

**NATIONAL SURVEY
OF THE BIOLOGICAL IMPACT
OF UNIVERSAL**

SALT
IODISATION

IN THE POPULATION OF SERBIA 2007



Institute of Public Health
of Serbia



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2007**

REPORT

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1

INTRODUCTION

Although it is one of the rare elements in nature, iodine traces are found everywhere: in sea and ocean water, the atmosphere, soil, flora and fauna, drinking water and food.

Its special characteristics related to the natural circulation cycle, its various manifestations in biosphere systems, and its specific functions in the human body classify iodine as an essential micro-element that humans need to obtain from their diet.

The health implications caused by insufficient iodine intake are well-documented and include goitre and cretinism. Like many European countries, Serbia has faced such implications in the past. The most concerning consequence, however, is the damage that may be caused to the developing brain of the foetus when an expectant mother is iodine-deficient. A recent survey showed that even small reductions in maternal thyroxin supply to the foetus early in pregnancy can distort the location where newly-formed brain cells are deposited, thereby reducing the density of the network of interconnections between mature brain cells, and affecting information storage and retrieval later in life. Meta-analyses of more than 70 studies worldwide have shown that the intellectual performance of school children in iodine-deficient populations is 10–15 IQ points lower than children in populations with adequate iodine nutrition.

1.1

Reasons for Conducting the Survey

The Balkan Peninsula and the Serbian region have always been known for high goitre potential, which indicates an exposure to iodine deficiency. Surveys conducted in the 1950s suggested that there were 650,000 persons with endemic goitre and 20,000 persons with endemic cretinism on the territory of the former Yugoslavia.

In 1951, the high occurrence of these phenomena in the Republic of Serbia led to the introduction of iodine prophylaxis in highly endemic regions (by iodising table salt with 5 mgKJ per 1 kg of salt) and later, the application of iodine prophylaxis at a higher mandatory iodine level throughout Serbia (1953, 10 mgKJ per 1 kg of salt). Studies of the effects of applied iodine prophylaxis, first conducted in the 1960s in endemic areas, showed that thyroid gland disorders were no longer endemic, but also that milder cases of goitre had not been eliminated. Assessments of the impact of iodine prophylaxis conducted during the 1990s on the same endemic areas established that there was a low degree of goitre among school children, and later, at the initiative of expert authorities, a new and higher norm on the mandatory iodisation of table salt (20 mg KJ per 1 kg of salt) was adopted in Serbia.

A nationwide survey conducted in 1998/99 on a representative sample of school children established, for the first time, that iodine deficiency

disorders in the Republic of Serbia had been eliminated (2.35% of examined school children had enlarged thyroid glands, and the iodine median value in urine was 158 $\mu\text{g/l}$).

However, the elimination of iodine deficiency disorders may be discussed only in the light of their sustainable elimination. For that purpose, it is necessary to continually monitor a number of important elements: salt manufacture/import, salt iodisation, diet, as well as an assessment of biological indicators of the effects of salt iodisation. These elements are linked as cause and effect, and their continuous monitoring is recommended by international expert groups of the ICCIDD (International Council for Control of Iodine Deficiency Disorders), the WHO and UNICEF. These recommendations were also adopted by the Republic Commission for Prevention of Iodine Deficiency Disorders and presented in its programme.

Furthermore, WHO (World Health Organisation), UNICEF and ICCIDD expert groups have recommended that all salt for human consumption should be iodised between 20–40 mg iodine/kg of salt, while Serbian national legislation stipulates salt iodisation at a level of 12 to 18 mg iodine/kg of salt.

Therefore, a new survey was commissioned to provide data on endemic goitre frequency within the population, iodine intake and salt iodisation; on the success of previous programme tasks envisioned in the “Universal Salt Iodisation” preventive programme; as well as on whether there was a need to change the level of salt iodisation used for human consumption and food production. In addition, the assessment of the biological impact of universal salt iodisation, as per the recommendations, would also cover iodine status among pregnant women because, due to their increased daily need for iodine, they showed a higher sensitivity to an iodine deficit. The results obtained

during the survey would, if positive, make it possible for the Republic of Serbia to submit a request to the WHO and ICCIDD to issue a certificate of sustainable elimination of iodine deficiency disorders, or would highlight elements that needed be corrected in order to achieve the same goal.

To gain an idea of the Republic of Serbia's previous involvement in the area of sustainable elimination of iodine-deficiency disorders and the achieved results, of the reasons for the expert justification for conducting a new survey, as well as of the draft plan and methodology prepared in line with ICCIDD recommendations, the UNICEF Office granted financial and expert assistance to the Public Health Institute of Serbia to conduct a survey entitled *Survey of the Biological Impact of Universal Salt Iodisation in Serbia* in 2007.

1.2

Survey Implementation

The field work for the *Survey of the Biological Impact of Universal Salt Iodisation in Serbia* took place between 24 September 2007 and 17 December 2007, and was managed by the Institute of Public Health of Serbia, with the financial and expert assistance of UNICEF.

The Survey was conducted by a team of experts (mostly from the Institute of Public Health of Serbia) and UNICEF, with the assistance of international consultants (Annex 1).

2

SURVEY GOALS

The main goal of the Survey was to establish if the Republic of Serbia had reached optimal iodine intake through universal salt iodisation.

The international criteria (1) for biological elimination of Iodine-deficiency disorders in the population are:

- **Percentage of households using adequately iodised salt $\geq 90\%$**
- **Urinary iodine concentration in school children from 100 to 199 $\mu\text{g/L}$**
- **Urinary iodine concentration in pregnant women from 150 to 249 $\mu\text{g/L}$**

The specific objectives of the Survey were to determine:

- the percentage of households using adequately iodised salt
- urinary iodine concentration among school children
- urinary concentration among pregnant women
- the link between using iodised salt in households and the nutritive iodine status of school children and pregnant women
- goitre prevalence among school children

3

MATERIAL AND METHODS

The methodology applied during the *Survey into the Biological Impact of Universal Salt Iodisation in Serbia* followed the recommendations of WHO, ICCIDD and UNICEF experts (2).

3.1

Criteria for Selecting Respondents

The selection of target groups for the Survey was based on the following factors: vulnerability to iodine deficiency, representativity (target group which has potential to represent the whole population) and accessibility. Vulnerability was defined by the level of exposure to the deficiency, severity of health impairment due to the deficiency, and the level of clinical and biochemical responses to the deficiency.

In line with the aforementioned criteria, the survey was conducted among the following groups of respondents:

- **Primary school-aged children.** This is the most frequent age group used for IDD assessments, being highly vulnerable and easily available, and its status reflects the current IDD status within the population, as well as the effects of preventive measures undertaken. (1)
- **Pregnant women.** This group is the most vulnerable population group and is available through pre-natal health services. Adequate iodine intake during pregnancy is essential for protecting the developing brain of the foetus and for the mother's health.

3.2

Design and Sample Size

The selection of primary school-aged children played a critical role in sample design.

Thus, the sample design was based on the expected prevalence of endemic goitre, relative precision, factor of the desired effect, reliability interval, as well as the total size of this population (1).

The sample selection and its size were determined by applying the PPS cluster sampling method (“proportionate to population size”). The basic prerequisite for applying PPS cluster sampling is the available list of sampling units (in our case primary schools and primary health centres), which permits a sampling frame to be constructed on the basis of the list of students in all schools.

The sampling frame for school-aged children was constructed on the basis of data obtained from the Republic Statistical Office and the Ministry of Education of the Republic of Serbia, which provided a list of all primary schools in Serbia. 30 clusters, i.e. territorial units (30 municipalities), were selected from the list by applying recommended systematic sampling within the defined geographic area (Republic of Serbia). In each of the 30 primary schools chosen, school children were picked by systematic random selection (60 pupils from each selected school, aged 6–14; in total 1,800).

The selection of primary health centres, i.e. pregnant women, was done in the second stage, after the selection of schools. The aim was to select pregnant women living in the same municipality as the selected schools, and therefore belonging to the primary health centres of the same municipality. The plan was to involve 360 pregnant women registered at ante-natal counselling services within the selected health centres (12 from each of the 30 selected health centres) in the survey.

3.3

Indicators for Evaluating Iodine Deficiency Disorders

There are several indicators that can be used to monitor the effects of the measures applied to eliminate IDD or to evaluate the impact of interventions on the population. For the purposes of this Survey, the following indicators were used:

- Volume of thyroid gland among school children
- Iodine concentration in urine samples of school children
- Iodine concentration in urine samples of pregnant women
- Iodine content in salt used in households where school children live
- Iodine content in salt used in households where pregnant women live

3.4

Survey Organisation

The survey included several stages: preliminary stage, a pilot survey, fieldwork and laboratory testing of iodine content in urine and salt, data processing, statistical analysis and drafting of the report.

In the **preliminary stage** 30 clusters were selected, with 30 schools (60 pupils from each school) and 30 associated primary health centres (12 pregnant women from each health centre). During this stage, approvals and consent for Survey implementation were obtained (from the Ministry of Education and the Ministry of Health, schools, parents, health centres and pregnant women) and the required documentation was drafted for schools and health centres (letters to ministries, schools and health centres). Endocrinologists were selected for the purposes of performing ultrasound examinations of children's thyroid glands, under the supervision of an international consultant through a standardised work process. By analysing the results obtained from duplicate measurements of the size of the respondents' thyroid glands, it was established that two of the doctors met the comparability criteria necessary for working on the Survey.

A fieldwork plan was prepared and Survey tools produced (instructions for fieldwork and procedures for team members' activities, a form for recording visits to schools and primary health centres, a protocol for data entry on performed examinations, a report form for laboratories, an Excel format for recording and analysing collected data).

The survey team was trained by international consultants.

Reliability of the iodine laboratory's work was ensured through introduction of a new method¹ for measuring iodine content in urine (ammonium-persulphate method²) and through a new analysis method for iodine content in salt (volumetric-titration-iodometric method – JUS E. Z8002–2001). Laboratory staff were trained, and missing laboratory equipment, instruments, and materials necessary for laboratory work were procured. It is also important to note that the iodine laboratory at the Institute of Public Health of Serbia participates successfully in the EQUIP sample exchange programme run by CDC, Atlanta.

A **Pilot Survey** was conducted in one of the primary schools in Belgrade, three months before the start of fieldwork. The Pilot Survey served as a pre-fieldwork test of all the details, with a view to defining the final survey instruments and forming the fieldwork team.

Fieldwork started at the end of September 2007. The schools and health centres were visited upon obtaining the required approvals, and once all the necessary preparations had been carried out by all the schools and health centres involved. The survey was conducted within one school and one health centre in the course of one day, in the morning and afternoon.

During the fieldwork, dimensions of pupils' thyroid glands were measured through ultrasound exams (performed by an endocrinologist), while a technician and doctor gathered urine and salt samples,

1 Until 2007, iodine content in urine was measured at the Institute's iodine laboratory by applying the method based on the digestion of urine by perchloric acid. Due to environmental concern about perchlorate and the suspension of the iodine laboratory's work, a new method was proposed.

2 This allowed the laboratory to be reinstated within the external inter-laboratory exchange programme (EQUIP Programme).

took anthropometric measurements, and entered data in the Survey Protocol (see Annex 2).

Thyroid gland volume was measured by means of a portable ultrasound device (ALOKA SSD-500), with a linear probe of 7.5 MHz frequency. With each child, the ultrasound examination – performed on the child lying down with neck hyper-extended – established the maximum width (a) and thickness (b) of the lobus at the transversal section and the length (c) at the longitudinal section, for the thyroid gland's left and right lobus respectively. The measured values were expressed in centimetres (cm). During final data processing, thyroid gland volume was obtained by adding the volumes of the left and right lobus respectively, which is calculated by applying the following formula

$$V = a \times b \times c \times 0.479$$

(0.479 is the empirically established factor of correction), and is expressed in millilitres.

Urine samples, gathered in the selected schools and health centres, were marked by applying a special code system. Samples were placed in sterile, 10 ml PVC test tubes, before being transported in a portable fridge in an Institute vehicle to the Institute of Public Health of Serbia, where they were frozen and kept for laboratory analysis.

Anthropometric testing involved measuring pupils' height (H) (expressed in centimetres in the data entry protocol) and weight (W) (expressed in kilograms in the data entry protocol). Height was measured using an anthropometer (altimeter), and the height value was rounded off to the nearest 0.1 cm. Body weight was measured using electronic scales, and was expressed as a whole number with

one decimal. Respondents' Body Surface Area (BSA) in square metres was calculated later, based on body height and weight, by applying the following formula

$$BSA = W^{0,425} \times H^{0,725} \times 71 \times 84 \times 10^{-4}$$

The salt samples were collected to establish salt iodisation at household level. Both school children and pregnant women brought a sample of salt from home (100 grams) in a clean, dry, plastic bag or small jar. Salt samples were marked by applying the special code system and were protected from direct sunlight, humidity and contact with urine samples, before being transported in an Institute vehicle to the Institute, where an analysis of iodine content was performed (volumetric-titration-iodometric method – JUS E. Z8002–2001).

Filled-out protocols and gathered samples were brought to the Institute successively, so that laboratory analyses of samples and data entry could begin during fieldwork.

Laboratory testing of iodine content in urine and salt was performed in separate laboratories.

The survey results were entered into a table calculation programme for **data processing and statistical analysis**, and were processed using a programme statistical package. Data was analysed according to children's sex and age, as well as according to settlement type (urban and rural). Iodine content in salt and urine (among both school children and pregnant women) were presented according to frequency distribution, median value and percentiles. Those above and below the internationally recommended borderline values were presented with a confidence interval of 95%, and differences among groups were compared by applying proportion tests. The link between the iodine content in salt and the iodine content in urine among children

and pregnant women was analysed using logistical regression. The values of thyroid gland volume were presented as a mean value, a standard deviation, a median value (P 50), and an upper limit of normal values (P 97). The upper limit of normal values related to thyroid gland volume was also shown in comparison with the calculated values of respondents' body surface area. Student t-tests were used for establishing the statistical significance of the difference between the mean values of the surveyed parameters. To evaluate the frequency of endemic goitre, all values of thyroid gland volume above the recommended upper limit of normal values were set aside and tested, factoring in respondents' sex, age and body surface area.

4

RESULTS

4.1

Sample Coverage

Out of 30 primary schools selected, 6 were located in the Belgrade area, 8 in Vojvodina, and 16 in Central Serbia. The majority of selected schools were located in urban areas (19), with 11 in rural areas. The Survey could not be conducted in Kosovo and Metohija.

Out of 1,800 primary school-aged children (aged 6–14) selected for the sample, 1,745 participated in the Survey.

All children that took part in the survey were successfully measured (body height, body weight, thyroid volume gland), for a measurement response rate of 100 percent. 994 urine samples, more than the 900 originally planned, were taken, yielding a response rate of 100 percent. The same thing happened with the salt sample, where 950 samples, instead of the planned 900, were taken, once again giving a response rate of 100%. Overall response rate for children was high, at 100 percent.

Out of 360 pregnant women planned to be surveyed, 347 entered the Survey. Urine samples were taken from 344 pregnant women, giving a response rate of 99.14%. Salt samples were taken from all pregnant women, which gave an excellent overall response rate of 99.14% for pregnant women.

The response rate was similar across municipalities and areas. This can be attributed to the openness and trust established between the Survey Manager and all partakers, as well as participants. The mistrust that existed in some of the schools was dispelled upon provision of detailed information by the Survey Manager to schools and primary health centres on the goals of the Survey and its particular significance, as well as by establishing partnership relations with authorised personnel in schools and primary health centres, and with pupils' parents who had given their consent to their children's participation in the Survey.

4.2

Characteristics of Respondents

Some background characteristics of school-aged children who participated in the Survey are presented in Table 1. These include distribution of children according to sex, type of settlement and age (in years).

Slightly more girls (52.84%) than boys (47.16%) participated in the Survey. The majority of children (57.99%) live in urban areas. The majority of the sample was made up of children aged 11 years (around 15%). The proportion of young children, aged 6 and 7, is significantly lower due to the mixed aged group of children enrolled in the first grade. The age distribution of the remaining children is well balanced.

The main background characteristics of pregnant women who participated in the Survey include information on age, type of settlement, and usage of dietary supplements containing iodine.

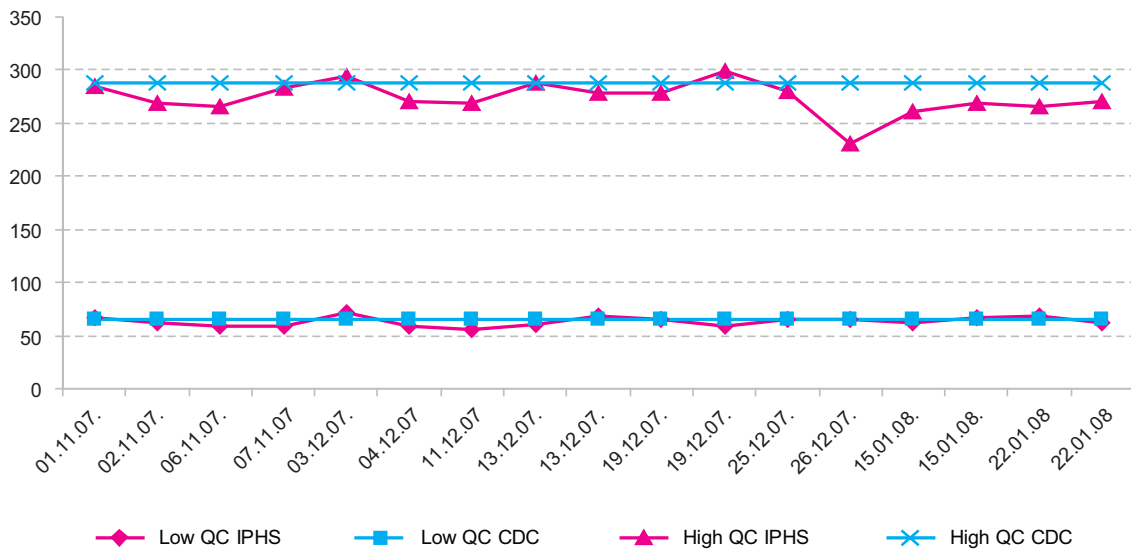
The majority of the sample was made up of women between the ages of 20 and 29 (61.96%). The average age of pregnant women was 28. Approximately two-thirds of women surveyed lived in urban areas and one third in rural areas. One third of pregnant women in the sample (33.9%) had used dietary supplements containing iodine during pregnancy.

4.3

Data Quality

Internal quality control data gave accuracy of $\pm 5\%$ for the urinary iodine tests. In order to ensure the quality of laboratory measurements, besides the internal quality control check, an external sample exchange programme with the reference IDD laboratory in CDC Atlanta (EQUIP Programme) was performed. The results are presented in Graph 1.

Graph 1
Results of external control at the Institute of Public Health of Serbia's iodine laboratory

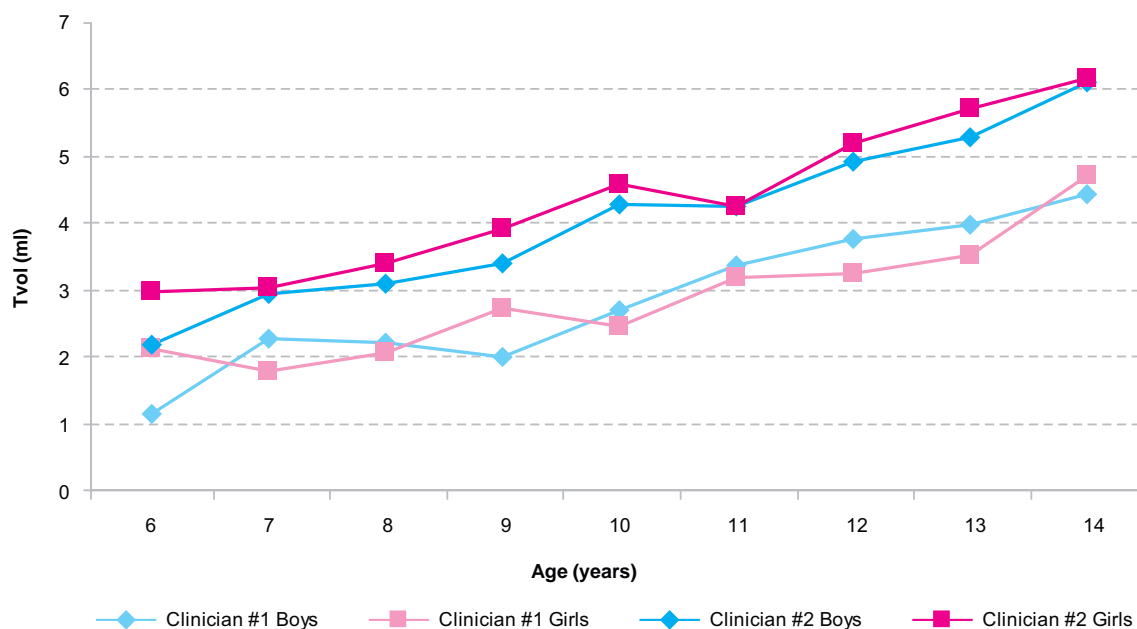


Those facts, together with effective Survey and sample design, supervised by experienced international experts, and a high response rate, contributed to the high quality data for the level of iodine in urine and salt (the main and most important indicators surveyed).

Unfortunately, some concerns exist about the quality of other indicators, such as the volume of thyroid gland among primary school-aged children. Although standardisation was applied in preparation for this survey, an analysis of the results of thyroid gland measurements performed by clinical doctors during the Survey highlighted a statistically significant difference between measurements of thyroid gland volume seen in Graph 2.

Graph 2

Median values of thyroid gland volume obtained by two clinical doctors, Serbia, 2007



It should be noted that the values related to gland volumes compared to children's age (volume of thyroid gland of children of certain ages) indicated in this Survey are greater than those stated within international criteria.

Those facts call into question the actual prevalence of goitre identified by the Survey.

4.4

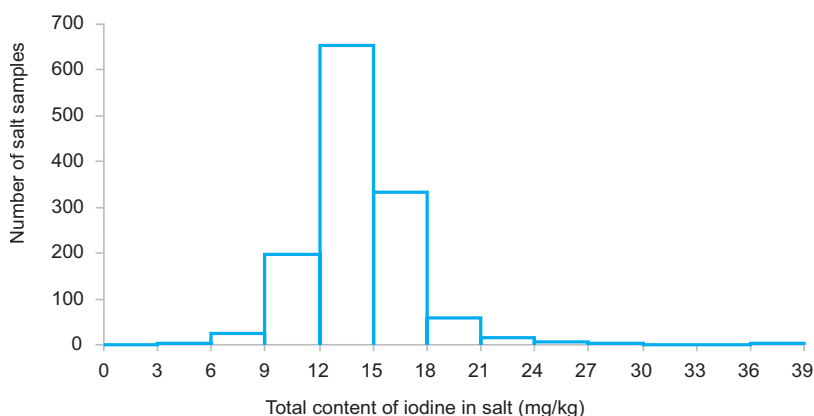
Key Findings

Salt iodisation at household level

Salt iodisation at household level is an indicator of the success of the implementation of the Universal Salt Iodisation Programme in the country. International recommendations state that a minimum of 90 percent of all households should be using adequately iodised salt. According to international criteria, that is salt which contains equal to or greater than 15 mg of iodine per kg. It is important to stress that national criteria (and national legislation) in Serbia differ from those at international level, allowing 12–18 mg iodine per kg of salt. The distribution of iodised salt at household level in Serbia is presented in Graph 3.

Graph 3

Distribution of Iodine content in household salt, Serbia, 2007



All salt in Serbia is iodised, but the iodisation level varies:

- *Only 32.2% of households are using adequately iodised salt in Serbia (according to international criteria)*
- *According to national legislation 76% of households are using adequately iodised salt (12–18mg/kg).*

The median value of the total content of iodine in salt was 13.9 mg/kg.

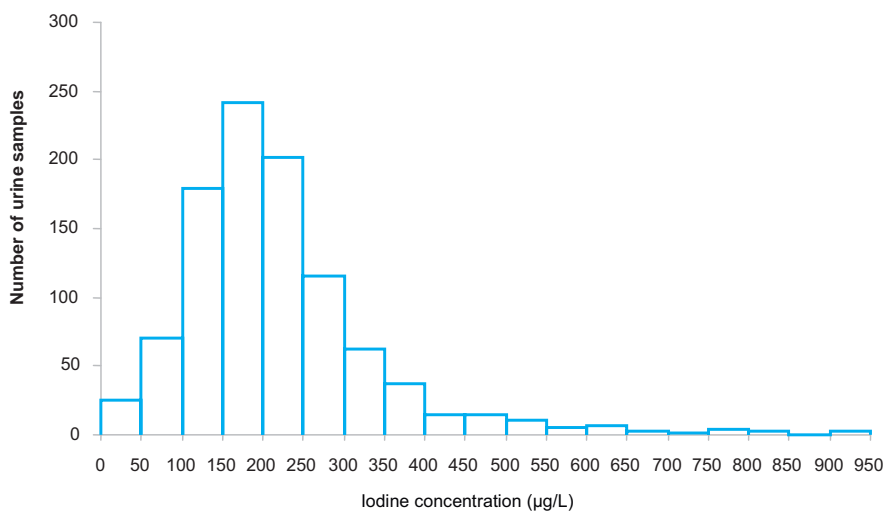
Iodine status of school children

Since no single parameter reflects the entire picture of iodine deficiency, use of at least two indicators is recommended. In this Survey, we measured the concentration of secreted iodine in urine in the iodine laboratory and the size of the thyroid gland using an ultrasound exam.

The level of iodine concentration in primary school-aged children's urine is an excellent indicator for evaluating the impact of Universal Salt Iodisation on the whole population. The current international recommendation is that the median value of iodine concentration in children's urine samples should be between 100 and 199 $\mu\text{g/L}$. The distribution of iodine concentration in the urine of school-aged children in Serbia is given in Graph 4.

Graph 4

Distribution of iodine concentration in urine of school children aged 6–14, Serbia, 2007



The median value of iodine concentration in children's urine samples amounted to 195.25 µg/L.

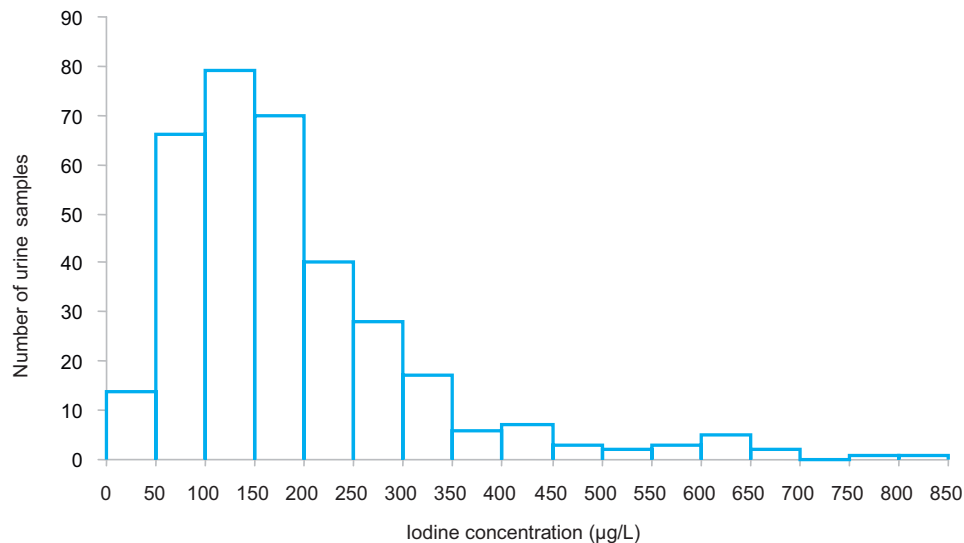
There were no significant variations between boys and girls, nor in terms of living area.

The recommended value of iodine concentration in children's urine samples of between 100 and 199 µg/L was present in 41.85% of children surveyed.

Iodine status of pregnant women

Pregnant women and their foetuses are more sensitive to insufficient intake of iodine, due to the increasing need for iodine in this period (2). Therefore, the international recommendation for the median value of iodine concentration in pregnant women's urine samples is higher than for children, and should be between 150 and 249 $\mu\text{g/L}$. Although the findings cannot be generalised to the whole population (as is the case with primary school children), they show whether policy measures on iodine intake are reaching pregnant women and newborns, as the most sensitive section of the population. The results are presented in Graph 5.

Graph 5
Distribution of iodine concentration in urine
of pregnant women, Serbia 2007



The median value of iodine content in urine of all pregnant women amounted to 158 µg/L.

Only one third of samples, 31.70%, had iodine concentration between 150 and 249 ug/L.

More detailed analysis was performed to determine the difference in iodine concentration in the urine of pregnant women who use supplements containing iodine, compared to pregnant women *not* using supplements (Table 1).

Table 1
Iodine concentration in urine of pregnant women compared to use of supplements, Serbia, 2007

| Use of supplements | Median value of iodine concentration in urine (µg/L) with 95% Confidence Interval | Number of women |
|--------------------|---|-----------------|
| No | 145.80 (126–158) | 205 |
| Yes | 195.30 (171–224) | 105 |

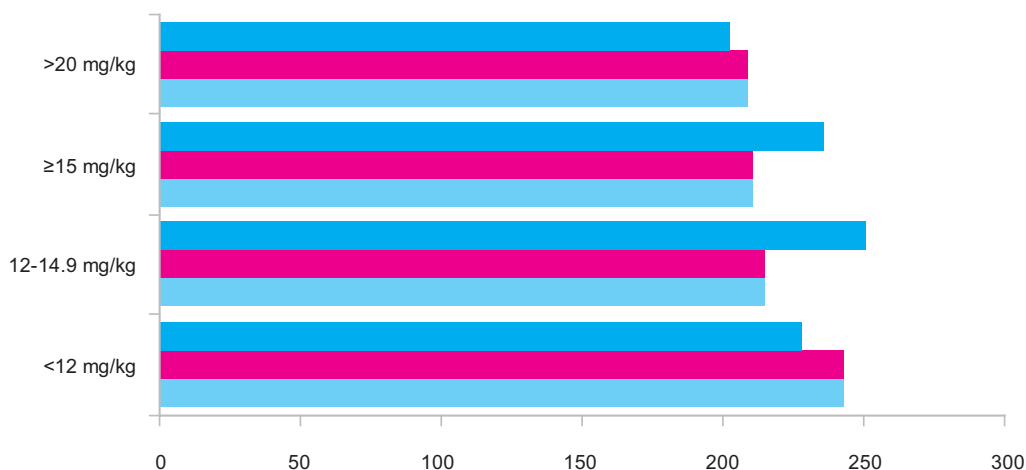
Iodine concentration in the urine of pregnant women who had used dietary supplements was statistically considerably higher (median value 195.30 µg/L) than that of pregnant women who had *not* used supplements (median value 145.80 µg/L) ($p < 0.001$).

The link between iodine level in salt and iodine status

The link between the iodine level in salt and the iodine status of primary school children and pregnant women can be seen in Graph 6 and Table 2 (in TABLES).

Graph 6

Iodine concentration in urine of pregnant women who had used dietary supplements compared to iodine content in salt used in their households, Serbia, 2007



Statistically, there is no significant difference between iodine concentration in urine among school children and pregnant women compared to iodine content in salt used in their households ($p > 0.005$).

Volume of thyroid gland of primary school-aged children

The volume of thyroid gland among primary school-aged children can be used as a yardstick of the impact of Universal Salt Iodisation of the population. The basic international recommendation is that the prevalence of enlarged thyroid gland (the exact value depends on age) should be below 5% in the population (2).

Since factors other than the level of iodine intake can influence the goitre prevalence level, this indicator should be used with caution, and in combination with the previous one (urinary concentration of iodine) in evaluating the results of Universal Salt Iodisation in the country.

Thyroid gland size was measured by an ultrasound exam, providing a more accurate measurement than palpation. In addition to an accurate measurement of the volume of the thyroid gland, ultrasound may also identify a potential change of gland structure, as well as reveal nodes that cannot be diagnosed through palpation.

Goitre prevalence among school children was 3.21%.

In spite of concerns raised in the previous chapter as to the quality of measurements conducted, these results *can* be taken into consideration when assessing the impact of USI in Serbia. Firstly, the findings are in logical correlation with the previous findings (optimal level of iodine concentration in urine of school children). Secondly, even if the measurements were not correctly performed, the fact that the volumes of thyroid gland measured in this Survey are bigger than those stated within international criteria can indirectly imply that actual thyroid gland volume is even lower in Serbia.

5

CONCLUSIONS

The National Survey of the Biological Impact of Universal Salt Iodisation in the Population of Serbia 2007 has established the following:

- According to international criteria only 32.22% of households in the Republic of Serbia use adequately iodised salt. Therefore, the country did not meet this criterion. However, the majority of households in Serbia (76.02%) use adequately iodised salt according to national legislation (with total iodine content in salt from 12 to 18 ppm). Non-iodised salt was not found in any households.
- The level of urinary iodine among school-aged children is optimal, right on target. The median value of urinary iodine in school-aged children is 195.25 $\mu\text{g/L}$ (international recommendation for median urinary iodine for school children is between 100–199 $\mu\text{g/L}$).
- The frequency of thyroid gland volume above the recommended upper level (P97) for school-aged children is within international criteria. 3.21% of school-aged children in Serbia have thyroid gland volume above the 97 percentile, i.e. less than 5%, as recommended.

The recommended level of excretion of urinary iodine and low frequency of enlarged thyroid glands among school-aged children suggests that Serbia has eliminated endemic goitre.

- The level of urinary iodine among pregnant women who used dietary supplements (195.30 $\mu\text{g/L}$) is optimal. Unfortunately, the level of urinary iodine among pregnant women who did not use dietary supplements with iodine was 145.80 $\mu\text{g/L}$, slightly below the internationally recommended value of 150–249 $\mu\text{g/L}$. The latest findings show potential vulnerability of pregnant women to iodine deficiency.

6

RECOMMENDATIONS

The Survey Board recommends the following:

- Improve existing legislation on salt for human consumption and food production. The following changes are recommended (to be considered by the Ministry of Health):
 - to increase the minimum content of iodine in salt from the current 12 mgJ/kg of salt to ≥ 15 mgJ/kg of salt;
 - to define the maximum level of iodine in salt
 - new, more precise definition of usage of potassium iodide and potassium iodate in the process of salt iodisation,
 - to stipulate, i.e. shorten, the expiry date of salt (currently salt producers are responsible for salt expiry dates), owing to potassium iodide instability.
- Promote usage of potassium iodate in the salt iodisation process, owing to the substance's higher stability.
- Promote usage of dietary supplements with iodine among pregnant women. These recommendations should be part of the new Guidelines for Mother and Child Health Care in Serbia (under preparation).

- Continue informational and educational campaigns targeting the population, pregnant women and children about the importance of adequate iodine nutrition for their health.
- Educate salt producers about the importance of adequately iodised salt, and adherence to proposed legislative changes (once they are adopted). Special focus should be given to replacing potassium iodide with potassium iodate in the salt iodisation process.
- To continue the implementation of the “Universal Salt Iodisation” Programme, with the focus on USI monitoring at all levels (import, wholesale, retail, households).
- To establish a regular salt and urinary surveillance system for pregnant women.
- To prepare a Decree on Protecting the Population from Iodine Deficiency Disorders, with defined goals and activities, by 2015.

TABLES

Table 1
Children's background characteristics

| | | Percent | Number of children |
|--------------------|-------|---------|--------------------|
| Gender | Boys | 47.16 | 823 |
| | Girls | 52.84 | 922 |
| Type of settlement | Urban | 57.99 | 1012 |
| | Rural | 42.01 | 733 |
| Age (in years) | 6 | 1.84 | 32 |
| | 7 | 8.25 | 144 |
| | 8 | 11.29 | 197 |
| | 9 | 12.20 | 213 |
| | 10 | 12.55 | 219 |
| | 11 | 15.47 | 270 |
| | 12 | 13.98 | 244 |
| | 13 | 13.24 | 231 |
| | 14 | 11.18 | 195 |
| Total | | 100.00 | 1745 |

Table 2

Iodine concentration in urine among school children and pregnant women compared to iodine content in salt used in their households, Serbia, 2007

| Salt iodine level | Urinary iodine $\mu\text{g/l}$ | | | | | |
|-------------------|--------------------------------|--------|---|--------|---|--------|
| | School children | | Pregnant women who had not used supplements | | Pregnant women who had used supplements | |
| | n | mean | n | mean | n | mean |
| <12 mg/kg | 146 | 243.21 | 36 | 157.35 | 25 | 228.15 |
| 12–14.9 mg/kg | 537 | 215.02 | 97 | 171.89 | 47 | 250.85 |
| ≥ 15 mg/kg | 161 | 210.37 | 53 | 179.02 | 26 | 236.35 |
| >20 mg/kg | 40 | 209.00 | 17 | 142.22 | 6 | 202.33 |

ANNEXES

Annex 1

Survey Team

Heads of Survey

Dr Tanja Knežević
Dr Dušica Nikosavić

Survey Management Board

Dr Frits van der Haar
Dr Oliver Petrović
Dr Katarina Spasović

Survey Manager

Dr Dragana Jović

Fieldwork

Dr Dragana Jović
Dr Zoran Anđelković
Dr Slavica Ćirić
Senior sanitary technician Dragoslav Milutinović

Analysis of iodine content in salt

Spec. san. chem. Ljiljana Boričić
Senior sanitary technician Dragana Tomić

Analysis of iodine content in urine

Spec. pharm. Biljana Tripković
Senior sanitary technician Katarina Simić
Senior sanitary technician Milan Milović

Data entry and processing

Dr Dragana Jović
Dr Frits van der Haar

International consultants

Dr Frits van der Haar
Dr Gregori Gerasimov
Feruza Ospanova

Preparation and drafting of the Report for the Institute

Dr Frits van der Haar

Annex 2

Questionnaire

INSTITUTE OF PUBLIC HEALTH OF SERBIA
„Dr Milan Jovanović Batut“ Belgrade

UNICEF

SURVEY OF THE BIOLOGICAL IMPACT OF UNIVERSAL
SALT IODISATION IN THE POPULATION OF SERBIA 2007

| | | | |
|----------------------------|----------------------|-------------------------------|----------------------|
| Cluster number | <input type="text"/> | Questionnaire number | <input type="text"/> |
| 1 | Type of settlement | Urban | 1 |
| | | Rural | 2 |
| 2 | Class (grade) | | <input type="text"/> |
| 3 | Surname | | <input type="text"/> |
| 4 | Name | | <input type="text"/> |
| 5 | Age (in years) | | <input type="text"/> |
| 6 | Gender | Male | 1 |
| | | Female | 2 |
| SALT SAMPLE FROM HOUSEHOLD | | Laboratory No. of salt sample | <input type="text"/> |
| Name of salt | | | <input type="text"/> |
| Name of salt producer | | | <input type="text"/> |

| | | | | | | |
|-----------------------------|----|--------------------------------|----------------|----|----|----|
| URINE SAMPLE | | Laboratory No. of urine sample | | | | |
| THYROID GLAND VOLUME | | | | | | |
| Lobus DEXTER | | | Lobus SINISTER | | | |
| w | A1 | | mm | A2 | | mm |
| h | B1 | | mm | B2 | | mm |
| l | C1 | | mm | C2 | | mm |
| ANTHROPOMETRIC MEASUREMENTS | | | | | | |
| Body weight | | kg | Body height | | cm | |

References

- 1 Iodine status worldwide, WHO Global Database on Iodine Deficiency, Department of Nutrition for Health and Development, World Health Organisation, Geneva, 2004
- 2 Assessment of iodine deficiency disorders and monitoring their elimination A GUIDE FOR PROGRAMME MANAGERS, Third edition, World Health Organisation, 2007