MINISTRY OF HEALTH OF
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REPORT

ON RESULTS OF NATIONAL REPRESENTATIVE SURVEY OF IODINE NUTRITION AND IMPLEMENTATION OF UNIVERSAL SALT IODIZATION PROGRAM IN ARMENIA

Yerevan 2005

CONTENT

ABSTRACT

In May-June 2004 a national epidemiological representative 30 clusters school-based survey of 911 children aged 8-10 was carried out in Armenia covering all but one administrative districts of the country. The survey was performed based on UNICEF, WHO, ICCIDD guidelines: "Assessment of iodine deficiency disorders and monitoring their elimination" (2001). The objective of this survey was to evaluate the progress in elimination of iodine deficiency in Armenia through universal salt iodization (USI). Results of this survey confirmed elimination of iodine deficiency in Armenian population on the entire territory of the country. This was achieved by universal availability of quality iodized salt that was found in 97% of the surveyed households. Median urinary iodine level (313 mcg/l) for the national sample was slightly above the optimal range (100-300 mcg/l) recommended by WHO, UNICEF and ICCIDD, and proportion of samples with iodine levels below 100 and 50 mcg/l were significantly below recommended thresholds. While existing level of iodine nutrition is adequate and safe for population, it was recommended to decrease the level of salt iodization from existing 50 mg/kg to 40 mg/kg.

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1. Introduction

This report is based on the results of national representative survey of iodine nutrition in Armenia population through universal salt iodization (USI) which was conducted in May-June 2005 in the framework of national program for elimination of iodine deficiency that is place in this country since 1996.

Iodine is an essential micronutrient and daily requirements for iodine are 100-200 mcg. While the consequences of iodine deficiency are know for ages, elimination of iodine deficiency became a global priority during last two decades. Iodine deficiency is the most frequent cause of preventable brain damage in children which can be prevented by adequate iodine nutrition. USI is the most reliable, cheap and safe method for prevention and elimination of iodine deficiency disorders (IDD) if more than 90% of households consume quality iodized salt.

Table 1 present epidemiological criteria for assessing the severity of iodine deficiency based median urinary iodine (UI) level.

Table 1. Epidemiological criteria for iodine deficiency [1]

Indicator	Severity of iodine deficiency as public health problem		
	Mild	**moderate**	**Severe**
Median urinary iodine level (mcg/l)	50-99.9	20-49.9	< 20

The objective of program for elimination of iodine deficiency is normalization of iodine consumption with food for the entire population of the country. When iodine consumption is adequate, median UI levels in population are from 100 to 300 mcg/l. Table 2 presents indicators for elimination of iodine deficiency through USI.

Table 2. Indicators of elimination of iodine deficiency [1]

Indicator	**Objective**
Urinary iodine level: • Median (mcg/l) • Proportion of samples with UI levels below 100 mcg/l • Proportion of samples with UI levels below 50 mcg/l	 • 100-300 • < 50% • < 20%
Salt iodization: • proportion of households consuming quality iodized salt	 • > 90%

First assessment of endemic goiter (EG) prevalence in Armenia was carried out in 1946-1950 when up to 20% of population was surveyed. Goiter prevalence amounted to 25-30% and even 3 cases of cretinism were found. Starting from 1955 measures to control EG were launched in Armenia covering areas with highest prevalence of EG. They included supply of iodized salt to EG areas and distribution of iodine tablets to risk groups (pregnant and breastfeeding women and children).

Staring from 1970 production of iodized salt sort “Extra” started on Avan Salt Plant (ASP), which supplied it for local needs and to other regions of the USSR. At the same time, non-iodized salt was also traded and used. In 1990 ASP produced 33 thousand tones of iodized salt. Potassium iodide (KI), fortification compound with relatively low stability, was used for salt fortification at that time and level of salt iodization was also relatively low (23+/-11 mg/kg) [2].

Due to complicated political and economic situation in Armenia in early 1990s production and supply of iodized salt were almost stopped and population used non-iodized salt from Ukraine and Iran. Assessment carried out in Armenia in 1995 showed that 50.4 % of pregnant women and 40 % of children below 12 years had EG.

In 1997, with UNICEF support, ASP received equipment for production and quality control of iodized salt, and production of iodized salt “Extra” was resumed. Technical standard for iodized salt has also been changed: more stable potassium iodate (KIO_3) at the level of 35+/-10 mg/kg was used for salt fortification. In the absence of legislation on universal salt iodization (USI), by the initiative of salt producer with support of UNICEF and government of Armenia all salt for human consumption has been iodized started from 1998. Having potential for production of 52 thousand tones of salt, ASP is producing annually 15 thousand tones of iodized salt mainly for local needs. Salt is packed in polyethylene bags ensuring stability of iodine.

All these efforts gave positive impact on iodine nutrition of population. Nutrition survey of women and children conducted in 1998 with assistance from Institute of Nutrition (Rome, Italy) showed that 68% of children below 5 years had urinary iodine level above 100 mcg/L (indicating optimum iodine nutrition), and 73% of households used iodized salt. At the same time out of 2,649 surveyed women of childbearing age (15-45 years old) 30% had first and second degree EG and 6% had visible goiter (third degree) [3].

Demographic and Health Household Survey (DHHS) carried out in Armenia in 2000 showed improved level of iodized salt use (Table 3).

Table 3. Iodization of household salt: percent distribution of households by level of iodine in salt (mg/kg), according to background characteristics (DHHS, 2000) [4].

Background characteristic	Level of iodine in household salt (ppm): 0	<15	15+	Missing	Total	Number of households tested
Residence						
Urban	6.9	6.9	85.5	0.7	100	3,630
Rural	13.7	5.3	80.5	0.5	100	2,346
Region						
Yerevan	1.1	8.5	89.7	0.8	100	1,944
Aragatsotn	6.4	1.9	90.0	1.7	100	248
Ararat	2.1	2.5	95.2	0.2	100	580
Armavir	3.3	1.6	94.9	0.2	100	496
Gegharkunik	16.2	7.5	76.0	0.2	100	505
Lori	24.3	5.2	69.1	1.4	100	
Kotayk	7.2	5.0	87.0	0.8	100	413
Shirak	27.3	4.5	68.2	0.0	100	602
Syunik	7.7	2.2	89.5	0.7	100	258
Vayots Dzor	10.9	12.5	76.1	0.5	100	111
Tavush	24.2	16.1	59.1	0.6	100	300
Total	**9.6**	**6.3**	**83.6**	**0.6**	**100**	**5,976**

Thus, almost 90% of Armenia households used iodized salt, while in 6.3% of samples iodine content in salt was below 15 mg/kg (ppm). In some regions (Lori, Shirak, Tavush) 24 -

27% of salt samples collected in households were not iodized. Based on results of these survey in 2001 iodine level in salt was increased to 50+/-10 mg/kg.

In February 2004 the Government of Armenia passed a Decree that required mandatory iodization of all salt for human consumption. Import of non-iodized salt was also banned. At the same time, the Government decided to conduct a survey of iodine nutrition in Armenia and requested technical support from UNICEF.

2. Materials and Methods

In May-June 2005 a national epidemiological representative 30 clusters school-based survey of 911 schoolchildren aged 8-10 was carried out covering all but one (Vayots Dzor) administrative districts (marzes) of the country. The survey was performed based on UNICEF/WHO/ICCIDD guidelines [1].

Iodine deficiency has most harmful effects on pregnant women and infants and women of childbearing age in general. Household-based surveys are usually needed to reach these target groups. However, from epidemiological point of view school-based surveys are more easy and efficient way to assess iodine nutrition of population. In Armenia all young children (aged 8-10 years) are attending schools irrespective of their social and income status. In this case, iodine nutrition of young schoolchildren representatively reflects iodine nutrition of the whole population because schoolchildren in Armenia do not receive any special iodine supplements.

In order to get representative results that would reflect iodine nutrition of entire population, selection of survey sites (schools) were conducted with two steps random proportional to population sampling (PPS). Special Field Manual was developed and used for conducting of a survey [5]. The database of Armenia schools and enrolments was provided by National Statistics Service that also made selection of 30 clusters (schools) for the survey. There are 1,406 schools in Armenia with 537,278 schoolchildren (15% of population). Using random numbers generator, 30 schools were selected with sampling interval (*k*) of 17,909. (Listing of selected schools is presented in **Annex 1**). Children from urban (485 schoolchildren) and rural (426 schoolchildren) were included in this survey.

In each of 30 selected schools (clusters) using systematic sampling and random number table 30 schoolchildren aged 8-10 years were selected for the assessment. Usually, the whole class (+/- 30 schoolchildren) was selected. If the number of children in the class was less than 30, additional schoolchildren of the same age were randomly selected from neighboring class.

During the preparation phase for the survey (March 2005) all leaders of survey teams were trained in survey methodology, including pilot field assessment of schoolchildren in the school of Artashat town in Ararat marz.

During the assessment urinary samples were collected into individual vials from all selected children. Samples of urine (2.0 ml) were transferred to small containers and were kept refrigerated or frozen until iodine assay. Samples of salt from schoolchildren's households were tested qualitatively for iodine using rapid test kits. All samples of salt with positive (pink) staining were considered as iodized. Additionally all collected salt samples were tested quantitatively for iodine by titration method in laboratory of Center for Sanitary Epidemiological Surveillance. Salt samples for iodine assay were also collected from local shops and school canteens.

Urinary iodine (UI) determinations were carried out in random urine portions collected during the survey by ceric-arsenite method modified by J. Dunn, 1993 after mineralization with ammonium persulfate [1]. The analytical parameters of this method are: sensitivity threshold - 5 mcg/L; relative standard precision, CV – 13.6%; analytical recovery – 80 – 104%. UI assays were performed by the laboratory of the National center for Hygiene, Medical Ecology and Nutrition (Sofia, Bulgaria). This laboratory is a member of International Resource Laboratories

for Iodine (IRLI) Network[1]. External quality control was provided by Centers for Disease Control and Prevention (CDC) Atlanta, USA. Additionally, 30 urine samples were collected during pilot study in the town Artashat and assayed for iodine in the laboratory of Endocrinology Research Center (Moscow, Russia), also member of IRLI Network.

Results of UI assays are presented as medians with minimal and maximal values for the entire group and for sub-groups divided by regions (marzes). Frequency distribution is calculated according to discriminating criteria of ICCIDD/UNICEF/WHO: 0-49, 50-99, 100-299, 300-499 mcg/L and > 500 mcg/L.

It should be stressed that sampling method used in this survey provided representative data on iodine nutrition only for the entire population of the country. Data by regions (marzes) is provided for illustration purposes only.

Information about the surveyed children was filled in the Registration forms for each cluster (**Annex 2)**. Information on the amount of laboratory work is presented in table 4.

Table 4. Amount of performed laboratory tests

Marzes	Amount of clusters	Amount of samples tested for urinary iodine	Amount of salt samples tested with rapid testers	Amount of salt samples tested by titration
Lori	2	60	63	63
Tavoush	1	30	33	33
Shirak	2	61	67	67
Aragatzotn	1	30	32	32
Kotaik	3	90	94	94
Armavir	5	155	165	165
Ararat	3	92	96	96
Gegharkiunik	3	91	92	92
Vayots Dzor	-	-	-	-
Siunik	2	62	65	65
City Yerevan	8	240	245	245
ARMENIA	**30**	**911**	**952**	**952**

3. Results and Discussion

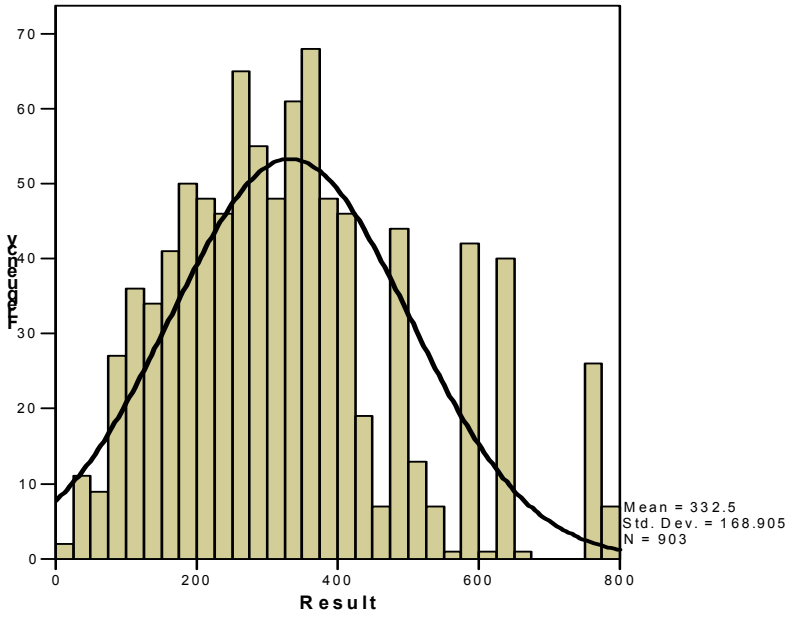
During the survey total 911 schoolchildren were selected using PPS sampling method over the whole territory of the country that provided reliable information on status of iodine nutrition for the entire Armenia population.

The distribution curve (Figure 1) for urinary iodine levels showed nearly normal pattern of distribution (mean value – 332.5 mcg/L; median – 313 mcg/L).

Table 5 provides median UI values for all surveyed marzes and the entire national group. From the nutritional point of view, optimal UI levels should be between 100 and 300 mcg/L. For the whole representative group of Armenia schoolchildren the median UI value was slightly above adequate level of iodine nutrition - 313 mcg/L. Median UI levels were almost similar in urban (304.5 mcg/L) and rural (323 mcg/L) subgroups.

[1] International Resource Laboratories for Iodine (IRLI) Network is a multi-agency (CDC, UNICEF, ICCIDD, WHO) led effort, which has taken on the global challenge to improve quality of UI analysis as a measure for iodine status.

Figure 1. Distribution curve of individual levels of UI in Armenia schoolchildren.



Based on distribution curve procession, 8 tests (0.9%) were found missing (urinary iodine concentration exceeded 2 standard deviations from the mean value). All further calculations (median values and frequency distribution charts) were made with 903 valid tests.

Table 5. Median urinary iodine (UI) levels for Armenia population.

Marzes	Number of clusters	Amount of urinary iodine tests*	Median UI levels	Minimal UI value	Maximal UI value
Lori	2	60	268	42	774
Tavoush	1	29	365	122	756
Shirak	2	59	316	45	780
Aragatzotn	1	30	365	80	630
Kotaik	3	90	340.5	83	778
Armavir	5	152	350	62	776
Ararat	3	92	294.5	107	774
Geogharkiunik	3	91	268	16	775
Siunik	2	60	159	30	634
City Yerevan	8	240	319.5	39	774
ARMENIA	**30**	**903**	**313**	**16**	**780**

Figure 2. Geographical distribution of median UI levels (mcg/l) by regions (marzes) of Armenia.

Geographical distribution of median UI levels by different regions of Armenia is presented in Fig. 2. No significant differences in median UI levels were observed among the regions of the country except Siunik marz where median UI was lower - 159 mcg/L.

Frequency distribution of UI levels provides important information on parameters of iodine nutrition of the population. In this study only one urinary sample had iodine concentration below 20 mcg/L and twelve – between 20 and 49 mcg/L. Discriminating UI levels is this study were - 0 - 49 mcg/l, 50 - 99 mcg/l (that characterized different levels of iodine deficiency), proportion of samples with normal UI levels (100 to 299 mcg/l) and proportion of samples with high UI levels - above 300 and above 500 mcg/l (Table 6).

Only 6.3% of samples had UI levels below 100 mcg/L; 41.5% were in the optimal range (100-300 mcg/l) while other UI concentrations in other samples exceeded 300 mcg/l. Compared to 1998 data iodine nutrition of population has increased. It should be noted that maximal UI concentration found in this survey was 780 mcg/L. WHO estimated that safe level of iodine consumption is below 1000 mcg/day [6, 7]. Iodine consumption by Armenian population is slightly above the optimal level. However this level of iodine consumption is absolutely safe and can not pose any danger to the population. Moreover, there is growing evidence that median UI indicating optimal iodine nutrition during pregnancy, lactation and neonatal periods should be in the range of 150-230 mcg/L [8]. These figures are higher than those recommended so far by international agencies.

It should be also noted that median UI level (280 mcg/L) obtained during small training survey of 30 schoolchildren in Artashat in March is similar to median UI value yielded during main assessment (313 mcg/l). Urinary samples from small survey were assayed by independent laboratory in Moscow, Russia.

Table 6. Frequency distribution of UI levels in samples from Armenia survey

	Urinary Iodine levels (mcg/L)									
MARZES	**0-49**		**50-99**		**100-299**		**300-499**		**> 500**	
	N	%	N	%	N	%	N	%	N	%
Lori	2	3.3	0	0	36	60	19	31.7	3	5.0
Tavoush	0	0	0	0	9	31	15	51.7	5	17.2
Shirak	1	1.7	2	3.4	26	43.7	21	35.6	9	15.3
Aragatzotn	0	0	2	6.7	7	23.3	14	46.7	7	23.3
Kotaik	0	0	1	1.1	28	31.1	43	47.8	18	20
Armavir	0	0	7	4.6	46	30.2	64	42.1	35	23
Ararat	0	0	0	0	49	53.2	32	34.8	11	12
Gegharkiunik	3	3.3	6	6.6	44	48.4	27	29.7	11	12.1
Siunik	6	10	10	16.7	34	56.7	6	10	4	6.7
City Erevan	1	0.4	8	3.3	96	40	100	41.7	35	14.6
Armenia	13	**2.3**	36	**4.0**	375	**41.5**	341	**37.8**	138	**15.3**

Nearly all salt consumed in Armenia is produced by single national salt producer (ASP). In 2001 salt iodization was established at the level of 50+/-10 mg/kg. This standard applies to iodine concentration in salt on production, wholesale and retail levels. It should be noted that these levels are higher than those recommended by WHO/UNICEF/ICCIDD [9]. These agencies recommended that mean levels of iodine in salt should be in the range of 20-40 mg/kg. Most CIS countries have established common level of iodine in salt – 40+/-15 mg/kg.

In the course of this survey 952 salt samples were collected from the households of schoolchildren, from retail shops and school canteens and checked for iodine content by rapid testers and by titration method. Rapid testing was carried out directly in schools and titration - in laboratory of Center for Sanitary-Epidemiological Surveillance.

Only 26 (out of 952) salt samples tested by rapid testers appeared to be non-iodized or with low iodine levels (< 15 ppm). Results of quantitative tests are presented in table 7.

Table 7. Results of quantitative testing of iodine in salt: percent distribution of households by level of iodine in salt (mg/kg) in Armenia and its administrative districts (marzes).

Marzes	**Iodine concentration in salt (mg/kg) and number of salt samples**				
	No iodine	< 15	15-40	40-60	> 60
Lori	0	0	15	36	11
Tavoush	0	0	13	12	8
Shirak	3	1	5	38	20
Aragatzotn	1	1	3	19	8
Kotaik	2	0	2	55	35
Armavir	3	0	133	8	21
Ararat	5	0	20	49	23
Gegharkiunik	0	1	10	69	12
Siunik	0	3	6	37	19
City Yerevan	6	0	52	160	27
ARMENIA	**20**	**6**	**259**	**483**	**184**
	2.1%	**0.6%**	**27.3%**	**50.7%**	**19.3%**

Results of titration test showed that only 2.7% of salt samples had no or small amounts of iodine. This is significant improvement compared to data of DHHS (2000): at that time 9.6% of salt samples were non-iodized and 6.3% samples had iodine levels below 15 ppm (table 3). Also in previous survey in some regions (Lori, Tavush, Shirak) 24-27% of salt samples were non-iodized. Results of this survey show that penetration of iodized salt is universally high in all administrative regions (marzes) of Armenia. All 20 samples of non-iodized salt were rock salt that is still available in retail shops and used primarily for pickling during the vegetable season. On household level 50.7% of salt samples had iodine levels within limits of national standard for iodine in salt (40-60 mg/kg) while 19.3% samples had levels of iodine even above 60 mg/kg. Based on results of this survey, it would be quite reasonable to decrease level of salt iodization in Armenia to 40 (+/-15) mg/kg by making subsequent changes to existing regulation.

4. Conclusion and Recommendations

1. The data obtained during national representative survey of iodine nutrition in Armenia show that the country ***has achieved the goal of elimination of iodine deficiency among its population through USI*** (table 8).

Table 8. Goals and indicators of elimination of iodine deficiency in Armenia

Indicators	Goal	Armenia results
Urinary iodine levels: • Median (mcg/l) • Proportion of samples below 100 mcg/l • Proportion of samples below 50 mcg/l	 • 100-300 • < 50% • < 20%	 • 313 • 6.3% • 2.3%
Salt iodization: • Proportion of households consuming quality iodized salt (iodine level > 15 mg/kg)	• > 90%	• 97%

2. Median UI level for the entire population group (313 mcg/L) slightly exceeds optimal values (100-300 mcg/L) due to relatively high level of salt iodization – 40-60 mg/kg. While average daily consumption of iodine in Armenia is within the safe level (below 1000 mcg/day) and unlikely can cause any negative effects on thyroid function, level of salt iodization in Armenia should be adjusted to lower iodine nutrition to optimal levels. Additional supplementation of risk groups (specifically – pregnant and breastfeeding women) with iodine containing pharmaceuticals or nutrition supplements is not required.

3. Recommended level of salt iodization in Armenia should be 40 mg/kg with sufficient margins to ensure production of quality iodized salt. Most of salt producing countries in CIS (Russia, Ukraine, Belarus, Kazakhstan, Turkmenistan and others) established common level of salt iodization – 40+/-15 mg/kg. By decreasing level of salt iodization, optimum level of iodine nutrition will be reached and sustained.

4. System for monitoring of iodine nutrition (product and impact/biological monitoring) should be strengthened to ensure sustainable elimination of iodine deficiency in future generations.

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ANNEX 1.

Listing of schools (clusters) for national representative survey of iodine nutrition in Armenia (May – June, 2005)

	Marz	Region	Location	School	Total number of school children
1	Gegharkunik	Gavar	Gavar	Gavar school N1	583
2	Gegharkunik	Vardenis	Tsovak	Tsovak school	597
3	Gegharkunik	Martuni	Eranos	Eranos school N1	702
4	Aragatsotn	Ashtarak	Ushi	Ushi secondary school	290
5	Ararat	Ararat	Ararat	Ararat secondary school	505
6	Ararat	Artashat	Artashat	Artashat school N6	502
7	Ararat	Masis	Masis	Masis school N5	238
8	Armavir	Armavir	Araks	Araks secondary school	590
9	Armavir	Armavir	Hacik	Hack secondary school	940
10	Armavir	Vagharshapat	Gaj	Gaj secondary school	1234
11	Armavir	Vagharshapat	Vagharshapat	Tarounik secondary school	648
12	Armavir	Vagharshapat	Tsiatsan	Tsiatsan secondary school	1158
13	Lori	Alaverdi	Kachachkut	kachachkut school	90
14	Lori	Tashir	Metsavan	Metsavan school N2	503
15	Sjunik	Goris	Khot	Khot secondary school	161
16	Sjunik	Megri	Megri	Megri school N1	507
17	Tavoush	Nojemberyan	Archis	Archis secondary school	226
18	Kotaik	Hrazdan	Charencavan	Charencavan school N5	539
19	Kotaik	Kotaik	Abovyan	Abovyan school N7	1053
20	Kotaik	Nairi	Nor-Geghi	Nor-Geghi school	700
21	Yerevan	Yerevan	Erebuni	School N68 after Mkhojan	841
22	Yerevan	Yerevan	Avan	Yerevan school N 16 special school	232
23	Yerevan	Yerevan	Arabkir	School N151 after Sevak	620
24	Yerevan	Yerevan	Kentron	School N33 after Nalbandyan	673
25	Yerevan	Yerevan	Malatcia	N162	1635
26	Yerevan	Yerevan	Shengavit	School N137 after Narekaci	1063
27	Yerevan	Yerevan	Non Nork	School N142 after Gharibyan	956
28	Yerevan	Yerevan	Nubarashen	School N95 after Ghevond Alishan	686
29	Shirak	Gyumri	Gyumri	School after P. Duryan	608
30	Shirak	Artik	Anushavan	Anushavan School	335

ANNEX 2.

РЕГИСТРАЦИОННАЯ ФОРМА
ДЛЯ ПРОВЕДЕНИЯ КЛАСТЕРНОГО ОБСЛЕДОВАНИЯ

Название велаята и этрапа_____
Название населенного пункта_____
Номер школы_____ **Код (номер) кластера**_____
Общее число обследованных детей_____

Инд. №	Имя и фамилия ребенка	Возраст (лет)	пол: 1- муж. 2- жен.	Соль*: 1 - йод 2 - нет	Уровень йода в моче	Прочее
1.						
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* - по результатам качественного экспресс теста: 1 - соль йодированная; 2 - соль нейодированная.