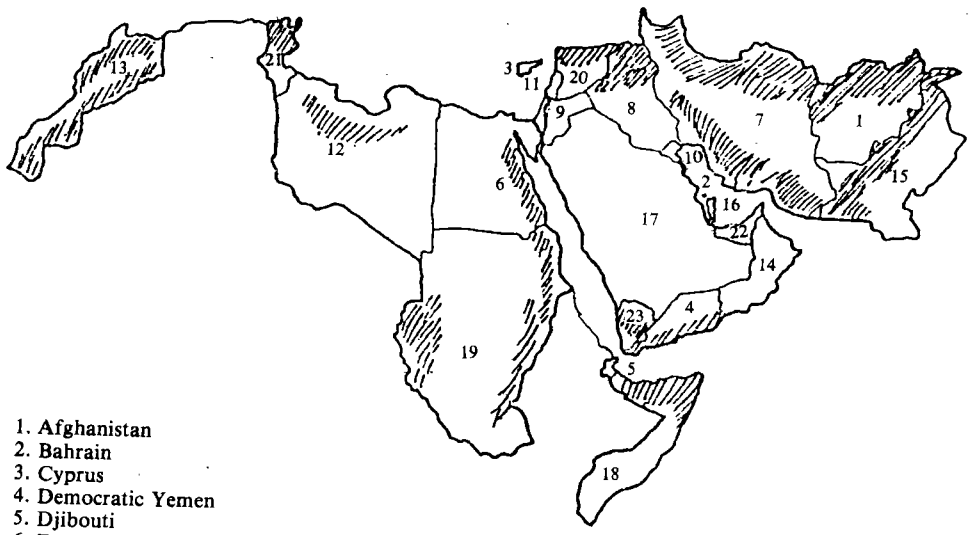


FIG.2. Eastern Mediterranean Region countries with iodine deficiency disorders vulnerable regions

As long as the population in an endemic area thrives on foods grown in that area, the only solution is to correct the balance by making the population consume the required amount of iodine through foods or water to which iodine has been added, or to provide the body with the required amount either through injection or oral medicaments. Consuming foods grown in other regions, with no environmental iodine deficiency, will also automatically overcome the problem. It should, however, be remembered that most highly endemic areas are situated in remote,

rather inaccessible, hilly areas, where the population usually survive on what they produce and in which importation would be a costly and impracticable process. The same is true for isolated endemic areas in deserts and oases.

### I – 3.2. Goitrogens

There are certain chemical substances which are known to interfere with iodine utilization by the thyroid gland. These are known as goitrogens and there are certain foods which are rich in these compounds e.g. cabbage, radish and cassava. Such foods are known as goitrogenic foods and their consumption in very large amounts, in exceptional situations, might produce iodine deficiency in the body. However, with the exception of the consumption of cassava and goitre endemicity in Zaire, this correlation between goitrogenic foods and the endemicity of iodine deficiency disorders has not yet been fully confirmed. On the other hand, it has been fully established that iodine supplementation by any route overcomes iodine inadequacy in the body, irrespective of the underlying cause.

## Chapter II

## THE SOLUTIONS

### II – 1. EXISTING TESTED TECHNOLOGIES

The methods available for the control of iodine deficiency disorders answer one principal question – How can the deficient quantity of iodine be introduced into the body? Various approaches have been, and are still being, tested for developing simple, cheap, and effective technologies suitable for developing countries with scarce financial resources and inadequate technical and managerial manpower.

The following methods are in use in various countries as national programmes for the control of iodine deficiency disorders:

(a) Iodination of common salt in such a proportion that approximately 10 g of salt, the average daily consumption of an individual, will supply 120 – 150 ug of iodine. This is the most commonly adopted control measure;

(b) Injecting iodinated poppy seed oil intramuscularly every 3 – 5 years, by means of which a store of iodine is created in the muscle. The body's requirements are drawn from this store every day for the next 3 – 5 years. For a number of reasons this is regarded as a good interim measure while a salt iodination programme is being planned and put into operation (see §II – 3);

(c) Administering iodinated poppy seed oil orally, thus creating a store in the thyroid gland and adipose tissue from which the daily requirement is drawn for the next 1 – 2 years. This is being tried out in some countries in place of injections;

(d) Iodination of water, either at the community or at the domestic level; this has the double effect of disinfecting water against microbes responsible for diarrhoea and other types of gastroenteritis and, at the same time, supplying an adequate quantity of iodine to the body. A few countries are testing this approach;

(e) Fortification of bread with iodine compounds to a level at which the average quantity of bread consumed daily by an individual will satisfy the iodine

requirement. This is currently is currently in operation in a few developed countries;

(f) Administering sodium iodate tablets orally. This was a common approach in the past but has now been generally discarded.

A large number of countries belonging to both the developed and the developing world has been using one or more of these methods for several decades. Switzerland, for instance, has been running iodinated salt programmes for more than 40 years. There is a considerable amount of experience regarding the strengths and weaknesses of each measure. The following may be regarded as a guideline regarding choice of method:

(i) Iodination of common salt is the preferred method for a long-term solution to iodine deficiency disorders. However, it takes a fairly long time to get such a programme underway with the necessary precautions, and a longer period still to observe fully the impact.

(ii) Injection of iodinated poppy seed oil intramuscularly every 3 – 5 years is the method of choice as an interim measure. Its impact is almost immediate. It is also the method of choice in remote inaccessible areas where normal salt marketing channels do not penetrate.

In most developing countries, a combination of these two methods might be needed to cover all regions. However, each country will have to take its own decision regarding choice of methods, after considering the favourable and unfavourable factors relating to each approach and the appropriateness of each to the local conditions.

## II – 2. A SALT IODINATION PROGRAMME

Implementation of a salt iodination programme is the commonest method in use for the control of iodine deficiency disorders. A large number of countries throughout the world, including the majority of developed countries, are using this method on a continuous basis. The method essentially consists of fortifying common salt crystals with an iodine compound, usually potassium iodate. The iodinated salt looks, smells and tastes like ordinary salt. The amount of iodine added to salt is such that 10 g provides 120 – 150 micrograms of iodine, the daily human requirement.

However, although the technology involved is quite simple and cheap, the implementation of such a programme in a developing country is far from simple. The absence of an organized salt industry and salt trade, the inadequacy of transport systems, and the lack of technical skills and manpower for quality control and monitoring are just a few of the difficulties that commonly hinder these programmes. Nevertheless, with adequate measures to organize and upgrade the salt industry, to ensure quality control in fortification and to ensure supply to endemic areas, the method is the one most preferred.

Experiences in a number of developing countries in WHO's South-East Asia Region were recently reviewed and a number of difficulties in the successful implemention of salt iodination programmes were identified [3]. In fact, it was difficult to identify any country in which the salt iodination programme could be said to be successful. The biggest salt iodination programme in that Region is in India and was implemented in 1966. It was found to be gravely faltering in all aspects and to have marginal impact, and has now been drastically revised to one of universal iodination i.e. iodination of all edible salt in the country to cover the entire population, amounting to about 5 million tonnes of salt per annum.

The question that has been repeatedy asked in recent years is why, in spite of the availability of simple low-cost technology, many developing countries using this method have not been able to make any appreciable impact on the problem of iodine deficiency disorders. A critical analysis was made by the South-East Asia Regional Office of WHO to identify the factors, mostly of an operational and logistic nature, which can cripple a salt iodination programme. The following are among the most important:

(a) In a country where salt production originates from a large number of small unorganized salt fields with outdated technology, it is extremely difficult to collect the salt and ensure that it is adequately iodinated;

(b) It is difficult to control the quality of iodination if there are a number of iodination plants in operation, each in the hands of a small salt manufacturer who does not employ the appropriate expertise to ensure uniform quality;

(c) There are complex management and logistic difficulties in trying to ensure a continuous and uninterrupted supply of iodinated salt from the plants through the salt trade channel and outlets to the target populations, especially those in remote peripheral areas;

(d) With the availability of non-iodinated salt in nearby areas or districts, it is extremely difficult to compel salt traders and retailers to sell only iodinated salt in the endemic areas. In other words, even with legal provisions, it is difficult to stop the entry of non-iodinated salt from the neighbouring areas into endemic areas. The retail sellers' interest is in selling salt to the consumers – whatever type is available at the moment;

(e) Since there is generally a price differential between iodinated and non-iodinated salt, it is difficult to persuade consumers to purchase only iodinated salt. This needs considerable motivation which unfortunately has rarely been attempted in any control programmes in the past;

(f) It is difficult to prevent consumers in endemic areas from procuring crude unrefined salt, for which they have age-old preference, from the local small-scale producers. A good example is the preference, in certain areas of Pakistan, for rock-salt which cannot be iodinated;

(g) In most developing countries, common salt is packaged and stored in jute bags, which are pervious to moisture and heat. For transport over long distance, these bags are often moved in open railway wagons for long periods. A significant proportion of iodine in the fortified salt leaches out in such storage and transport conditions. Packing in polyethylene-lined bags and/or transport in covered railway wagons will minimize such iodine loss. However, these are expensive procedures.

### II – 2.1. Important early stages in a salt iodination programme

In order to avoid pitfalls during the implementation of this programme, it is extremely important to identify clearly the different stages of the programme and the difficulties and constraints in each. The following summary is useful.

#### *II – 2.1.1. The salt consumption profile*

A salt iodination programme is based on four assumptions:

- that everyone consumes 10 g of salt per day;
- that everyone consumes or will consume refined white crystalline salt usually produced by the large salt producers (as opposed to locally produced crude or rock salt);
- that crystalline salt is added to the food while it is being cooked and the destruction of iodine is minimal during cooking;
- that all consumers buy their salt from the retail grocers in the locality.

It should be noted that there are situations in which one or more of these facts might not be true. In many areas or communities, the average daily salt consumption might be 30 g or more; in some cold regions, for instance, salt is used either in place of sugar or in combination with sugar in tea (e.g. Azad Kashmir in Pakistan) pushing up the daily consumption to a high level. On the other hand, in urbanized middle and upper income families, daily consumption might be much less than 10 g. In literate well-informed urban families, the tendency is to cut down on salt because of its association with hypertension. In some regions people prefer rock-salt, while in others salt is repeatedly washed until it becomes a concentrated brine and then used for cooking. The effect of different cooking procedures, especially deep frying over a long period, on the iodine content of food has not yet been clearly determined. All these areas are suitable for further investigation.

Thus, before starting a national programme of salt iodination, it is essential that a rapid study be undertaken in the region where the iodinated salt programme is to be implemented, to collect as much information as possible about salt consumption, its use in cooking, and its procurement and storage in the grocer's shop and at home i.e. a salt consumption profile. A properly designed operational research study for situation analysis in representative areas of the endemic region will establish the relevant information on the basis of which the control programme is to be developed.

### *II – 2.1.2. Salt production*

Most developing countries implementing salt iodination programmes produce their own salt, with partial import in some cases. Salt production in these countries is almost always in the private sector with outdated technology and with almost no quality control. There are usually a number of producers scattered all over the country producing salt from either sea water, salt lakes or salt swamps. Within a single country, there may be several varieties of salt produced; not all types are suitable for iodination. Rock salt, for example, cannot be iodinated.

A detailed inventory of salt producers and type, quality and quantity of salt produced, as well as information about the salt trade channels should be obtained from the industry sector of the government before planning the details of a salt iodination programme. It is important to include a representative of the industry sector, which is specifically responsible for salt industry in the country, in the planning and implementation of the programme, since the health sector, which will usually run the programme, has no access to or influence over the salt traders.

### *II – 2.1.3. Methodology of salt iodination*

The technology of salt iodination is relatively simple and iodination plants can be produced in most developing countries. The process of salt iodination aims to mix salt with a fixed quantity of iodine compound to ensure the desired level of iodine in the fortified salt. Iodine is normally introduced as a compound such as potassium iodide, potassium iodate or calcium iodate. Of these, potassium iodate is the preferred compound. There are two processes commonly used for iodinating salt (i) dry mixing and (ii) spray mixing.

(i) In the dry mixing process, a mixture of potassium iodate and an anti-caking agent like calcium carbonate or magnesium carbonate is prepared in a ratio of 1:9. One part of the stock mixture is then mixed with 10 parts of salt, and this pre-mix is introduced into a screw conveyer at a fixed rate. Salt is also introduced into the conveyer and the mixing takes place continuously as the material moves through the conveyer. This process is suitable for powdered salt only.

(ii) In the spray mixing process, salt received in crystal form is crushed to a coarse powder in a roller mill and manually fed to a feed hopper which regulates the flow of salt onto an inclined conveyer belt. It is thus discharged into a spray chamber where it receives a fine, atomized spray of potassium iodate solution. Uniformity is ensured by passing the iodinated salt through a screw conveyer.

An important point, about which the goverment has to take a careful decision, is that of who should be responsible for the iodination of salt. It may either be given to one or more major salt producers with clear-cut directives regarding quality control or it may be handled directly by the government in one or more iodination plants, thus ensuring uniform quality and regular uninterrupted supply to the endemic areas. If the private salt producers operate iodination plants, they should be provided with potassium iodate and also some form of incentive for undertaking iodination following strict guidelines. In addition, there should be some mechanism for continuous monitoring of the plants.

If the government assumes the responsibility for iodinating salt, the major part of the operation is to bring the salt from the private producers to one or more places for iodination. Preferably, the iodination plants should be located in the endemic areas so that the iodinated salt will not have to be transported over long distances risking interruption in supply. The government should also assume the responsibility for handing the iodinated salt over to the salt wholesalers in the

region, from where it goes to the retailers. These stages call into focus the importance of also including in the planning and implementation of a salt iodination programme a representative of the goverment sector responsible for the salt trade. Usually, this would be covered by the food and civil supplies sector.

There is no universal specification regarding the level of iodination of salt. This will depend upon the degree of endemicity in the region, the per caput consumption, the usual storage period with the grocers and the possible losses of iodine at different stages between production and consumption. Taking all these factors into consideration, particularly the loss of iodine during transport and storage, in general the iodine level at an iodination plant is kept at 30 – 40 parts per million (ppm), so that by the time the salt reaches the consumer the level will be at least 15 ppm.

### II – 2.2. Transport of iodinated salt

The transport of iodinated salt to different parts of the country is not an easy task, especially if the country is big. There must be a continous uninterrupted supply of salt to all individuals in an endemic area through their grocers. In the absence of a supply of iodinated salt, and assuming that the profit margin is the same, the grocer will have no hesitation in passing off non-iodinated salt as iodinated. After all, his main motive in trading is to make money.

Salt is usually transported in railway wagons, many of which are open and uncovered. Sometimes, if the country is very large, it might take weeks for a supply of iodinated salt to go from the iodination plants to the retailers. Salt is a hygroscopic substance and attracts moisture which means it easily becomes wet. Recent studies have shown that iodinated salt packed in cheap jute bags and exposed to moisture and sometimes rain loses an appreciable amount of iodine. Packing of iodinated salt in high density polyethylene (HDPE)-lined bags will prevent this loss during transit. Such bags are usually of 75 kg capacity and, at the next stage, the salt should be repacked in 1/2 – 1 kg low density polyethylene (LDPE) bags by the retailer.

### II – 2.3. Consumption of iodinated salt

The most crucial phase of a salt iodination programme is the actual consumption of such salt by the population in the endemic areas. An important decision to be made by the government is that of whether the iodinated salt is to be targeted at only the endemic areas or at the whole country. India, for example, has taken the

decision to iodinate all edible salt in the country by 1992 – a process generally termed universal iodination. This decision was taken as a result of the comparative failure of targeted distribution in which the iodinated salt was distributed to only prescribed endemic areas. However, since targeted distribution is cheaper, most countries will opt for this type of approach, especially if the endemic areas are limited.

Once this decision has been taken, the government should be aware of a number of pitfalls that might occur during programme implementation. The first and foremost problem in targeted distribution is that of how to ensure that non-iodinated salt does not reach the retailers in endemic areas. Of course, retailers will offer ordinary salt to the consumers if: (i) iodinated salt is in short supply; (ii) the profit in selling ordinary salt is more than for iodinated salt; (iii) consumer preference is for salt other than iodinated e.g. rock salt; or (iv) non-iodinated salt is cheaper.

Each of these four situations can be rectified by taking appropriate measures: (i) by ensuring the continuous supply of iodinated salt; (ii) by providing an incentive to the retailer for selling iodinated salt; (iii) by making consumers aware of the benefit of iodinated salt; and (iv) by placing a government subsidy on the cost of iodination in order to keep the price of iodinated salt at the same level as the non-iodinated variety or, better still, at a lower level. Each of these measures, although apparently simple, needs quite a lot of planning and close collaboration with a number of sectors e.g. commerce, trade, finance, civil supplies and information and communication.

### II – 2.4. Legal provisions for banning entry of ordinary salt into endemic areas

In addition to all the measures mentioned above in § II – 2.3, it will be necessary to ban the entry of non-iodinated salt into endemic areas. This could be done under the legal provisions of the civil supplies act by which the supply of commodities for consumption in circumscribed areas, like provinces, districts, or sub-divisions, is regulated.

This may be further strengthened by bringing iodinated salt under the provisions of the food control order prevailing in that region. With the help of such legal provision, food or sanitary inspectors will be able to take random samples on a continuing basis from grocers, and have them analysed in the district or municipal laboratories designated by the food control order. This will determine whether or

not iodinated salt is being sold and, at the same time, the level of iodination of the salt when it reaches the consumers. Punishment for infringement of the food control order would act as a deterrant to the selling of non-iodinated salt in endemic areas.

In peripheral areas where laboratory facilities are not available, effective monitoring may carried out by primary health care workers by visiting, at regular intervals, village grocers and examining the markings on the bags of salt. However, this would then need an administrative decision that all bags of iodinated salt be labelled or marked in a manner approved by the government.

## II – 3. AN IODINATED OIL PROGRAMME

Oils of poppy seed, soybean or walnut are used as vehicles for iodination. The best known and most commonly used commercial preparation is Lipiodol, a product made by Laboratoire Guerbet in Paris, which is iodinated poppy seed oil with 38% of its weight as iodine. One millilitre of this product contains 480 mg of iodine. Lipiodol has been used for radiological investigation for decades. Its use as a vehicle for introducing iodine into the human body to overcome iodine deficiency started only in the 1950s. Intramuscular injection of iodinated poppy seed oil for controlling endemic goitre and cretinism has been in operation for almost 30 years in several developing countries. However production of iodinated oil is very restricted. In recent years, oral administration of the oil has been tested, for effectiveness and to avoid the use of syringe and needles.

### II – 3.1. Intramuscular injection of iodinated oil

Injection of iodinated oil is a highly effective and tested means of correcting iodine deficiency. It is injected intramuscularly and most of the iodinated oil will remain at the injection site for several weeks or months and the iodine released slowly into the circulation. Once in the circulation, the iodine is taken up by the thyroid gland, excreted in the urine or perhaps stored in adipose tissue.

A number of studies have been carried out in several countries regarding dosage schedule, period of protection and possible toxicity. The following is a reliable summary:

(a) The generally accepted dosage is 1 mL which gives protection for a minimum period of three years;

(b) In very remote, difficult to reach areas a dosage of 2 mL is preferable which gives protection for at least five years;

(c) A dosage of 0.5 mL is recommended for children in the first year of life;

(d) The target groups, in order of priority, are:
- women of childbearing age;
- children 0 – 5 years of age;
- children over 5 years of age;
- men aged 15 – 45 years;

(e) Administration of iodinated oil to pregnant women increases the chances of survival, good birth weight and proper development quotient of the off-spring. Pregnant women should be specifically included in the programme.

### II – 3.2. When to select iodinated oil injection?

Below are the indications for adopting the iodinated oil injection approach.

(a) This approach may be adopted by any country and is particularly suitable when the prevalence of iodine deficiency disorders is alarming and requires immediate intervention.

(b) This approach is ideal as an interim measure during which the government may undertake the detailed planning and implementation of a salt iodination programme.

(c) In remote, inaccessible areas, such as in hills, mountains, small scattered islands and oases, this is the method of choice since individuals need only be contacted every 3 – 5 years and since the normal salt trade channels do not usually operate in these areas.

(d) This method is also indicated among populations who persistently reject all types of salt other than that preferred, which cannot be iodinated e.g. rock salt and crude unrefined salt converted into brine.

### II – 3.3. Some difficulties involving the iodinated oil injection approach

In spite of all its advantages, iodinated oil injection is not commonly adopted by many developing countries for several reasons, of which the following are important:

(a) Iodinated oil is very expensive, presumably due to the monopoly of its manufacture by one major commerical firm in France. Iodinated walnut and

soya bean oil are preparations which have been developed in China and are being extensively used for control of iodine deficiency disorders there. They are much cheaper, however, these products are not yet available in other countries.

(b) This approach requires all individuals in the endemic areas, whether actual or potential victims, to be individually contacted for the injection. This is not a simple task in a country where the health services are inadequate both in coverage and in manpower. Moreover, in many parts of the world, women and children are often reluctant to have injections.

(c) Disposable syringes and needles are recommended for injection since sterilization of needles is an impossible task in the prevailing situations of most developing countries. Even so inoculators have a tendency to use the same needle for more than one person and this is increasingly viewed with alarm these days with the all-prevailing threat of AIDS, in addition to that of hepatitis. Indeed, oral administration of iodinated oil is now receiving more attention for exactly this reason. It should, however, be noted that oral administration of iodinated oil is more expensive than injection due to its shorter duration of protection (1 to 2 years). Moreover, there is very limited experience available with oral administration.

### II – 3.4. Some administrative aspects

An iodinated oil injection programme will, obviously, be the responsibility of the ministry of health. In a country with a well-established and functioning primary health care system, injection might be the responsibility of the primary health care worker. In other countries, and especially in regions where health coverage is very inadequate, a specially constituted team of inoculators will have to cover the population as a "vertical programme". An average inoculator could cover about 100 persons a day. If carried out in an organized, well-charted manner, by a team of, say, ten inoculators, endemic areas in a country might need four to five years to achieve full coverage. Obviously, the time required for complete coverage would depend on the number of inoculators and the speed of their movement.

A new approach, which has been tried out recently in several countries, is to include iodinated oil injection as one of the activities of the inoculation team of the immunization programme. The target beneficiaries, young children and pregnant women, are the same for both the immunization and the iodine deficiency disorders control programmes.

### II – 3.5. Oral administration of iodinated oil

Oral administration of iodinated oil has several advantages over injection. Not only are people more willing to take medicaments by mouth than by injection but it also obviates the need for needles and syringes which are costly and carry risk of infection if used more than once. The usual method is to give orally 1 mL of iodinated oil, usually in the form of a capsule containing 1 mL of oil with 200 mg of iodine. This gives protection for at least one year. Because of the protection time, oral administration is several times more expensive than the intramuscular route. The target group is the same as for injection.

Unlike injection, in which a storage site is created in the muscle, oral administration immediately puts a large quantity of iodine into the circulation, in the kidney and in the storage sites in adipose tissues, thereby creating a potential strain on the system as a whole. The experience with oral administration is too limited at present for any clear-cut recommendation.

## II – 4. OTHER METHODS

Iodination of drinking water through the municipal water supply system is another means of correcting iodine deficiency in the environment. It has the additional advantage of disinfecting the water, a positive factor in countries or regions with high prevalence of diarrhoea and other water-borne diseases, at the same time as supplying the necessary iodine to the body. However, piped water supplies do not exist in most IDD endemic areas of the developing world; populations tend to depend on other sources like wells, rivers and springs. Studies are in progress in several countries to explore the possibility of adding iodine compounds to stored water in individual households. Depending on the capacity of the receptacle used for storing water, simple iodination kits are being developed for use at household level.

Bread has occasionally been used as a means of introducing iodine into the human body if this is an item of daily diet. However, this requires bakeries with the necessary expertise in iodine fortification and quality control. By no means is this a method suitable for most developing countries.

Direct administration of iodine in the form of potassium or sodium iodide or iodate tablets or as Lugols' Solution was tried out in several countries with varying results. These approaches are not recommended.

## Chapter III

## ADMINISTRATIVE SUPPORT

The success of a programme for the control of iodine deficiency disorders depends to a very large extent on administrative and managerial competence. While the technologies involved are relatively simple, their application for programme implementation needs very careful planning and administrative support, especially if the control programme is based on iodinated salt which needs close coordination between a large number of government sectors and traders. The main areas needing administrative support are described below.

### III – 1. ADVOCACY FOR POLITICAL COMMITMENT

Political commitment is the most basic requirement for a control programme. The present situation in the Eastern Mediterranean Region is a good example of what happens in the absence of political commitment. Not less than seven countries in the Region have reported alarming prevalence of iodine deficiency disorders during the last two decades; yet, until 1980, not one had developed and implemented any kind of control programme due to the absence of just such commitment at the highest level. During the biennium 1978 – 1979, the Regional Director of the Eastern Mediterranean Region of WHO pleaded for the inclusion of goitre control programmes as part of the WHO Collaborative Programmes in Nutrition. The Regional Programme Statement of the programme budget for that biennium said: "Goitre is endemic mainly in certain countries of the Region. During the biennium, WHO will assist countries to put control measures for this disease into effective practice". However, no significant progress could be made in this direction due to the relatively low priority assigned to it by the Member States, and to the direction of financial resources to other "more pressing needs". It was only in 1980 that Libyan Arab Jamahiriya implemented a salt iodination programme of limited nature, while Pakistan is now in the process of implementing a national control programme for iodine deficiency disorders.

At that time the more sinister nature of iodine deficiency disorders was not properly known. Now, however, the effects of iodine deficiency on the entire life span of man as revealed by recent scientific studies may be forcefully utilized in nutrition advocacy. Obviously, the health sector should take the leading role in such advocacy.

There are several different approaches to nutrition advocacy which include preparation of a brief for politicians and decision-makers, raising the issues through pressure groups in the national parliament, and arousing public awareness through the mass media. A number of excellent video films are now available to create "IDD awareness" among groups of decision-makers. The Agha Khan Foundation in Pakistan has recently prepared a video film on iodine deficiency disorders and others have been made by UNICEF. There is no rigid rule concerning the correct approach for nutrition advocacy. However, the most important point is the identification of a focal point in the ministry of health to play the major role in working work out a strategy for such advocacy. In most situations, the nutrition unit of the ministry of health undertakes this responsibility.

Once decision-makers at the highest level have been convinced of the dangers of iodine deficiency in the country and of the availability of affordable, feasible technology for its control, development of administrative policy and, if necessary, legislation should be relatively easy.

## III – 2. SITUATION ANALYSIS

The first step in the formulation of a control programme for iodine deficiency disorders is to carry out a situation analysis to enable programme planning to be undertaken. Such an analysis should include the following components:

(a) A rapid prevalence survey in different geographical regions of the country based on clinical examination of schoolchildren. Schools are the best targets for a prevalence survey since this is the simplest way to examine as many subjects as possible;

(b) A rapid dietary survey to establish the types of foods commonly consumed in the different areas. This could be obtained through a questionnaire;

(c) An inventory of the sources of drinking water in these areas and, if laboratory facilities are available, testing for the iodine content of such water samples. However, this latter information is not essential;

(d) An outline of the salt production sites in the country, and how these are regulated by the government. An outline of the salt trading channels will also be necessary. This is always available through the industry sector which is responsible for regulating the salt industry;

(e) The salt consumption profile of the country indicating the average amount of salt consumed per day in different regions, the type of salt preferred, and the ways in which the salt is used e.g. cooking, pickling or other preparation for edible purposes.

## III – 3. ADMINISTRATIVE SET-UP IN THE HEALTH SECTOR

A programme for the control of iodine deficiency disorders is the logical responsibility of the ministry of health. Like other programme areas in a health service a technical unit will have to be designated as the focal point for all matters related to iodine deficiency disorders. Experiences in developing countries indicate the following alternatives:

(a) A separate unit in the ministry of health set up to be totally responsible for IDD control;

(b) The nutrition unit in the ministry of health;

(c) A national institute devoted to health and/or nutrition;

(d) The technical unit responsible for the expanded programme on immunization, particularly if the approach decided upon is that of iodinated oil injection.

Irrespective of where the focal point for IDD control is located, it is essential that it be adequately staffed to undertake its responsibilities, which are in the following broad categories:

- situation analysis;
- programme planning and implementation;
- intrasectoral collaboration;
- acting as the secretariat of an intersectoral committee or commission which might be established specifically to watch over the IDD control programme;
- programme monitoring and evaluation.

## III – 4. INTERSECTORAL COORDINATING COMMITTEE

Few health programmes need more intersectoral collaboration than a programme for control of iodine deficiency disorders, especially if it is to be based on salt iodination. The common mistake in the past in many developing countries was to place the entire responsibility on the ministry of health. Other concerned sectors were only marginally involved. However, as noted earlier, without the close involvement of the salt industry and transport sector, the health ministry can have

| STEPS | 1<br>Salt production | 2<br>Iodination of salt | 3<br>Transport of iodinated salt | 4<br>Storage and sale by wholesalers/ retailers | 5<br>Consumer awareness and use | 6<br>Iodine status monitoring |
|---|---|---|---|---|---|---|
| SECTORS INVOLVED | Mostly unorganized private sector Some public sector. | Can be in both govt. and private sectors but controlled by INDUSTRY SECTOR | Usually railway but also water-ways and other carriers TRANSPORT SECTOR | Private sector and government CIVIL SUPPLIES SECTOR | Mass commun-ication. Food control INFORM-ATION & HEALTH SECTORS. | Network of iodine monitoring laboratories HEALTH SECTOR |

FIG.3. Major steps in an iodinated salt programme for control of iodine deficiency disorders and the government sectors involved.

no control on salt iodination, or its transport and distribution in the endemic areas. The over-concentration of responsibilities in the ministry of health may be a reason for the faltering of the programme in a number of countries in the South-East Asia Region.

Fig.3 shows the major steps entailed by a salt iodination programme and the sectors involved. The responsibilities of the different sectors or ministries in a salt iodination programme are indicated below.

(a) Salt production in the private sector is supervised and controlled by the ministry of industry.

(b) Salt iodination is controlled by the ministry of industry in collaboration with the ministry of health which fixes the level of iodination.

(c) Transport of salt, both ordinary and iodinated, is the responsibility of the ministry of transport.

(d) Regulating entry of iodinated salt into the endemic area, and banning the entry of ordinary salt into these areas are responsibilities of the ministry of civil supplies and food.

(e) Ensuring use of iodinated salt in the endemic areas through the provision of a food control order is the responsibility of the ministry of health.

(f) Monitoring the use of iodinated salt and the iodination level of the salt at the different stages from production to consumer level through a network of iodine monitoring laboratories are responsibilities of the ministry of health.

(g) Creating awareness among the general population through the various media is the responsibility of the ministry of information in collaboration with the ministry of health.

(h) Issues related to salt pricing, subsidy and incentives are the concern of the ministry of finance.

An intersectoral committee or a commission, with the minister of health as the chairman and the representatives of the above-mentioned ministries or departments as members will be necessary as an over-viewing body. The secretariat of the committee should preferably be held by the focal point in the ministry of health since it is responsible for IDD control overall (Fig.4).

If the government decides to opt for the iodinated oil injection approach, the responsibility will obviously lie almost entirely with the ministry of health. However, the need for collaboration and coordination with the ministry of information to create public awareness about iodine deficiency disorders will still be there. Similarly, coordination with the ministry of education, ministry of social welfare and other ministries will be necessary to facilitate coverage of schoolchildren, pre-school children and women.

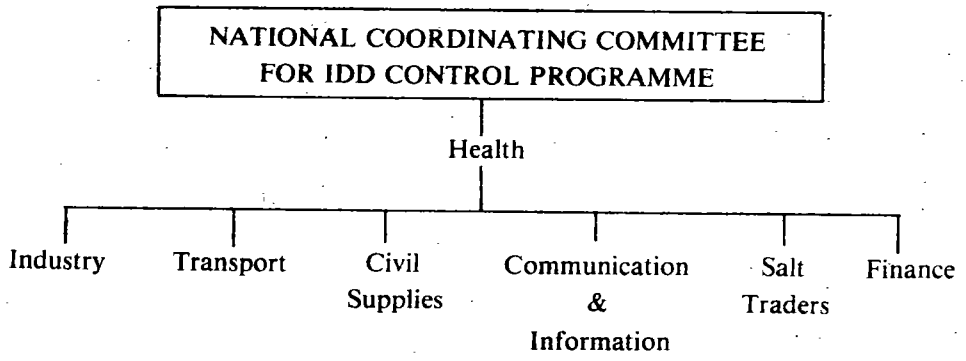


FIG.4. Relationship between the national coordinating committee and the sectors involved in a salt iodination programme.

## III – 5. PROCUREMENT OF SUPPLIES AND EQUIPMENT

The following supplies and equipment are necessary for a salt iodination programme:

(a) Iodination plants are required which are suitable for the spray drying process and with capacity corresponding to the calculated need of the endemic area. This is usually calculated on the basis of a per caput salt consumption of 5 kg per year. If the government decides to allow private salt producers to iodinate salt, then there will be need for small plants, some of which might even be mobile. Iodination plants can be manufactured in many developing countries. A standard model spray dry plant can produce up to 10 000 tonnes of iodinated salt per year. UNICEF has a long history of assisting countries through donation of such plants for IDD control programmes.

(b) Potassium iodate has to be imported by all developing countries for salt iodination programmes. However, countries with a fairly well-developed chemical industry might import iodine and convert it into potassium iodate, a much cheaper procedure.

(c) Chemicals and glassware will be necessary for the quality control laboratories at the iodination plants, and for the laboratories forming the network for monitoring iodine levels. These laboratories will have to undertake estimations of iodine in iodinated salt, estimations of iodine and creatinine in urine and, in some cases, estimations of iodine in water. More details will be given in the section on monitoring (see Chapter 4).

A rough estimate of the cost of production of one tonne of iodinated salt is US$4.00. If packaging costs, with HDPE-lined jute bags is included, then the cost per tonne of iodinated salt goes up to US$8.00. The average annual cost per person is 4 cents.

If the iodinated oil injection approach is selected, then the following supplies are needed:

(a) Ampoules of Lipiodol which have to be imported from the French firm. These are expensive, and the order has to be placed well in advance since supplies are rather restricted. Each ampoule contains 10 mL of iodinated oil;

(b) Disposable syringes and needles in adequate numbers to ensure that one set is used for every individual;

(c) Transport like Jeeps, motorcycles or cycles so that the inoculators can cover as many individuals as possible every day.

The cost of iodinated oil for injection, produced in France, is about US$3.00 for a 10 mL vial suitable for 10 persons. A recent assessment in an Indonesian programme indicated a figure of US$1.00 per injection including all expenses.

Whether the iodinated salt or iodinated oil injection approach is adopted, the programme would need supplies and equipment for communication, e.g. development of audio-visual materials for person-to-person and mass media health education.

## III – 6. TRAINING OF TECHNICAL AND MANAGERIAL STAFF

The success of any programme depends on the technical and managerial competence of staff at all levels of operation. For a programme based on salt iodination, managerial competence of all concerned staff belonging to the different sectors is the most important requirement. For the iodinated oil injection approach, the entire primary health care network should be adequately sensitized and trained, starting with the district health or medical officer. Yet, very often the primary health care worker and his supervisors have very little or no knowledge of the extent and significance of iodine deficiency disorders or of the importance or existence of an IDD control programme. Even with iodinated salt prophylaxis, the entire primary health care network, if adequately sensitized and trained, can be of immense help in creating public awareness through the health infrastructure and person-to-person contact and can assist enforcement of the legal provisions of the food control order relating to iodinated salt.

All training courses for workers at different levels of an IDD control programme should have two components:

(a) Technical information; it is important to convey to all workers in an IDD control programme basic information about the dangers of iodine deficiency and the means of overcoming them;

(b) Operational and managerial training for workers with different responsibilities.

## III – 7. COMMUNITY INVOLVEMENT

No control measure, be it consumption of iodinated salt or injection of iodinated oil, will succeed until and unless the people cooperate fully and willingly. The lack of success of most IDD control programmes in South-East Asian countries has largely been due to the conspicuous absence of any effort to create mass awareness about the dangers of iodine deficiency and the advantages of either iodinated salt or of iodinated oil, and to seek community cooperation.

In general, such awareness may be created through the following approaches:

(a) Audio-visual materials such as simple illustrated posters in health centres, community meeting places, schools and places of religious congregation;

(b) Simple messages conveyed verbally by school teachers, health workers, and religious and community leaders;

(c) Messages conveyed by the mass media (radio, television and newspapers).

In addition to the government sectors, the cooperation of non-governmental organizations should be obtained, since these bodies have, quite often, profound influence on the population. Their flexible methods of operation are very often more effective and have greater impact than government efforts.

In the health sector, the IDD focal point should work in close collaboration with the units responsible for health education in developing suitable messages and in the production of audio-visual materials. Close collaboration with the ministry of information has to be ensured in the use of the media, starting with short briefing courses for journalists and staff of radio and television. The role of the ministry of health is to provide the necessary technical information; the total strategy should be entrusted to the media specialists.

## III – 8. PRIMARY HEALTH CARE AND IDD CONTROL

The great potentials of the primary health care approach can be effectively utilized for the implementation of an IDD control programme. Community involvement and intersectoral collaboration, the two essential characteristics of primary health care, are likewise the basic requirements for the success of an IDD control programme. The need for appropriate training is obvious but the following are specific areas in which the primary health care workers can play important roles:

(i) conducting prevalence surveys on the basis of the degree of thyroid enlargment, with some practical training;

(ii) creating awareness through person-to-person contact in the community regarding the dangers of iodine deficiency and the importance of using iodinated salt;

(iii) monitoring the sale of iodinated salt in the community by inspecting, at frequent intervals, the village grocery shops;

(iv) encouraging the target population to have iodinated oil injections and assisting the inoculation team, if this approach is adopted.

## Chapter IV

# MONITORING A CONTROL PROGRAMME

Continuous monitoring of an IDD control programme is essential for its success. There are four different types of monitoring required:

(a) Monitoring of the level of iodine in the iodinated salt at different stages e.g. production site, during transportation, during storage with the wholesalers and retailers and at the consumer level;

(b) Monitoring of the iodine status of the beneficiaries of the programme by estimating their iodine excretion in urine per gram of creatinine;

(c) Monitoring of the clinical status of the beneficiaries based on the degree of enlargement of the thyroid gland;

(d) Thyroid function tests i.e. T3, T4 and TSH, may be of use in limited cases, for monitoring the impact of iodinated oil.

## IV – 1. IODINE MONITORING LABORATORIES

Obviously, for an iodinated oil injection programme (a) is not applicable but (b) and (c) are essential for either approach. For a salt iodination programme it is absolutely essential to establish a network of monitoring laboratories in the endemic area. These laboratories should preferably by located within the district health laboratories. The staff responsible for the monitoring should be specially trained in the following analytical techniques:

- estimation of iodine in salt;
- estimation of iodine in urine;
- estimation of creatinine in urine.

Since it is difficult to collect a 24 hour urine sample from all individuals, the simple alternative is to express iodine excretion (from a sample of urine) per gram of creatinine excreted in the same period. It is desirable to designate one or two especially competent biochemical laboratories to act as reference laboratories, both for training and monitoring of techniques.

## IV – 2. SALT IODINE LEVEL AND CONSUMER IODINE STATUS

Estimation of the level of iodine in iodinated salt by chemical analysis is a simple procedure. A booklet entitled "The Use of Iodated Salt in the Prevention of Iodine Deficiency Disorders – A Handbook of Monitoring and Quality Control" [4][1] is available free on request. It describes in detail the monitoring and quality control of iodinated salt. A videotape on the same subject is also available from the same source.

The iodine status of an individual can also be accurately assessed by determining the levels of several thyroxine derivatives in serum. However, these are complicated procedures and can only be done in endocrinal laboratories. To monitor the iodine status of those who are either consuming iodinated salt or have had iodinated oil injection, the simplest method is to assess the level of iodine excretion in the urine.

An individual with satisfactory iodine status will excrete about 100 ug of iodine in 24 hours per gram of creatinine or per litre of urine. With excretion between 25 and 50 ug, goitre will be very common. Below 25 ug, cretinism will be common, with alarming prevalence of goitre. The level of iodine in the urine rises steeply after iodinated oil injection and continues at a high level during the protection period. With iodinated salt consumption, it will take several months to establish a high level of urinary excretion, but this level is maintained with continued consumption of iodinated salt. The levels of excretion of iodine in urine at different levels of iodine status should be set before the monitoring starts. The level of iodine can be expressed as micrograms of iodine per dL of urine or per gram of creatinine.

## IV – 3. CLINICAL MONITORING

The beneficiaries of an IDD control programme, whether implemented through salt iodination or iodinatd oil injection, should eventually show an improvement in their clinical status which may be assessed according to the degree of thyroid enlargement. However, a change in the clinical status will obviously take a much longer time to become apparent than will change in the urinary excretion of iodine. In the absence of laboratory facilities, clinical monitoring may be adopted with certain precautions: subjects for monitoring should be only young children in primary schools with slight thyroid enlargements; and monitoring should remain the responsibility of field workers experienced in detecting slight thyroid enlargements.

1. Available from UNICEF Regional Office for South and Central Asia, 73 – 74 Lodi Estate, New Delhi 110003, India.

The standard method of grading size of thyroid should be followed for such monitoring. The grades are as follows:

Stage 0 – No goitre

Stage 1A – Goitre detected only by palpation, and not visible even when the neck is fully extended.

Stage 1B – Goitre palpable but visible when the back is fully extended.

Stage 2 – Goitre visible with the neck in normal position.

Stage 3 – Very large goitre which can be recognized at a considerable distance.

## Chapter V

## RESEARCH AREAS

While control measures are urgently needed in the countries affected by iodine deficiency disorders to prevent further degradation of human life, simultaneous research studies are essential to provide answers to many questions concerning the aetiology, effects, treatment and prevention of iodine deficiency disorders. Some possible areas of research, relevant to the Eastern Mediterranean Region, are listed below.

### V – 1. ENVIRONMENTAL AND HOST FACTORS

While iodine deficiency in the soil leading to iodine deficiency in water and food is clearly the major underlying cause of iodine deficiency disorders, there are examples of uneven distribution of goitre among localities with equal iodine intake. Goitrogenic foods have been cited as a cause and more data are needed about unusual goitrogenic foods consumed in special circumstances and areas. The existence of other possible environmental goitrogens should be studied as well as the role of bacterial pollution.

Further research should also be directed toward the implications of nutritional status and nutrient interactions for iodine deficiency disorders. For instance, does the protein status of a child have any influence on iodine storage and utilization? What is the effect of nutritional status on the disposal rate of iodinated oil given intramuscularly or orally?

Despite similar environmental conditions, only a segment of the population may develop goitre. The influence of host factors such as genetic variation, immunological profiles, and sex, needs to be studied.

### V – 2. DISORDERS DUE TO IODINE DEFICIENCY

The few studies undertaken recently demonstrate the alarming prevalence of neonatal hypothyroidism in endemic areas, emphasizing a further need to identify these. Corrective measures for the newborn, and preventive measures for women of childbearing age will have to be implemented. Techniques have been developed for carrying out field surveys to assess the prevalence of this type of iodine deficiency disorder. However, no countries of the Eastern Mediterranean Region have, as yet, adopted this approach.

The relationship between iodine deficiency and sub-optimal performance in neurological, mental and other functions, as well as various degrees of hypothyroidism, especially in mild and sub-clinical forms, requires research of a multi-disciplinary nature. The improvement of scholastic performance in schoolchildren in hyperendemic areas as a result of iodinated oil injections has recently been reported in some countries. The question of whether neuro-motor coordination significantly improves in children of pre-school age who receive iodine supplementation remains unanswered also. Carefully controlled studies to assess the impact of iodine supplementation on manifestations of iodine deficiency other than goitre are very few.

## V – 3. THERAPY AND PREVENTION

Oral administration of iodinated oil is an approach with great potential and an important area for operational research. Similarly, further research into iodination of drinking water in individual homes and its effects on diarrhoeal diseases as well as iodine deficiency disorders is an area of far-reaching importance, since most IDD endemic areas in developing countries are also characterized by high mortality and morbidity due to diarrhoeal diseases. Finally, whether common salt might be fortified with both iodine and iron, so that the fortified salt could be used against nutritional anaemia as well as iodine deficiency disorders is another valuable area for research.

## Chapter VI

## AREAS FOR POSSIBLE EXTERNAL SUPPORT

Most national programmes for the control of endemic goitre in the developing countries have been supported by one or more international agencies, notably WHO and UNICEF. Generally, WHO has provided technical expertise in defining the extent and magnitude of the problem and in the development of a control programme while UNICEF has supplied the necessary equipment. Both WHO and UNICEF continue to give a high priority to the control of iodine deficiency disorders. The recently implemented WHO/UNICEF Joint Nutrition Support Programme, funded by the Italian Government, has taken up IDD control as its main objective in three countries. The national programme for the control of iodine deficiency disorders in Pakistan, which is now in the process of being implemented, received assistance from a WHO consultant, and is now being supported by UNICEF.

### VI – 1. SPECIFIC AREAS FOR SUPPORT

The following are areas in which external support may and should be sought:

(a) Conducting situation analyses, including prevalence surveys, identification of major causes, determination of salt consumption profiles and nature of the salt trade;
(b) Development of a control programme for iodine deficiency disorders;
(c) Provision of supplies and equipment – for salt iodination the iodination plant and potassium iodate are the most expensive items;
(d) Training of workers at different levels;
(e) Exposing key personnel to successful programmes in other countries;
(f) Development of audio-visual and mass media materials;
(g) Establishment of monitoring laboratories and training of laboratory technicians.

Training is an essential component of an IDD control programme in which WHO's assistance is extremely useful and may be sought. There are three distinct types of training needed for a control programme:

(a) Training of a core of senior trainers who will have responsibility for organizing training programmes in IDD control for workers at different levels throughout the country;

(b) Training workshops for nationals with managerial responsibilities either in the salt iodination or iodinated oil injection programmes;
(c) Training courses for technicians responsible for the iodine monitoring laboratories. Similarly, training courses will have to be organized for technicians responsible for screening for neo-natal hypothyroidism, if this component is proposed for inclusion in the IDD prevalence study.

The establishing of monitoring laboratories is another area in which WHO can play an active role. Several developing countries have established such a network of monitoring laboratories and visits to such countries to acquire on-the-spot experience might be incorporated as part of WHO's collaborative programme in manpower development.

The following international agencies and technical bodies may provide support and assistance in the development and implementation of national IDD control programmes:

(i) World Health Organization (WHO);
(ii) United Nations Children's Fund (UNICEF);
(iii) Administrative Coordination Committee of the United Nations – Subcommittee on Nutrition (ACC/SCN).
(iv) International Council for the Control of Iodine Deficiency Disorders (ICCIDD);
(v) Bilateral agencies e.g. United States Agency for International Development (USAID).

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