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Epidemiology of iodine deficiency: Salt iodisation and iodine status

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- iodised salt
- monitoring
- iodine status
- urinary iodine
- goitre
- epidemiology

Universal salt iodisation (USI) and iodine supplementation are highly effective strategies for preventing and controlling iodine deficiency. USI is now implemented in nearly all countries worldwide, and two-thirds of the world's population is covered by iodised salt. The number of countries with iodine deficiency as a national public health problem has decreased from 110 in 1993 to 47 in 2007. Still one-third of households lack access to adequately iodised salt. Iodine deficiency remains a major threat to the health and development of populations around the world, particularly in children and pregnant women in low-income countries. Data on iodine status are available from 130 countries and approximately one-third of the global population is estimated to have a low iodine intake based on urinary iodine (UI) concentrations. Insufficient control of iodine fortification levels has led to excessive iodine intakes in 34 countries. The challenges ahead lie in ensuring higher coverage of adequately iodised salt, strengthening regular monitoring of salt iodisation and iodine status in the population, together with targeted interventions for vulnerable population groups.

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The introduction of universal salt iodisation (USI) as a global strategy to control iodine deficiency is approaching its 20th anniversary. Iodine deficiency is the result of insufficient dietary iodine intake and the physiological consequence is abnormal thyroid function, hypothyroidism and goitre. Low iodine intake is the most common cause of preventable mental impairment worldwide, which is why there is a global drive to eliminate iodine deficiency through the highly effective strategies of salt iodisation and iodine supplementation.

The first comprehensive global review of iodine deficiency was made by the World Health Organization (WHO) in 1960 when national goitre rates up to 50% were reported. A subsequent review in 1993 estimated a global total goitre prevalence of 12%, with 655 million individuals in 110 countries having palpable goitre. Since then, the expansion of USI and interventions with iodine supplements has made tremendous progress. USI programmes are now implemented in most countries where iodine deficiency was identified as a public health problem. The indicator for measuring the prevalence of iodine deficiency has also changed from goitre prevalence to median urinary iodine (UI) concentration. Since 2001, UI concentration is the recommended indicator for monitoring iodine status. The shift from clinical to biochemical assessment of iodine status has improved the availability and quality of nationally representative iodine deficiency prevalence data. The magnitude of iodine deficiency, based on UI concentration, was more recently estimated by the WHO in 2003 and 2007. This article reviews the latest global data on salt iodisation and the most recent global and regional estimates of iodine deficiency. We also describe the current and future trends in population-based monitoring of iodine status.

Salt iodisation coverage

To monitor the progress of USI, the United Nations Children’s Fund (UNICEF) compiles country data on the proportion of households consuming adequately iodised salt in the UNICEF Global Database on Iodised Salt Consumption. Data are derived from national household surveys (Multiple Indicator Cluster Surveys, Demographic and Health Surveys and national nutrition surveys) testing iodine levels in household salt. An adequate iodine level in household salt is defined as salt containing 15–40 mg iodine kg$^{-1}$. The data compiled by UNICEF are mainly from developing countries and countries in transition. Household coverage data from industrialised countries are limited.

More than two-thirds (68%) of households worldwide are using salt containing $>15$ mg iodine kg$^{-1}$ salt. Out of 123 countries with data, 34 countries have attained salt iodisation with the international goal of at least 90% of households consuming adequately iodised salt. In Europe, only 9 of 40 countries have reported coverage at the household level of at least 90%.

We analysed the current UNICEF data and estimated the number of school-age children (6–12 years) still not covered by iodised salt by the WHO region. Survey data coverage was calculated by dividing the school-age children population in countries with data with the total school-age children population in all countries. The number of children without access to adequately iodised salt was calculated at the country level by applying the proportion of population with iodised salt household coverage <90% to the national population of children aged 6–12 years (90–100% coverage: assigned 0; <90% coverage: 100% minus the coverage). The total number of children without access was calculated by summing the number of individuals with national household salt coverage <90% for each country and dividing the sum by the total population of all countries with available data. In the absence of uniform country data on the proportion of households with children, it was assumed that the proportion of households consuming iodised salt is equal to the proportion of children consuming iodised salt.

Data are available for 122 WHO member-states, of which 110 are developing countries, covering 88.4% of the total school-age children population (Table 1). All countries have implemented salt iodisation, albeit to various degrees. The UNICEF data show that 88 countries have not yet achieved ≥90% of household coverage. Almost one-third (31.4%) of school-age children, 232.3 million, do not have access to iodised salt (Table 2). Those with the greatest access are children living in the WHO regions of
the Western Pacific and the Americas, and those with the least access are children residing in the Eastern Mediterranean region.

Trend analysis

The percentage of households covered by adequately iodised salt increased from <10% to 66% between 1990 and 2002. The increase over the past 5 years (between 2002 and 2007) has been from 66% to 68%. The data indicate that the penetration of adequately iodised salt in households worldwide is slowing. There are several reasons for this trend, including limited consumer awareness and availability of iodised salt. The iodine level and salt quality is as important as iodised salt coverage. In recent years, several countries have identified gaps between labelled iodine content and appropriate iodine levels measured in salt at the household level. In India, the national average of self reported consumption is 76.1%, but only 51.1% of Indians consume adequately iodised salt as measured by the National Family Health Survey (NFHS-3) 2005–2006. Inconsistent production or limitations in quality-controlled iodisation technology at the factory, poor packaging and ineffective transport channels may be explanations for varying iodine levels and iodine losses, resulting in inadequate amounts of iodine in salt at the households. Further obstacles to the implementation of USI are: difficulties in enforcing legislation on iodised salt; problems caused by having a high number of small-

Table 1
Data coverage: school-age children (6–12 years) population coverage by iodized salt household coverage surveys carried out between 2000 and 2006 and urinary iodine (UI) surveys carried out between 1993 and 2006, by WHO region.

<table>
<thead>
<tr>
<th>WHO region</th>
<th>Total no. of school-age children (millions)</th>
<th>Data coverage for school-age children</th>
<th>Consumption of iodized salt</th>
<th>Urinary iodine (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Countries (n)</td>
<td>Total no. (millions)</td>
<td>Proportion (%)</td>
<td>Countries (n)</td>
</tr>
<tr>
<td>Africa</td>
<td>141.3</td>
<td>44</td>
<td>139.8</td>
<td>98.9</td>
</tr>
<tr>
<td>Americas</td>
<td>109.1</td>
<td>23</td>
<td>76.8</td>
<td>70.4</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>241.4</td>
<td>11</td>
<td>241.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Europe</td>
<td>73.8</td>
<td>20</td>
<td>37.5</td>
<td>50.8</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>88.7</td>
<td>16</td>
<td>82.1</td>
<td>92.5</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>183.2</td>
<td>8</td>
<td>162.8</td>
<td>88.9</td>
</tr>
<tr>
<td>Total</td>
<td>837.5</td>
<td>122</td>
<td>740.3</td>
<td>88.4</td>
</tr>
</tbody>
</table>

a 193 WHO Member States.

Table 2
Number of countries, proportion of school-age children (6–12 years) and number of children with inadequate iodized salt coverage (% of households <90%), by WHO region, 2007.

<table>
<thead>
<tr>
<th>WHO region</th>
<th>Inadequate iodized salt coverage (% households &lt;90%)</th>
<th>School-age children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Countries (n)</td>
<td>Proportion (%)</td>
</tr>
<tr>
<td>Africa</td>
<td>38</td>
<td>34.4</td>
</tr>
<tr>
<td>Americas</td>
<td>8</td>
<td>10.1</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>9</td>
<td>42.3</td>
</tr>
<tr>
<td>Europe</td>
<td>15</td>
<td>45.2</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>12</td>
<td>59.5</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>6</td>
<td>5.2</td>
</tr>
<tr>
<td>Total</td>
<td>88</td>
<td>31.4</td>
</tr>
</tbody>
</table>

a 193 WHO Member States.
b Based on latest survey data. Adapted from UNICEF 2009.
c Based on population estimates in the year 2005.
scale salt producers and the absence of an effective operational monitoring system. Another limitation to determining the global situation of iodised salt coverage is the lag time in data reporting and old survey data from some countries. The UNICEF estimates are based on the most recent national survey available in the timeframe 2000–2007. As household surveys are generally carried out only every 3–5 years, recent initiatives to improve iodisation programmes may not show immediate changes in the global statistics. A further limitation is the restricted availability of data from industrialised countries. Assessment of household consumption of iodised salt is not an optimal indicator in western countries and in countries in transition where a large proportion of the total salt intake comes from processed foods (up to 75%). In Europe, 23 out of 40 countries have some legislation or regulation in place covering USI at the household level, but legislation covering processed food is rare and only one-half of the European countries have a national monitoring programme.

Recently, the use of salt as vehicle for food fortification has been questioned after the issue of recommendations for reduced salt intake for the prevention of cardiovascular disease. A recent WHO expert consultation found no conflict between reducing salt consumption and maintaining the USI strategy. The current guidelines recommend a level of fortification of 20–40 mg iodine g⁻¹ salt and is based on the assumption of an average salt intake of 10 g per day at the population level. With reduced salt intakes, the average national level of salt intake in the population must guide the level of fortification and the iodine intake must be closely monitored.

Additional alternative vehicles for iodine fortification may be explored to complement reduced iodine intake in populations where iodised salt consumption decrease. Other vehicles for iodine fortification have been used with success, such as iodised salt in bread in Holland, Denmark, New Zealand and Tasmanian, iodisation of water in areas of China and Thailand and iodised cow fodder with improved milk iodine content in countries such as Norway and Finland. Iodine supplementation with iodised oil or iodine tablets is recommended in areas with moderate-to-severe deficiency or in areas with insufficient access to iodised salt for some groups within the population, such as pregnant women and young children. Yet, USI is still the most feasible and cost-effective approach for iodine deficiency control worldwide.

Indicators of iodine status

Iodine nutrition: urinary iodine concentration

Iodine nutrition in populations is assessed by measuring the UI concentration in spot urine samples. UI concentrations reflect recent changes in iodine intake and thus allow for monitoring intakes over time and comparison between countries. Easy methods for the collection and analysis of UI have allowed this indicator to be widely used in population-based assessments of iodine status. Only a small volume (3 ml) of urine is required and can be collected at any time of the day in population-based studies samples. A new urine collection method using a pad technique makes the assessment of UI concentrations now feasible in newborns, infants and preschool-age children.

National population-based UI monitoring is recommended in school-age children (6–12 years old), every 5 years. Iodine status in school-age children serves as proxy for the general population, as schools are relatively easy to access for large-scale studies in countries at all developmental stages. However, whether school children are good proxy for the population groups most vulnerable to iodine deficiency, such as young children and pregnant women, needs further investigation. The recommended study design is a cross-sectional 30-cluster survey design with at least 30 children per cluster. A minimum of 100–500 spot urine samples are required for each group or subgroup, depending on the variation of iodine intake within the population and the precision of the estimates.

Classification of iodine nutritional status is based on the population median UI. In school-age children, iodine deficiency is considered to be a public health problem in countries in which the median UI is <100 μg l⁻¹, because this indicates an insufficient iodine intake. Table 3 shows the recommended levels for daily iodine intake and for optimal iodine nutrition by age and population group.
a population based on median or range of UI concentrations are listed in Table 4. These ranges are meant for population studies and should not be applied to individuals.25,28

Thyroid function: goitre, newborn thyroid-stimulating hormone and blood thyroglobulin

The ultimate objective of an iodine intervention is to correct thyroid function.29 The optimal range of iodine intake is relatively narrow and both low and high iodine intakes may interfere with thyroid function.7,30 Historically, goitre was the main indicator of thyroid function.3 However, thyroid size might not return to normal for months or years after correction of iodine deficiency.31 Thyroglobin and newborn thyroid-stimulating hormone (TSH) are, more responsive indicators of thyroid function in populations.1,7,32,33 (Table 5). Newborn TSH obtained in whole blood collected 3–4 days after birth is a sensitive indicator of iodine status in the newborn period.32,34,35 A few drops of whole blood are collected on filter paper from the cord or by heel prick. Studies performed in iodine-sufficient populations suggest the cut-off for defining iodine deficiency in a population is a prevalence of >3% of newborn TSH values above 5 mU l−1.36,37 A field-friendly assay for thyroglobulin has similarly been developed for dried blood spots, taken by a finger prick.38,39 In prospective intervention studies, dried

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**Table 3**
Recommended nutrient intake for iodine by age or population group and epidemiological criteria for assessing adequate iodine intake based on median urinary iodine concentrations of populations.7

<table>
<thead>
<tr>
<th>WHO recommendations</th>
<th>Iodine intake (µg per day)</th>
<th>UI concentration for adequate intake (µg l−1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children 0–5 years</td>
<td>90</td>
<td>≥100 µg l−1</td>
</tr>
<tr>
<td>Children 6–12 years</td>
<td>120</td>
<td>100–199 µg l−1</td>
</tr>
<tr>
<td>Children ≥12 years + adults</td>
<td>150</td>
<td>100–199 µg l−1</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>250</td>
<td>150–249 µg l−1</td>
</tr>
<tr>
<td>Lactation</td>
<td>250</td>
<td>≥100 µg l−1</td>
</tr>
</tbody>
</table>

* For children <2 years of age.

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**Table 4**
Epidemiological criteria for assessment of iodine nutrition in a population based on median or range of urinary iodine concentrations, or both UI cut offs.7,24

<table>
<thead>
<tr>
<th>Iodine intake</th>
<th>Iodine nutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20 µg l−1</td>
<td>Insufficient</td>
</tr>
<tr>
<td>20–49 µg l−1</td>
<td>Severe iodine deficiency</td>
</tr>
<tr>
<td>50–99 µg l−1</td>
<td>Moderate iodine deficiency</td>
</tr>
<tr>
<td>100–199 µg l−1</td>
<td>Mild iodine deficiency</td>
</tr>
<tr>
<td>200–299 µg l−1</td>
<td>Adequate</td>
</tr>
<tr>
<td>&gt;300 µg l−1</td>
<td>Excessive</td>
</tr>
<tr>
<td>&lt;150 µg l−1</td>
<td>Insufficient</td>
</tr>
<tr>
<td>150–249 µg l−1</td>
<td>More than adequate</td>
</tr>
<tr>
<td>&gt;250 µg l−1</td>
<td>Risk of iodine-induced hyperthyroidism in susceptible groups</td>
</tr>
<tr>
<td>≥500 µg l−1</td>
<td>Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid disease)</td>
</tr>
</tbody>
</table>

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* The term excessive means in excess of the amount needed to prevent and control iodine deficiency.

In lactating women, the numbers for median urinary iodine are lower than the iodine requirements, because of the iodine excreted in breastmilk.
blood spot thyroglobulin has been shown to be a sensitive measure of iodine status and reflects improved thyroid function within several months after iodine repletion.\textsuperscript{38,39} An international reference range and a reference standard for dried blood spot thyroglobin in iodine-sufficient school-age children (4–40 mg l\textsuperscript{-1}) are available.\textsuperscript{39} At the present time, data on the recent prevalence of goitre, newborn TSH and thyroglobulin are limited, and therefore global estimates of iodine status based on these indicators are lacking.

### Epidemiology of iodine status

#### Global and regional monitoring

The collection and reporting of global, regional and national data on iodine status is important for assessing the current magnitude of iodine deficiency, monitoring and evaluating salt iodisation and iodine supplementation strategies and identifying new emerging population groups or pocket areas with remaining iodine deficiency or excess iodine intake. The mandate to track and report countries progress towards achieving the standing global public health goal of the elimination of iodine deficiency lies with WHO.\textsuperscript{40} In 2005, a World Health Assembly resolution requested WHO to report on the global situation of iodine deficiency every 3 years.\textsuperscript{40}

#### WHO Global Database on Iodine Deficiency

WHO compiles country data on UI and goitre in the WHO Global Database on Iodine Deficiency.\textsuperscript{41} Data are collected from the scientific literature and through a broad network of collaborators, including WHO regional and country offices, United Nations organisations, ministries of health, other national institutions, non-governmental organisations and research and academic institutions. MEDLINE (1966 onwards) and WHO regional databases also serve as sources of data. Data have been gathered since the 1960s and the database currently holds data from population-based surveys conducted from the 1940s to the present day.
Iodine deficiency

The most current global and regional estimates of the prevalence of iodine deficiency was estimated by WHO in 2007, based on recently published data on UI in school-age children (6–12 years).\(^9\) Iodine status was estimated from new nationally representative UI surveys conducted in 41 countries between 1997 and 2006 along with 89 country estimates from 2003 (53 of which are nationally representative\(^8\)). Data for UI were available from 130 countries and covered 92.7% of the world’s population of 6–12-year-olds (Table 1). Regional population coverage varied from 85.8% in the European region to 98.8% in the Southeast Asia region. No estimates were made for the 63 countries that lacked UI data, representing only 7.3% of the world’s population of 6–12-year-olds.

The median UI obtained from the survey data was used to classify countries according to the international criteria of public health significance of iodine nutrition (Table 4). Iodine intake was considered insufficient in 47 countries, adequate in 49, more than adequate in 27 and excessive in seven countries. Of the 47 countries with insufficient intake, 10 were classified as moderately deficient and 37 as mildly deficient. No countries were categorised as severely deficient.

The global and regional prevalence of insufficient iodine intake was estimated based on the proportion of the population with a UI below 100 mg l\(^{-1}\). For each country, the population proportion derived from the survey data was applied to the national population of children 6–12 years of age and the general population and then pooled for global and regional estimates. The most recent United Nations population estimates of children 6–12 years of age were used.\(^{42}\)

It was estimated that the iodine intake of 31.6% (266.7 million) of school-age children worldwide is insufficient (Table 6). Iodine intake is estimated to be below the requirement in 73 million children in Southeast Asia region and in 58.5 million children in the Africa region. In the European, Eastern Mediterranean and Western Pacific regions, the figure is approximately 40 million children, whereas in the Americas, 12 million children do not have enough iodine in their diet. The greatest proportions of children with inadequate iodine intake live in the regions of Europe (52.4%) and the Eastern Mediterranean (48.8%), and the smallest proportions are found in the Western Pacific (22.7%) and the Americas (10.6%). Extrapolating from the proportion of school-age children to the general population, it is estimated that 2 billion people have an insufficient iodine intake (Table 6). Complete country-specific data are available in the WHO Global Database on Iodine Deficiency.\(^{41}\)

Excess iodine intake

Iodine excess occurs when the iodine intake is too high, generally due to too high iodine levels in salt or resulting from poor salt monitoring.\(^{29}\) In populations with history of iodine deficiency, a sudden

<table>
<thead>
<tr>
<th>WHO region(^b)</th>
<th>Insufficient iodine intake (UI &lt; 100 µg l(^{-1}))</th>
<th>General population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Countries (n)</td>
<td>School-age children</td>
</tr>
<tr>
<td>Africa</td>
<td>13</td>
<td>41.4</td>
</tr>
<tr>
<td>Americas</td>
<td>3</td>
<td>10.6</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>0</td>
<td>30.3</td>
</tr>
<tr>
<td>Europe</td>
<td>19</td>
<td>52.4</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>7</td>
<td>48.8</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>5</td>
<td>22.7</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>31.6</td>
</tr>
</tbody>
</table>

\(^{a}\) Adapted from de Benoist et al. 2008.\(^9\)

\(^{b}\) 193 WHO Member States.

\(^{c}\) Based on population estimates in the year 2006 (2004 revision).\(^{42}\)
increase in iodine intake may cause iodine-induced hyper- or hypothyroidism. The risk of thyroid dysfunction due to excess iodine intake is increased in susceptible individuals in populations with UI concentrations \(>200\, \mu\text{g}\, \text{l}^{-1}\) (Table 4). The extent of the risk depends on how quickly the intake of iodine is increased and the severity of pre-existing iodine deficiency.

The WHO estimates report iodine intake to be more than adequate in 27 countries (median UI \(>200\, \mu\text{g}\, \text{l}^{-1}\)) and even excessive in seven (median UI \(>300\, \mu\text{g}\, \text{l}^{-1}\)). For example, in Armenia, Uganda and several South American countries, median UI concentration are \(>300\, \mu\text{g}\, \text{l}^{-1}\).

**Trend analysis**

Between the 2003 and 2007 estimates, 17 new nationally representative studies were available, three from countries without previous UI data and 14 for countries for which the previous estimate was based on subnational data.

Country data on UI were compared in trend analysis (classified according to their iodine nutrition status) for the two periods 1993–2003 and 1997–2006. Of the 37 countries with estimates in both 2003 and 2007, only two countries with earlier adequate iodine nutrition deteriorated to inadequate intake in 2007. Of 16 countries with inadequate iodine intake in 2003, 12 progressed to adequate or more-than-adequate iodine nutrition in 2007. In the 2007 estimates, four countries reported iodine intake for the first time. Three of the four countries reported insufficient iodine intake, a finding that increases the number of countries with inadequate intake and may slightly mask the overall progress that has been made in the countries with data at both time points. The number of countries in which iodine deficiency is a public health problem decreased from 110 to 54 between 1993 (with total goitre prevalence as an indicator) and 2003 (with UI as an indicator), and is now (2007) a problem in 47 countries.

The global prevalence of insufficient iodine intake in school-age children has decreased by 5% from 2003 to 2007. The greatest progress occurred in Southeast Asia (9.6%) and in Europe (7.5%). The Americas was the only region that remained stable, with a prevalence of around 10%. Recent data from several industrialised countries, for example, Australia and the U.S., indicate lower intakes of iodine. The WHO estimates also report an increase in number of countries with more than adequate iodine intake from 29 countries in 2003 to 34 countries in 2007.

**Limitations**

The current estimates of iodine nutrition based on UI concentration are subject to several limitations. First, extrapolation from a population indicator (median UI) to define the number of individuals affected has been questioned e.g., a country in which children have a median UI concentration of 100\, \mu\text{g}\, \text{l}^{-1} is classified as being iodine sufficient; at the same time, 50% of the children are classified as having inadequate iodine intakes. Second, only approximately one-half of the countries have conducted nationally representative surveys, representing 60% of the world’s population. The remaining estimates were based on data from only one or more subnational surveys. Subnational data represent approximately 30% of the population covered by the 2007 estimates. Iodine deficiency is often expressed geographically and may cluster in specific areas even when there is no problem at the national level. Subnational data may therefore underestimate or overestimate the extent of iodine deficiency, depending on the area surveyed. Other times, easily accessible areas are surveyed, where the population potentially has greater access to iodised salt, and this may also underestimate the prevalence of iodine deficiency. The country estimate of India is one example of the use of subnational data that is potentially problematic. The national estimate is based on weighted mean UI concentrations from approximately 20 available subnational studies, which overall show adequate iodine nutrition. However, as described earlier, the coverage of adequately iodised salt in India is only 51% and adequate iodine nutrition on a national scale is therefore unlikely. Third, for countries with no new national data, the subnational data estimate from 2003 remained the same for the 2007 estimates. Fourth, several countries still have no data or have not conducted a survey recently. Another limitation may also be that the data available are extracted from publications and reports that present data in inconsistent formats and with varying degrees of analysis. The models developed to standardise the data and derive one measure from another are potential sources of error. The standardised
methodology and the use of subnational data applied in the WHO estimates allowed consistent use of country data for global and regional estimates. However, the example with subnational data from India highlights the limitations of country estimates in the absence of representative national data. Until national data are available, interpretation of individual country estimates of iodine deficiency should be done with caution and with consideration of the data on the coverage adequately iodised household salt as well as the limitations of that data. National data are not only critical for national, regional and global assessments, but it is also important to ensure that there is adequate representation from the different geographic regions within a country.

**Iodine deficiency in pregnant women**

Iodine requirements increase during pregnancy, and pregnant women are at higher risk for iodine deficiency than the general population. An increasing number of studies are reporting insufficient iodine status in pregnant women in areas where the overall iodine status in children show sufficient iodine intake.

As of December 2006, the WHO database contained 59 surveys of pregnant women conducted between 1965 and 2005, covering 42 countries. Twenty of these surveys were nationally representative and were conducted in 13 countries. For the period after 2000, there were 28 surveys, 12 of which were nationally representative, conducted in eight countries. The data were spread over the six different regions, with one-third of the surveys coming from the European region. The number of recent surveys of iodine nutrition in pregnant women is limited and a global estimate of the prevalence of iodine deficiency in pregnant women is not yet possible.

**Summary**

In summary, the global situation of iodine deficiency has improved dramatically over the past 20 years, a great success for the USI strategy. The number of countries where iodine deficiency is a public health problem decreased from 110 in 1993 to 47 in 2007. Yet, concern about optimal iodine status remain in several countries in all regions of the world; low iodine intakes with risk of iodine deficiency in 47 countries and excessive iodine intakes with the risk of iodine-induced thyroid disease in 34 countries. Although USI has been largely implemented, the main challenges ahead are to improve iodised salt coverage for both household use and food production, to ensure adequate salt iodisation levels and to strengthen iodine deficiency control programmes. Legislation on the level of iodine in salt has to be adjusted to any changes in consumption pattern and to any substantial reductions in salt consumption. Standardised and field-friendly indicators are available for monitoring iodised salt coverage and iodine status. Monitoring efforts have resulted in an increasing number of countries collecting nationally representative data. Nevertheless, regular monitoring and more surveys on iodine status in pregnant women and other susceptible populations groups are required. In addition to UI, collection of data on newborn TSH and thyroglobin (for assessing thyroid function) should be encouraged. Effective surveillance systems should also include monitoring of iodised salt quality at industrial, retail and household levels to ensure that salt iodisation programmes are safe and effective. Continued national and international commitment is required for reaching the goal of sustainable optimal iodine status in all populations and population groups worldwide.

**Research agenda**

- Evaluation of the current recommendation to use median UI concentration in school-age children as a proxy for the iodine status in the general population and population groups most vulnerable to iodine deficiency, such as young children and pregnant women.
- Reference values for dried blood spot thyroglobulin in pregnant women.
- Development of reliable field-friendly test-kits for quantitative monitoring of salt iodine levels.
References


