World Health Organization

Urinary iodine concentrations for determining iodine status in populations

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VMNIS | Vitamin and Mineral Nutrition Information System

Inside

Background

An estimated 35% of the world's population has insufficient iodine intake (*1*) and continues to live at risk for iodine deficiency and associated iodine deficiency disorders. Iodine deficiency poses a threat throughout the life-cycle and has been associated with mental impairment and goitre in older children and adults and complications with pregnancy, including stillbirth and congenital anomalies (*2*). Inadequate iodine intake during pregnancy may lead to irreversible fetal brain damage (*3*).

Urinary iodine is a well-accepted, cost-efficient and easily obtainable indicator for iodine status. Since the majority of iodine absorbed by the body is excreted in the urine (*4*), it is considered a sensitive marker of current iodine intake and can reflect recent changes in iodine status (*5*). However, this indicator does not provide direct information about thyroid function (*6*). Although an individual's urinary iodine concentration can vary daily, or even within the same day (*7*), these variations tend to even out within populations, providing a useful measure of the iodine status of populations (*2*). Urinary iodine concentrations are, therefore, not useful for the diagnosis and treatment of individuals (*6*). Because urinary iodine values tend not to be normally distributed, the median is the preferred measure of central tendency, and percentiles, rather than standard deviations, are most commonly used to describe the distribution of data (*2*).

Scope and purpose

This document aims to provide users of the Vitamin and Mineral Nutrition Information System with guidance about the use of urinary iodine for assessing the iodine status of populations. It is a compilation of the current World Health Organization (WHO) recommendations on the topic and summarizes existing information on the cut-off values, as well as the chronology of their establishment.

The use of these cut-off points permits the identification of populations at greatest risk of iodine deficiency or excess and priority areas for action,

especially when resources are limited. They also facilitate the monitoring and assessment of progress towards international goals of preventing and controlling iodine deficiency disorders.

Description of technical consultations

This document synthesizes the current WHO guidelines, published previously in the documents listed next:

A practical guide to the correction of iodine deficiency (*8*). This document was published in 1990 in conjunction with the United Nations Children's Fund (UNICEF) and the International Council for the Control of Iodine Deficiency Disorders (ICCIDD). The target audience of this guide was non-experts with an interest in preventing the consequences of iodine deficiency. It summarizes the major consequences of iodine deficiency, the means for its correction, and the key elements in control programmes.

Indicators for assessing iodine deficiency disorders and their control programmes (*9*) and *Indicators for assessing iodine deficiency disorders and their control through salt iodization* (*10*). These documents were published in 1993 and 1994, respectively, following a technical consultation on indicators of iodine deficiency held in Geneva, Switzerland, 3–5 November 1992. They provide guidance on the use of indicators for surveillance of iodine deficiency disorders and on the recommended values for salt iodization.

Methods for measuring iodine in urine (*11*). This is a WHO/UNICEF/ICCIDD booklet published in 1993 as a follow-up to *A practical guide to the correction of iodine deficiency* (*8*). In addition to the cut-off values for urinary iodine, this document reviews the most widely used techniques for measuring urinary iodine and contains detailed instructions on how to perform each method and their use in programmes to control iodine deficiency disorders.

Assessment of iodine deficiency disorders and monitoring their elimination, 2nd edition (*12*). In 1999, experts in the field of iodine were commissioned to review and update the publication *Indicators for assessing iodine deficiency disorders and their control through salt iodization* (*10*). The updated sections were used as the background documentation for an expert technical consultation held in Geneva, Switzerland, 4–6 May 1999, with the objective of conducting a critical analysis of the revised sections and of subsequently developing a new document. The manual, published in 2001, emphasizes the use of process indicators towards eliminating iodine deficiency, in particular those indicators related to iodized salt quality control at the production and/or importation stages and consumption of iodized salt in a population.

Report of a WHO technical consultation on prevention and control of iodine deficiency in pregnant and lactating women and in children less than 2 years of age (*6*). This document was published in 2007 following a technical consultation held in Geneva, Switzerland, 24–26 January 2005, to examine the iodine status and iodine needs of the three key groups indicated in the title. The objectives of the meeting were: (i) to review the functional consequences of iodine deficiency for pregnant women and for child development, and their public health significance; (ii) to review the current requirements for iodine of pregnant and lactating women and children less than 2 years of age; (iii) to review the current indicators for adequate iodine nutrition status in these groups; and (iv) to review current strategies to eliminate iodine deficiency disorders in these groups. WHO commissioned five review papers, which were presented during the consultation and discussed in detail. After presentation of these background papers, the meeting participants were divided into two working groups in order to develop recommendations to WHO and its Member States on iodine requirements, the assessment of iodine status, and measures to prevent and control iodine deficiency in the target groups.

Assessment of iodine deficiency disorders and monitoring their elimination, 3rd edition (*2*). This document was published in 2007 for use as a background document for a technical consultation held in Geneva, Switzerland, 22–23 January 2007, and is an updated version of the document published in 2001 (*12*). It contains new indicators of thyroid function, adjusted iodine requirements for pregnant and lactating women and children less than 2 years of age, refinements in monitoring household iodized salt use, and information on thyroglobulin as an impact indicator.

Recommendations

In 1990, urinary iodine was presented as an effective biochemical indicator to assess recent dietary iodine intake, and a median urinary iodine level of 50 µg/L or less was proposed for classifying iodine deficiency along with a series of values to establish the degree of urgency for its correction (important, urgent or critical) (*8*). In a consultation held in 1992 (*10, 11*), the cut-off value for iodine deficiency was raised to a median urinary iodine concentration lower than 100 µg/L and severity was classified as mild, moderate or severe.

The major epidemiological consequence of iodine excess is iodine-induced hyperthyroidism (*13, 14*). In 2001, cut-off values for urinary iodine that are indicative of a more than adequate or excessive iodine intake were first introduced (*12*). Iodine intakes above 300 µg/L per day are considered excessive and should be discouraged in order to avoid possible adverse health consequences, including iodine-induced hyperthyroidism and autoimmune thyroid diseases. Furthermore, in populations characterized by longstanding iodine deficiency with rapid increases in iodine intake, median values for urinary iodine above 200 µg/L in adults are not recommended because of the risk of iodine-induced hyperthyroidism (*12*).

Importantly, all these cut-off values are based on urinary iodine concentrations from school-age children.

Iodine requirements are greatly increased during pregnancy and lactation, owing to metabolic changes (*15–18*). During pregnancy, maternal thyroid hormone production (i.e., thyroxine) is upregulated and the transfer of thyroxine and iodine from the mother to the fetus is essential for proper brain development and thyroid function in the fetus (*17*). Although the rate of production of thyroid hormone returns to normal during lactation, iodine requirements remain elevated, as the breastfeeding mother provides the nursing infant with its sole source of iodine while the infant is exclusively breastfed (*6*).

Epidemiologic criteria for assessing iodine nutrition based on median urinary iodine concentration in pregnant and lactating women were first published in 2007 (*2, 6*). Similar criteria have been established for children less than 2 years of age, who are also at a high risk of iodine deficiency because of the continuing high iodine demands that are necessary for supporting brain and thyroid development (*12, 19*).

The median urinary iodine concentrations used to assess iodine nutrition among school-age children, pregnant and lactating women, and children less than 2 years of age are presented in Table 1.

Table 1
Epidemiologic criteria for assessing iodine nutrition based on median urinary iodine concentrations in different target groups[a]

Median urinary iodine (µg/L)	Iodine intake	Iodine status
School-age children (6 years or older)[b]		
<20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Adequate iodine nutrition
200–299	Above requirements	May pose a slight risk of more than adequate iodine intake in these populations
≥300	Excessive[c]	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid disease)

[a] Source: references (*2, 12*).
[b] Applies to adults, but not to pregnant and lactating women.
[c] The term "excessive" means in excess of the amount required to prevent and control iodine deficiency.

Median urinary iodine (µg/L)	Iodine intake	Iodine status
Pregnant women		
<150	Insufficient	
150–249	Adequate	
250–499	Above requirements	
≥500	Excessive[c]	
Lactating women[d] and children aged less than 2 years		
<100	Insufficient	
≥100	Adequate	

[c] The term "excessive" means in excess of the amount required to prevent and control iodine deficiency.
[d] Although lactating women have the same requirement as pregnant women, the median urinary iodine is lower because iodine is excreted in breast milk (*6*).

There are many analytical techniques to quantify iodine in small amounts of urine (0.5–1.0 mL), varying from very precise measurements with highly sophisticated instruments, to semi-quantitative "low-tech" methods. Most methods depend on the role of iodide as a catalyst in the reduction of ceric ammonium sulfate to the cerous form, in the presence of arsenious acid (the Sandell–Kolthoff reaction). The choice of method depends on local needs and resources (*2*).

Iodine concentrations measured in urine samples collected in the morning, or from other spot urine collections, have been shown to adequately assess a population's iodine status; 24-hour sampling is harder to achieve and not necessary (*2*).

Summary of statement development

This summary contains information primarily from multiple WHO publications. In 1990, urinary iodine was presented as an effective biochemical indicator to assess recent dietary iodine intake and to determine iodine status at the population level (*8*). Current urinary iodine cut-off values for deficiency were first published in *Indicators for assessing iodine deficiency disorders and their control programmes* (*9*) and *Indicators for assessing iodine deficiency disorders and their control through salt iodization* (*10*), after a technical consultation held in 1992. Cut-off values for urinary iodine that are indicative of a more than adequate or excessive iodine intake were introduced in 2001. In 2007, the third edition of *Assessment of iodine deficiency disorders and monitoring their eliminations* (*2*) reinforced the utility of urinary iodine as an effective indicator of a population's iodine nutrition and recommended its use an impact indicator, namely a marker used to monitor the effects of an intervention on the iodine status of a population. It also includes cut-off values for pregnant and lactating women.

Plans for update

The WHO Evidence and Programme Guidance Unit, Department of Nutrition for Health and Development, is responsible for reviewing this document and, if needed, will update it by 2016, following the procedures of the *WHO handbook for guideline development* (*20*).

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