Current global iodine status and progress over the last decade towards the elimination of iodine deficiency

Maria Andersson,[1] Bahi Takkouche,[1, 2] Ines Egli,[1] Henrietta E. Allen,[1, 3] & Bruno de Benoist[1]

Objective To estimate worldwide iodine nutrition and monitor country progress towards sustained elimination of iodine deficiency disorders.

Methods Cross-sectional data on urinary iodine (UI) and total goitre prevalence (TGP) in school-age children from 1993–2003 compiled in the WHO Global Database on Iodine Deficiency were analysed. The median UI was used to classify countries according to the public health significance of their iodine nutrition status. Estimates of the global and regional populations with insufficient iodine intake were based on the proportion of each country's population with UI below 100 μg/l. TGP was computed for trend analysis over 10 years.

Findings UI data were available for 92.1% of the world's school-age children. Iodine deficiency is still a public health problem in 54 countries. A total of 36.5% (285 million) school-age children were estimated to have an insufficient iodine intake, ranging from 10.1% in the WHO Region of the Americas to 59.9% in the European Region. Extrapolating this prevalence to the general population generated an estimate of nearly two billion individuals with insufficient iodine intake. Iodine intake was more than adequate, or excessive, in 29 countries. Global TGP in the general population was 15.8%.

Conclusion Forty-three countries have reached optimal iodine nutrition. Strengthened UI monitoring is required to ensure that salt iodization is having the desired impact, to identify at-risk populations and to ensure sustainable prevention and control of iodine deficiency. Efforts to eliminate iodine deficiency should be maintained and expanded.

Keywords Iodine/deficiency/therapeutic use/urine; Goiter, endemic/epidemiology/prevention and control; Sodium chloride, Dietary/therapeutic use; Prevalence; Population surveillance/methods; World health; Health status indicators; Reference values; Meta-analysis; Child; Databases, Factual (*source: MeSH, NLM*).

Mots clés Iode/déficit/usage thérapeutique/urine; Goitre endémique/épidémiologie/prévention et contrôle; Chlorure sodium diététique/usage thérapeutique; Prévalence; Surveillance population/méthodes; Santé mondiale; Indicateur état sanitaire; Valeur référence; Méta-analyse; Enfant; Base données factuelles (*source: MeSH, INSERM*).

Palabras clave Yodo/deficiencia/uso terapéutico/orina; Bocio endémico/epidemiología/prevención y control; Cloruro de sodio dietético/uso terapéutico; Prevalencia; Vigilancia de la población/métodos; Salud mundial; Indicadores de salud; Valores de referencia; Meta-análisis; Niño; Bases de datos factuales (*fuente: DeCS, BIREME*).

Arabic

Bulletin of the World Health Organization 2005;83:518-525.

Voir page 523 le résumé en français. En la página 524 figura un resumen en español.

Introduction

Iodine deficiency is a major threat to the health and development of populations worldwide, particularly in preschool children and pregnant women. When requirements for iodine are not met, thyroid hormone synthesis is impaired, resulting in a series of functional and developmental abnormalities collectively referred to as iodine deficiency disorders (IDD) (*1*). Conditions related to iodine deficiency include goitre, stillbirth and miscarriage, hypothyroidism and impaired growth. However, the most devastating toll is from the mental and neurological disorders resulting from brain damage; preventing these is the primary motivation behind the current worldwide drive to eliminate iodine deficiency. Although cretinism is the most extreme manifestation, the more subtle degrees of mental impairment leading to poor school performance, reduced intellectual ability and impaired work capacity are of considerably greater significance (*2*, *3*).

Universal salt iodization (USI), defined as iodization of all salt used for human and animal consumption, is the main

[1] Department of Nutrition for Health and Development, World Health Organization, 1211 Geneva 27, Switzerland. Correspondence should be sent to Dr de Benoist at this address (email: debenoistb@who.int).

[2] Department of Preventive Medicine, University of Santiago de Compostela, Santiago de Compostela, Spain.

[3] Parasitic Diseases and Vector Control, World Health Organization, Geneva, Switzerland.

Ref. No. **04-015669**

(*Submitted: 28 June 2004 – Final revised version received: 19 November 2004 – Accepted: 23 November 2004*)

strategy used to control iodine deficiency (*4*, *5*). Iodine supplementation is usually restricted to areas in which severe iodine deficiency is endemic, and which have no access to iodized salt (*5*, *6*). In most countries where iodine deficiency has been identified as a public health problem, control measures have been implemented (*7*). Globally, 66% of households now have access to iodized salt (*8*).

Until the 1990s total goitre prevalence (TGP) was used as the main indicator for assessing iodine deficiency in a population. However, TGP is of limited utility in assessing the impact of salt iodization. This is primarily because it takes a long time for goitre to disappear following the introduction of iodized salt. As urinary iodine (UI) is a more sensitive indicator of recent changes in iodine intake, this indicator is now recommended rather than TGP (*5*).

In 1960, WHO published the first global review on the extent of endemic goitre (*9*). This review, covering 115 countries, was instrumental in focusing attention on the scale of the public health problem. WHO subsequently established a global database on iodine deficiency which currently holds data from surveys conducted from the 1940s to the present day (*10*). Its objective is to assess the global magnitude of iodine deficiency, to evaluate the strategies for its control and to monitor each country's progress towards achieving the international community's goal of the elimination of IDD (*11, 12*). In 1993, using data from 121 countries, WHO published revised global estimates on the prevalence of iodine deficiency based on TGP (*13*). Given the increasing number of countries that have launched salt iodization programmes and conducted surveys to assess iodine status since then, updated global estimates of iodine deficiency are now considered necessary. This article presents worldwide estimates of iodine nutrition based on UI. TGP was also used to compare the current situation with the 1993 estimates (*13*).

Methods

Data sources — WHO Global Database on Iodine Deficiency

The WHO Global Database on Iodine Deficiency compiles country data on UI and TGP and presents them in a standardized and easily accessible format.

Data are collected from the scientific literature and through a broad network of collaborators, including WHO regional and country offices, UN organizations, nongovernmental organizations, ministries of health, other national institutions, and research and academic institutions. MEDLINE (1966–2003) and regional databases (African Index Medicus, Index Medicus for the WHO Eastern Mediterranean Region, Latin American and Caribbean Center on Health Sciences Information, Pan American Health Organization Library Institutional Memory Database and Index Medicus for the South-East Asia Region) are also systematically searched. Articles published in non-indexed medical and professional journals and reports from principal investigators are also searched. Data are extracted from reports written in any language.

For inclusion in the database, a complete original survey report providing details of the sampling method used is necessary. Studies must have a population-based sample frame and must use standard UI and TGP measuring techniques (*5*). Only TGP data obtained by measuring goitre by palpation are included. Until recently no international reference values for thyroid size measured by ultrasonography were available, and thus results from surveys using this technique have not yet been included (*14*).

When a potentially relevant survey is identified and the full report obtained, all data are checked for consistency as part of routine quality control. When necessary, the authors are contacted for clarification or additional information. Final data are extracted and entered into a standard data form. The full archive of documentation and correspondence is available to users on request.

As of June 2003, the database contained 389 UI surveys and 409 goitre surveys. Surveys received at WHO after this date were not included in this analysis, but are available in the online database and will be included in a future analysis (*10*).

Data selection and analysis

Data collected between 1993 and 2003, available to WHO in June 2003, were reviewed for WHO's 192 Member States. Data on UI and TGP were selected for each country using two variables: the administrative level for which the population sample was representative (national or subnational) and the population groups surveyed (school-age children or other).

Whenever available, data from the most recent national survey — defined as those that used a nationally representative sample — were used in preference to subnational (regional, provincial, district or local) surveys. WHO recommends that iodine status be regularly assessed (*5*). Thus, if a national survey was 5 years old or more, and more recent subnational data were

Table 1. **Epidemiological criteria for assessing iodine nutrition based on median urinary iodine (UI) concentrations in school-age children**

Median UI (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 within 5–10 years following introduction of iodized salt in susceptible groups
⩾ 300	Excessive	Risk of adverse health consequences (iodine induced hyperthyroidism, autoimmune thyroid diseases)

Source (*5*).

Table 2. **Equations used for predicting missing values based on a sub-sample of studies carried out among non-overlapping populations**

Predicted variable	Predictor	Intercept	Slope/coefficients	R^2
Median	Mean	1.128	0.864	0.93
Mean	Median	7.447	1.081	0.93
Median	% UI[a] < 100 μg/l	277.67	4.96 (% UI < 100 μg/l) + 0.0254 (% UI < 100 μg/l)^2	0.83
% UI < 100 μg/l	Median	86.3	–0.324	0.83
TGP[b] general population	TGP school-age children	0.954	0.742	0.94

[a] UI = urinary iodine.
[b] TGP, thyroid goitre prevalence.

available, preference was given to the subnational data to reflect current USI regulations and recent changes in iodine status.

In the absence of national data, subnational data were used. When two or more subnational surveys of the same subnational level had been carried out in different locations in the same country during the analysis period, these survey results were pooled into a single summary measure, using a weighted sample size for each survey. When, as in a few cases, information on sample size was missing for one subnational survey, it was assumed to have a number of subjects equal to the average sample size of the other surveys included in the pooling.

Exceptionally, data from different subnational levels were pooled, for example a survey carried out in the capital city, classified as local, was pooled with a district-level survey.

WHO recommends that iodine deficiency surveys examine school-age children aged from 6 to 12 years (*5*). When data for this age group were not available, data on the next closest age group were used in the following order of priority: data from the children closest to school age, adults, the general population, preschool-age children, other population groups.

Urinary iodine

Because UI values from populations are not usually normally distributed, the median rather than the mean is used as a measure of central tendency (*5*). Countries were classified as having different degrees of public health significance using WHO median UI cut-off points (Table 1). Iodine deficiency is considered to be a public health problem in countries in which the median UI is below 100 μg/l (*5*). Regional and global populations with insufficient iodine intake were estimated on the basis of the proportion of the population with UI below 100 μg/l in each country. The proportion of the population with iodine deficiency was subsequently used to estimate the total proportions with iodine deficiency in the regional population of school-age children and the general population. The same principle was applied to generate global estimates.

For subnational data, the proportion of populations with UI below 100 μg/l were pooled into a single summary measure. Since direct pooling of medians may give rise to erroneous results in the absence of a normal distribution, means were first pooled. The estimated mean obtained was then converted into a pooled median through simple linear regression (Table 2).

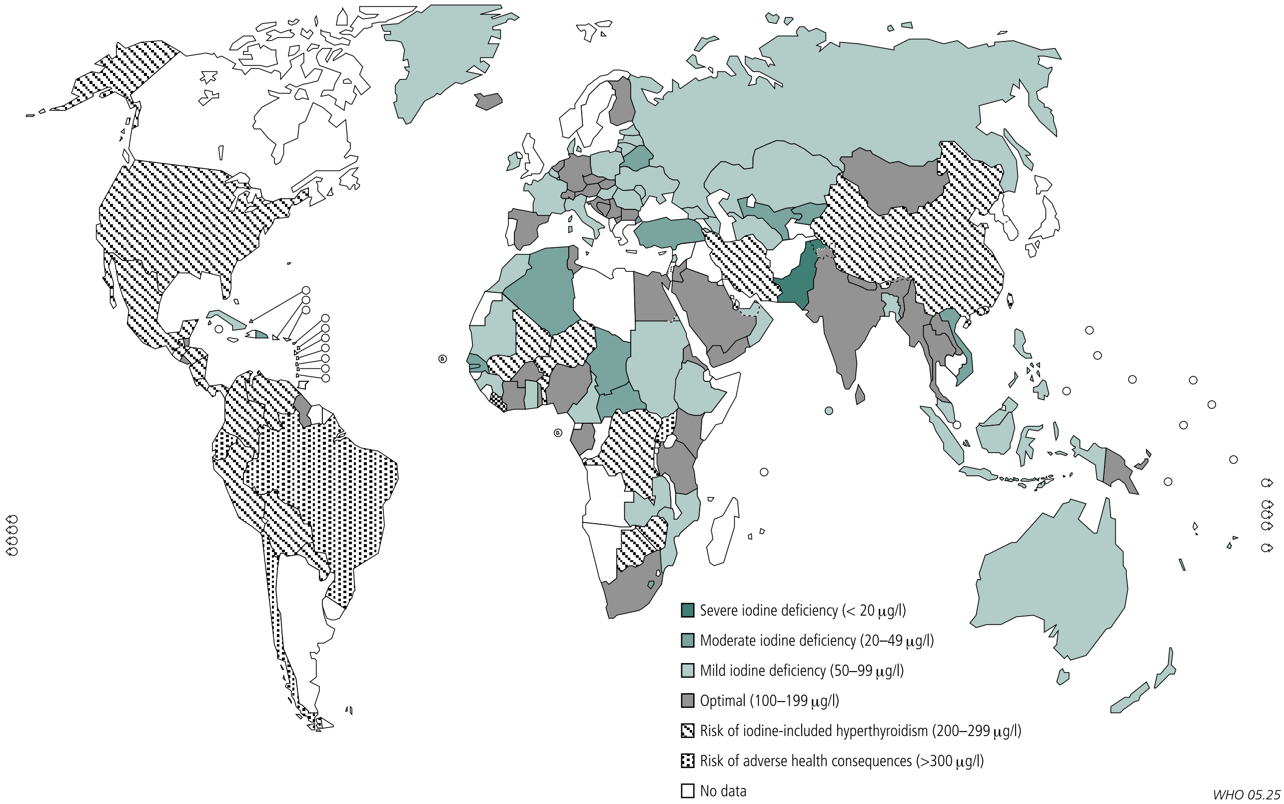
Some survey reports gave only one of the above measures, or provided means instead of medians. In such cases, equations to derive one measure from another were obtained from models generated from subsamples of the database (*15*). Data points from non-overlapping populations presenting medians, means and proportions of subjects with UI below 100 μg/l, allowed modelling to be undertaken. Details of the equations used are given in Table 2. To avoid obviously erroneous values, countries with high medians (> 300 μg/l) were assigned a proportion of UI values below 100 μg/l of 0%, rather than the value predicted by the equation.

Table 3. **School-age children (6–12 years): population coverage by urinary iodine and total goitre prevalence surveys carried out between 1993 and 2003, by WHO region**

WHO region[a]	Total number of school-age children (millions)[b]	Urinary iodine		Total goitre prevalence	
		Number (millions)	Proportion (%)	Number (millions)[a]	Proportion (%)
Africa	128.9	116.9	90.7	117.6	91.2
Americas	109.0	98.8	90.6	50.7	46.5
South-East Asia	242.4	239.4	98.8	232.1	95.7
Europe	81.2	70.5	86.8	46.9	57.8
Eastern Mediterranean	87.1	72.6	83.4	76.5	87.8
Western Pacific	199.4	183.0	91.8	184.0	92.3
Total	**848.0**	**781.2**	**92.1**	**707.7**	**83.5**

[a] 192 WHO Member States.
[b] Based on population estimates for the year 2002.
Source (*16*).

Fig. 1. **Degree of public health significance of iodine nutrition based on median urinary iodine**



Total goitre prevalence

In order to compare the present TGP data, which are derived from information on school-age children, with the 1993 TGP estimates which were generated for the general population, a model-based equation was derived from surveys that measured prevalence in both populations (Table 2). The equation was then applied to the current national TGP for school-age children to convert it to TGP for the general population. Regional and global TGP were generated in the same way as for calculations of regional and global UI.

Results

Data on UI from surveys conducted between 1993 and 2003 were available for 126 countries and data on TGP were available from 100 countries. For the same time period, 92 countries had no data on goitre and 66 lacked urinary surveys. The available UI data covered 92.1% of the world's population of 6–12-year-olds (Table 3). Regional population coverage varied from 83.4% in the Eastern Mediterranean Region to 98.8% in the South-East Asia Region. Of the 126 countries for which UI data were available, 75 had made nationally representative surveys. Population coverage for TGP surveys was 83.5%, ranging from 46.5% in the Americas to 95.7% in South-East Asia.

In Fig. 1 countries are classified according to the six degrees of public health significance with respect to their iodine intake estimated from median UI (Table 1). In 54 countries the population had an insufficient iodine intake as indicated by a median UI below 100 μg/l. These countries were classified as iodine deficient: one country had severe iodine deficiency, 13 had moderate deficiency and 40 mild deficiency. In 43 countries, the population had adequate iodine intake with a median UI between 100 and 199 μg/l. Iodine nutrition in these countries was considered as optimal. In 24 countries, median UI was between 200 and 299 μg/l indicating that the population had a more than adequate iodine intake. In these countries, there is a risk of iodine-induced hyperthyroidism in susceptible groups. In five countries, there was excessive iodine intake as shown by a median UI above 300 μg/l. In these countries, there is a risk of iodine-induced hyperthyroidism and other adverse health consequences.

It is estimated that the iodine intake of 36.5% (285 million) school-age children worldwide is insufficient (Table 4). In South-East Asia, 96 million children had a low iodine intake and in Africa and the Western Pacific an estimated 50 million children had a low iodine intake. The figures for children with a low iodine intake in Europe and the Eastern Mediterranean are about 40 million children each, and in the Americas 10 million. The highest proportions of iodine-deficient children are found in Europe (59.9%) and South-East Asia (39.9%) while the lowest are found in the Americas (10.1%) and the Western Pacific (26.2%). Extrapolating from the proportion of school-age children to the general population, it is estimated that nearly two billion individuals have insufficient iodine intake (Table 4).

Globally, the TGP in the general population is estimated to be 15.8%, ranging from 4.7% in the Americas to 28.3% in Africa (Table 5). A comparison of current TGP estimates with the 1993 estimates showed that TGP had increased by 31.7% worldwide. This masks a decrease in two regions (46.0% in the Americas and 32.2% in the Western Pacific). All other regions experienced an increase in TGP ranging from 18.5% in South-East Asia to 81.4% in Africa.

Table 4. **Proportion of population and number of individuals with insufficient iodine intake in school-age children (6–12 years) and in the general population (all age groups), by WHO region, 2003**

WHO region[a]	Insufficient iodine intake (UI < 100 µg/l)			
	School-age children		General population	
	Proportion (%)	Total number (millions)[b]	Proportion (%)	Total number (millions)[b]
Africa	42.3	49.5	42.6	260.3
Americas	10.1	10.0	9.8	75.1
Europe	59.9	42.2	56.9	435.5
Eastern Mediterranean	55.4	40.2	54.1	228.5
South-East Asia	39.9	95.6	39.8	624.0
Western Pacific	26.2	48.0	24.0	365.3
Total	**36.5**	**285.4**	**35.2**	**1988.7**

[a] 192 WHO Member States.
[b] Based on population estimates in the year 2002.
Source (*16*).

Complete country-specific data are available in the WHO Global Database on Iodine Deficiency (*10*, *15*).

Discussion

Data gathered in the WHO Global Database on Iodine Deficiency permit the magnitude, severity and distribution of iodine deficiency worldwide to be described and facilitate the making of decisions on the most effective strategy for eliminating iodine deficiency. Estimates of iodine nutrition were calculated based on UI data available from 126 countries, representing 92.1% of the world's population of school-age children (Table 3). The current estimates are thus believed to be an accurate reflection of the situation. The 66 countries for which data were lacking, or for which no recent data were available, are mainly small countries (half of them with a total population of fewer than a million inhabitants) representing only 7.9% of the world's school-age population. Some countries have not carried out UI surveys simply because they have never considered iodine deficiency to be a public health problem.

The estimates presented are subject to several limitations. Sixty per cent of countries had made nationally representative surveys; the remainder had made only one or more subnational surveys. The lack of nationally representative surveys may lead to substantial bias. Underestimation may occur when parts of a country which may have inadequate iodine nutrition, have not been surveyed. Overestimation may occur when the population of one or more region(s) in which iodine deficiency is endemic is over-sampled. The data for some countries are still weak which makes classification and accurate analysis of their national situation difficult. For example, large countries like India and Spain with previously known endemic areas and regional differences in iodine status had no nationally representative data, but had data from many local and regional surveys. The overall results of pooling the subnational data indicate optimal iodine nutrition in these countries. In the absence of nationally representative data, the whole country has therefore been classified accordingly, when in fact the national situation might be different. Thus, the methods used for pooling subnational survey results into one summary measure are not ideal. Nevertheless, they are regarded as the best estimate available in the absence of nationally representative data.

Table 5. **Change in total goitre prevalence (TGP) between 1993 and 2003, by WHO region**

WHO region[a]	General population TGP (%)		Percentage change
	1993	2003	
Africa	15.6	28.3	+81.4
Americas	8.7	4.7	–46.0
Eastern Mediterranean	22.9	37.3	+62.9
Europe	11.4	20.6	+80.7
South-East Asia	13.0	15.4	+18.5
Western Pacific	9.0	6.1	–32.2
Total	**12.0**	**15.8**	**+31.7**

[a] 192 WHO Member States.

The data compiled in the database are extracted from final publications and reports, which present data in various formats and with varying degrees of analysis. The models developed to standardize the data and derive one measure from another are also potential sources of error. Raw data sets are not available in the database and thus render any further verification impossible.

These limitations highlight the need to improve data quality. It is important for countries to conduct nationally representative surveys on a regular basis and to ensure representative samples. Standardized data collection and presentation will also aid the comparison of countries and regions, allow for more precise monitoring and reduce the range of uncertainty around future global estimates of iodine nutrition.

WHO recommends that school-age children are surveyed to assess iodine status because they are readily accessible and their iodine status is an acceptable proxy for the iodine status of the general population. Results of surveys of school-age children were thus extrapolated to the general population (Table 4). However, national systems to monitor the impact of USI also need to include other vulnerable groups, especially pregnant women, who may be considered for future global analysis as more data become available.

Salt iodization is an effective strategy for reducing iodine deficiency. Iodine nutrition is optimal in 43 countries (Fig. 1). The number of countries in which iodine deficiency was a public health problem decreased from 110 to 54 between 1993 (using TGP as an indicator) and 2003 (using UI). Nevertheless iodine nutrition is still inadequate in 54 countries. In these countries USI needs to be strengthened and fully implemented. Iodine intake was more than adequate or even excessive, with a median UI above 200 µg/l, in 29 countries. Here attention should be drawn to the emerging risk of iodine-induced hyperthyroidism in susceptible groups following the introduction of iodized salt. Salt-quality monitoring should be reinforced to ensure that the level of iodine in salt is not too high, but is adequate to ensure optimal iodine nutrition.

Overall, one-third of the world's school-age children population had UI below 100 µg/l indicating insufficient iodine intake (Table 4). This group is therefore exposed to the risk of iodine deficiency. For the six WHO regions, the proportion of the population with UI below 100 µg/l ranged from 10% (in the Americas) to 60% (in Europe). Noteworthy is the correlation between household coverage of iodized salt and prevalence of low iodine intake. The Americas has the highest number of households consuming iodized salt (90%) and the lowest proportion of the population with an insufficient iodine intake. In contrast, the European Region which has the lowest household consumption of iodized salt (27%), has the highest proportion of the population with an insufficient iodine intake (*7*, *8*). These results, however, should not mask the fact that there are large variations between countries within regions, and within countries themselves.

The worldwide TGP of 15.8% is above the 5% cut-off point used to signal a public health problem. However, the TGP increase of 31.7% between 1993 and 2003 is inconsistent with current iodine status based on UI. This has several possible explanations.

First, there is a time-lag between the implementation of a salt iodization programme and the disappearance of clinically detectable goitre (*17*). This time-lag may be further increased when USI is only partially implemented.

Second, 70% of the TGP surveys in the analysis period (1993–2003) were carried out between 1993 and 1998, i.e. before the extensive implementation of USI programmes. In fact, when analysis is restricted to surveys carried out in the last 5 years, TGP is 28.9% lower than in 1993. Data available in the WHO database also show that between 1993 and 1998, TGP was the main indicator used to assess iodine deficiency. Since that time, there has been a gradual shift towards the use of UI as the preferred indicator and consequently over the past 5 years, there have been more data collected on UI than on TGP.

Third, in areas affected by mild iodine deficiency, the sensitivity and specificity of TGP measured by palpation are poor (*18*). Ultrasonography is a promising method to overcome the inherent limitations of the clinical assessment of thyroid volume as iodine status improves. New international reference values are now available allowing comparison between countries (*14*).

In spite of its limitations for global trend analysis, TGP remains a practical indicator for baseline assessment, especially in areas where severe iodine deficiency is endemic (*5*, *19*).

In conclusion, there has been substantial progress in the last decade towards the elimination of iodine deficiency. However, continued efforts are needed to cover at-risk populations and salt iodization programmes need to be strengthened and maintained in order to reach the goal of eliminating IDD. Current estimates of iodine deficiency based on UI provide the baseline for future global estimates. The challenge now is to improve data quality in order to trigger appropriate and timely interventions and to track progress more accurately and rapidly. ■

Acknowledgements

The authors wish to thank the numerous individuals, institutions, governments, national and international nongovernmental organizations, and UN-agencies, especially UNICEF, for providing data. Without such a continual international collaboration in keeping the WHO Global Database on Iodine Deficiency up-to-date this compilation of data on worldwide patterns and trends in iodine deficiency would not have been possible. We also wish to thank Grace Rob, WHO, Geneva, Switzerland for her assistance in data management. The database was developed with the financial support of UNICEF, through a grant from the Bill and Melinda Gates Foundation.

Competing interests: none declared.

Résumé

La carence en iode dans le monde aujourd'hui et les progrès réalisés au cours de la dernière décennie en vue de son élimination

Objectif Procéder partout dans le monde à des estimations des apports nutritionnels en iode et surveiller les progrès réalisés dans les pays en vue de l'élimination durable des troubles dus à une carence en iode.

Méthodes On a analysé les données transversales relatives à l'iode urinaire (IU) et la prévalence totale du goitre chez les enfants d'âge scolaire entre 1993 et 2003, à partir de la base de données mondiale sur la carence en iode de l'Organisation mondiale de la Santé. L'iode urinaire médian a été utilisé pour classer les pays en fonction de l'importance des apports nutritionnels en iode pour la santé publique. Les estimations relatives aux populations mondiales et régionales dont les apports en iode sont insuffisants ont été basées sur la proportion de personnes qui, dans chaque pays, ont une valeur de l'IU inférieure à 100 µg/l. On a analysé par ordinateur la tendance présentée par la prévalence totale du goitre sur 10 ans.

Résultats Des données relatives à l'iode urinaire étaient disponibles pour 92,1 % des enfants d'âge scolaire dans le monde. La carence en iode constitue toujours un problème de santé publique dans 54 pays. Au total, les estimations ont montré qu'il y avait 36,5 % d'enfants d'âge scolaire (285 millions) dont les apports en iode étaient insuffisants, la couverture des besoins allant de 10,1 % dans la Région des Amériques à 59,9 % dans la Région européenne. En extrapolant ces résultats à la population générale, on obtient une prévalence estimée de près de deux milliards d'individus carencés en iode. Cet apport en iode est plus

que suffisant, voire excessif, dans 29 pays. La prévalence totale du goitre dans la population générale mondiale est de 15,8 %.
Conclusion Quarante-trois pays ont réussi à garantir un apport nutritionnel en iode optimal. Une surveillance renforcée de l'iode urinaire est nécessaire pour veiller à ce que l'iodation du sel donne les résultats escomptés, pour identifier les populations à risque et assurer une prévention durable de la carence en iode et sa correction. Les efforts visant à éliminer la carence en iode doivent être poursuivis et multipliés.

Resumen

Situación mundial en relación con el yodo y progresos de la última década hacia la eliminación de la carencia de yodo

Objetivo Estimar la situación del aporte nutricional de yodo en todo el mundo y vigilar los progresos realizados por los países hacia la eliminación sostenida de los trastornos por carencia de yodo.
Métodos Se analizó un conjunto de datos transversales sobre el yodo urinario (YU) y la prevalencia total de bocio (PTB) en niños en edad escolar entre 1993 y 2003, extraídos de la Base de Datos Mundial sobre la Carencia de Yodo de la Organización Mundial de la Salud. Se usó la mediana del YU para clasificar los países de acuerdo con el impacto de salud pública de su situación en cuanto al aporte nutricional de yodo. Las estimaciones de las poblaciones mundial y regionales con ingesta insuficiente de yodo se basaron en la proporción de la población de cada país con unas concentraciones de YU inferiores a 100 μg/l. Se calculó la PTB para realizar un análisis de tendencias a lo largo de 10 años.
Resultados Se disponía de datos sobre el YU del 92,1% de los niños en edad escolar de todo el mundo. La carencia de yodo representa aún un problema de salud pública en 54 países. Se estimó que un 36,5% (285 millones) de los escolares no consumían la cantidad necesaria de yodo, oscilando el porcentaje entre el 10,1% de la Región de las Américas de la OMS y el 59,9% de la Región de Europa. La extrapolación de esta prevalencia a la población general llevó a estimar en casi 2000 millones las personas con aporte insuficiente de yodo. La ingesta de yodo era más que suficiente, cuando no excesiva, en 29 países. La PTB mundial en la población general era del 15,8%.
Conclusión Un total de 43 países han alcanzado una situación óptima en cuanto al aporte de yodo. Es preciso reforzar la vigilancia del YU para comprobar que la yodación de la sal tenga el impacto deseado, identificar las poblaciones en riesgo y garantizar unas medidas sostenibles de prevención y control de la carencia de yodo. Se deben mantener y expandir los esfuerzos encaminados a eliminar la carencia de yodo.

Arabic

References

1. Hetzel BS. Iodine deficiency disorders (IDD) and their eradication. *Lancet* 1983;8359:1126-9.
2. DeLong GR, Robbins J, Condliffe PG. *Iodine and the brain.* New York: Plenum Press; 1989.
3. Stanbury JB. *The damaged brain of iodine deficiency.* New York: Cognizant Communication Corporation; 1994.
4. World Health Organization, United Nations Children's Fund, International Council for Control of Iodine Deficiency Disorders. *Recommended iodine levels in salt and guidelines for monitoring their adequacy and effectiveness.* Geneva: World Health Organization; 1996. WHO document WHO/NUT/96.13.
5. World Health Organization, United Nations Children's Fund, International Council for Control of Iodine Deficiency Disorders. *Assessment of the iodine deficiency disorders and monitoring their elimination.* Geneva: World Health Organization; 2001. WHO document WHO/NHD/01.1.
6. Anonymous. Safe use of iodized oil to prevent iodine deficiency in pregnant women. A statement by the World Health Organization. *Bulletin of the World Health Organization* 1996;74:1-3.
7. World Health Organization, United Nations Children's Fund, International Council for Control of Iodine Deficiency Disorders. *Progress towards the elimination of iodine deficiency disorders (IDD).* Geneva: World Health Organization; 1999. WHO document WHO/NHD/99.4.
8. United Nations Children's Fund. *The state of the world's children 2004.* New York: United Nations Children's Fund; 2004.
9. World Health Organization. *Endemic goitre.* Geneva: World Health Organization; 1960.
10. World Health Organization. *The WHO Global Database on Iodine Deficiency.* Geneva: World Health Organization (cited May 2004). Available from: URL: http://www3.who.int/whosis/micronutrient/

11. World Health Organization. *National strategy for overcoming micronutrient malnutrition, Report to the Director General, 45th World Health Assembly.* Geneva: World Health Organization; 1992. WHO document WHA 45.33.
12. United Nations Children's Fund. *A world fit for children.* New York: United Nations Children's Fund; 2002.
13. World Health Organization, United Nations Children's Fund, International Council for Control of Iodine Deficiency Disorders. *Global prevalence of iodine deficiency disorders.* Geneva: World Health Organization; 1993. Micronutrient Deficiency Information System working paper 1.
14. Zimmermann MB, Hess SY, Molinari L, De Benoist B, Delange F, Braverman LE, et al. New reference values for thyroid volume by ultrasound in iodine-sufficient schoolchildren: a World Health Organization/Nutrition for Health and Development Iodine Deficiency Study Group Report. *The American Journal of Clinical Nutrition* 2004;79:231-7.
15. de Benoist B, Andersson M, Egli I, Takkouche B, Allen H, editors. *Iodine status worldwide. WHO Global Database on Iodine Deficiency.* Geneva: World Health Organization; 2004.
16. United Nations Population Division. *World population prospects: the 2002 revision.* New York: United Nations; 2003.
17. Delange F. Iodine deficiency in the world: where do we stand at the turn of the century? *Thyroid* 2001;11:437-47.
18. Zimmermann MB, Saad A, Hess SY, Torresani T, Chaouki N. Thyroid ultrasound compared with World Health Organization 1996 and 1994 palpation criteria for determination of goitre prevalence in regions of mild and severe iodine deficiency. *European Journal of Endocrinology* 2000;143:727-31.
19. Peterson S, Sanga A, Eklöf H, Bunga B, Taube A, Gebre-Medhin M, et al. Classification of thyroid size by palpation and ultrasonography in field surveys. *Lancet* 2000;355:106-10.