The WHO Global Database on iodine deficiency disorders: the importance of monitoring iodine nutrition

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Abstract

Iodine deficiency is the leading cause of preventable brain damage in childhood. Iodine nutrition has improved worldwide during the last decade due to the existence of cost-effective prevention measures such as iodization of salt. In all countries with a previous history of iodine deficiency regular monitoring of iodine nutrition is important to ensure effective and sustainable control. Country data on urinary iodine and goitre are compiled in the WHO Global Database on iodine deficiency disorders (IDD) to monitor iodine status on a global level. Monitoring and evaluation has improved over the last decade but many countries have still not implemented national monitoring systems. The information available in the database shows that iodine deficiency is still a public health problem in 54 countries. The database intends to draw the attention to iodine deficiency control, to encourage governments and international organizations to strengthen efforts and collaborations among the partners involved in IDD control, in particular the health authorities and the salt industry and to allow a comparison of iodine status between countries and regions.

Keywords: *global monitoring*; *goitre*; *iodine deficiency disorders*; *school aged children*; *urinary iodine*

Introduction

Iodine deficiency is a major public health concern throughout the world. The main factor responsible for iodine deficiency is a low dietary supply of iodine (1). Iodine deficiency occurs among populations living in areas where the soil is deprived of iodine, which is the result of past glaciation compounded by the leaching effects of snow, water and heavy rainfall.Under normal conditions, iodine is present in the body in minute amounts, mainly in the thyroid gland, with its major role in the synthesis of thyroid hormones. When iodine requirements are not met, the resultant iodine deficiency causes hypothyroidism and a series of functional and developmental abnormalities, that are grouped under the term iodine deficiency disorders (IDD) (see Table 1). Irreversible mental retardation and cretinism are the most damaging disorders induced by iodine deficiency (2, 5, 6). If iodine deficiency occurs during the critical period of brain development, from fetal life up to the third month after birth, the resulting thyroid failure will lead to irreversible alterations in brain function (7, 8). Under severe conditions iodine deficiency is responsible for a mean IQ loss of 13.5 points in children (8).

Prevention and control efforts aim primarily at ensuring adequate iodine intake in order to maintain normal thyroid function. Increased iodine intake can be implemented through food fortification with iodine and/or iodine supplementation. Over the last century, many different food vehicles have been fortified with iodine: bread, milk (9), water (10) and salt. However, salt is the most commonly used vehicle since it is inexpensive and widely available. Salt iodization is relatively easy to implement, to regulate and to monitor. Although, it was first introduced in 1920 in the United States (11) and in Switzerland (12) the global expansion of this strategy did not take place until the 1990s when the World Health Assembly adopted Universal Salt Iodization (USI) (i.e. the iodization of all salt for human and livestock consumption) as the main strategy to eliminate IDD (13). WHO recommends

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Table 1. The spectrum of iodine deficiency disorders (IDD)

Fetus	Abortions Stillbirths Congenital anomalies Increased perinatal mortality Endemic cretinism
Neonate	Neonatal goitre Neonatal hypothyroidism Endemic mental retardation Increased susceptibility of the thyroid gland to nuclear radiation
Child and adolescent	Goitre (Subclinical) hypothyroidism-hyperthyroidism Impaired mental function Retarded physical development Increased susceptibility of the thyroid gland to nuclear radiation
Adult	Goitre with its complications Hypothyroidism Impaired mental function Spontaneous hyperthyroidism in the elderly Iodine-induced hyperthyroidism Increased susceptibility of the thyroid gland to nuclear radiation

Adapted from reference (2–4).

to add 20–40 mg of iodine per kg of salt in order to meet iodine requirements assuming that the average consumption of salt per capita is 10 g per day (14).

There are two forms of iodine fortificants, iodate and iodide, usually added as potassium salt. Iodate is more stable under adverse climatic conditions and is, therefore, preferred in countries with tropical climate. It is important to ensure that all salt for human consumption is effectively iodized, included table salt and salt added to processed foods as there is a changing trend in industrialized countries, and progressively in developing countries, to reduce its consumption of table salt and increase its consumption of processed foods.

Iodine supplementation with iodized oil was the main approach to correct iodine deficiency in developing countries until the 1990s before the salt iodization strategy was introduced. Iodine supplementation is now recommended for population groups living in severe endemic areas that are not reached by iodized salt (15).

Salt iodization is safe. However, excessive iodine intake may result in iodine-induced hyperthyroidism (IIH) which can be prevented by a careful monitoring of iodine status (16).

Monitoring iodine status

Monitoring of iodine deficiency prevention and control programmes involves a series of well-established steps (13) summarized in Table 2.

Table 2. Criteria for monitoring progress towards sustainable elimination of iodine deficiency disorders

Indicators	Goals
Urinary iodine	
● Proportion of population with urinary iodine levels below 100 μg/L	< 50%
● Proportion of population with urinary iodine levels below 50 μg/L	< 20%
Salt iodization coverage	
● Proportion of households consuming adequately iodized salt	> 90%
Programmatic indicators	At least 8 of the 10
● National body responsible to the government for IDD elimination. It should multidisciplinary, involving the relevant fields of nutrition, medicine, education, the salt industry, the media, and consumers, with a chairman appointed by the Minister of Health	
● Evidence of political commitment to USI and elimination of IDD	
● Appointment of a responsible executive officer for the IDD elimination program	
● Legislation or regulations on USI	
● Commitment to regular of progress in IDD elimination, with access to laboratories able to provide accurate data on salt and urinary iodine	
● A program of public education and social mobilization on the importance of IDD and the consumption of iodized salt	
● Regular data on iodized salt at the factory, retail and household levels	
● Regular laboratory data on urinary iodine in school-aged children, with appropriate sampling for higher risk areas	
● Co-operation from the salt industry in maintenance of quality control	
● A database for recording of results or regular monitoring procedures particularly for salt iodine, urinary iodine and, if available, neonatal TSH, with mandatory public reporting	

Adapted from reference (13).

The goal with an intervention program is to achieve optimal iodine nutrition in the population which is why in addition to monitoring iodized salt quality, iodine status also needs to be monitored.

Baseline information on the population's iodine status is required to accurately design and implement a USI program. When a salt iodization program is in place, it is recommended to conduct a national urinary iodine survey every 3–5 years in order to make sure that the program is effective. Frequent monitoring of iodine status coupled with monitoring of salt quality will help to ensure that iodized salt is accessible, consumed, and that the level of iodine in salt is adequate (13). Monitoring also enables identification of high risk groups/ populations and pocket areas with high endemicity requiring additional measures beyond USI, or areas not yet reached by salt iodization. National representative data should be collected in order to elucidate regional variations and to allow effective evaluation of a national USI program. Through an effective monitoring system, excessive iodine intake can also be identified and corrected.

Urinary iodine concentration and goitre are the most common indicators to assess iodine status in a population. Urinary iodine is a good marker of recent dietary iodine intake whereas goitre reflects past iodine status. Goitre prevalence remains useful for initial assessment of the problem. However, urinary iodine, since it is a more sensitive indicator to recent changes, is the recommended indicator for evaluating the degree of iodine deficiency, and for monitoring and evaluating its correction (13). School-based sampling method is the most efficient and practical approach to monitor iodine deficiency (13). Iodine deficiency is considered to be a public health problem in populations of school aged children (6–12 years) where median urinary iodine concentration is below 100 μg/L (Table 3).

Table 3. Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations in school-age children

Median urinary iodine (μg/L)	Iodine intake	Iodine nutrition
<20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Optimal
200–299	More than adequate	Risk of iodine-induced hyperthyroidism
≥ 300	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid disease)

Adapted from reference (13).

The WHO Global Database on IDD

The WHO's mandate with regard to iodine deficiency is to assess the global magnitude of iodine deficiency, to monitor and evaluate the impact of strategies for its prevention and control, and to track trends over time. The Department of Nutrition for Health and Development manages the WHO Global Database on Iodine Deficiency Disorders that compiles data on urinary iodine and goitre prevalence from WHO Member States, presents them in a standardized way and makes them widely available on its website.

Data sources are collected from the scientific literature and through a wide network of national and international collaborators, including WHO regional and country offices, United Nations agencies, non-governmental organizations, Ministries of Health and other national institutions, as well as research and academic institutions.

Urinary iodine and goitre prevalence data are included from original reports and publications. Data from cross-sectional studies with population based sampling frame are eligible. Detailed information on the procedures, sampling method, survey design and administrative level (e.g. national, regional, province, district, local) used in each survey should be given in a comprehensive survey report.

When a potentially relevant survey is identified and the documentation is obtained, data are checked for consistency as part of routine data quality control. The available information is extracted from the documents and filled into a standard data-entry form. For clarification of any queries and to obtain any additional results, the data holders are contacted. The full documentation and correspondence are archived and made available to users on request.

As of October 2003, the database included 389 surveys on urinary iodine carried out from 1967 onwards: 116 national surveys from 85 countries and 273 subnational surveys from 96 countries. A total of 409 surveys are included for goitre carried out from 1946 onwards: 126 national surveys from 81 countries and 286 subnational surveys from 92 countries.

Based on available data the prevalence of iodine deficiency worldwide was estimated in 1993 (17) and

2003 (18). Data on urinary iodine in the time period 1993–2003 is available from 126 countries covering 92% of the global population (18). Globally, 54 countries are affected by iodine deficiency.

The evidence accumulated in the WHO Global Database on IDD has made it possible to compare magnitude, severity, trends, and geographical distributions of iodine deficiency in school age children worldwide. Additionally, this information provides a baseline for assessing national and global progress and helps encourage national government to take the necessary actions to implement and strengthen national IDD control programs.

When compiling information on urinary iodine from previously published reports, a restriction is that data quality checks are limited to the information provided. An effort by countries to adopt standardized approaches for data presentation is important to facilitate management not only within a country, but also to allow comparison between countries.

The quality of urinary iodine data also depends on the capacity of national laboratories to carry out reliable measurements of urinary iodine. The International Resource Laboratory Network for Iodine (IRLI) was recently established to provide countries with the support needed to monitor effectively their IDD control programme and thereby improve data quality.

Future challenges for the database involve collection of individual data sets and reporting iodine nutrition in high-risk populations. In monitoring iodine status, median urinary iodine remains the key defining indicator. However, once the iodine content of salt has been consumed at a level that results in the normalisation of urinary iodine, attention may shift to the evaluation of actual thyroid function by the determination of the serum levels of thyroid hormones to ensure that iodine intake is enough to maintain normal thyroid function.

Conclusion

In 2002, the international community adopted the goal of sustained elimination of IDD by the year 2005. This goal requires collaboration among many different partners involved in IDD control. Iodine deficiency can re-appear if salt iodization is interrupted as a result of demobilization of the public health authorities or the lack of interest of the salt industry. To prevent such negligence and in order to assess sustainability and to track the progress towards the goal of IDD, monitoring of USI should include information on urinary iodine, household salt iodization coverage and programmatic indicators. A coordinated effort from all partners involved in iodine deficiency control to maintain consistent monitoring and evaluation is needed to meet the goal of sustained IDD elimination.

The WHO Global Database on iodine deficiency disorders and the report of prevalence of iodine deficiency worldwide are available on the WHO web-site (http://www3.who.int/whosis/micronutrient/). To provide data on iodine deficiency, please contact (micronutrients@who.int).

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