IODINE DEFICIENCY DISORDERS: CURRENT STATE OF THE PROBLEM IN THE BRYANSK REGION

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BACKGROUND: The Bryansk region is one of the regions of the Russian Federation most affected by the accident at the Chernobyl nuclear power plant on April 26, 1986.In the conditions of a chronic uncompensated deficiency of iodine in the diet in the first months after the accident, an active seizure of radioactive iodine by the thyroid tissue took place, which inevitably resulted in an increase in thyroid diseases from the population in the future. The article presents the results of a control and epidemiological study carried out in May 2021 by specialists of the National Medical Research Center of Endocrinology of the Ministry of Health of Russia, aimed at assessing the current state of iodine provision in the population of the Bryansk region.

AIM: Assessment of iodine supply of the population of the Bryansk region.

MATERIALS AND METHODS: The research was carried out in secondary schools of three districts of the Bryansk region (Bryansk, Novozybkov and Klintsy).The study included 337 schoolchildren of pre-pubertal age (8–10 years), all children underwent: measurement of height and weight immediately before the doctor's examination, which included palpation of the thyroid gland (thyroid gland); Thyroid ultrasound using a portable device LOGIQe (China) with a multi-frequency linear transducer 10–15 MHz; determination of iodine concentration in single portions of urine. A qualitative study for the presence of potassium iodate in samples of table salt (n = 344) obtained from households and school canteens was carried out on the spot using the express method.

RESULTS: According to the results of a survey of 337 pre-pubertal children, the median urinary iodine concentration (mCIM) is 98.3 μg / L (range from 91.5 to 111.5 μg / L, the proportion of urine samples with a reduced iodine concentration was 50.1%). According to the ultrasound of the thyroid gland, 17% of the examined children had diffuse goiter, the frequency of which varied from 9.4 to 29% in the areas of study.
The share of iodized salt consumed in the families of schoolchildren in the study areas was 17.8% (values range from 15.6 to 19%), which indicates an extremely low level of iodized salt consumption by the population. All salt used for cooking in school canteen areas of the study was iodized, which confirms compliance with the requirements of SanPiN 2.4.5.2409–08.

CONCLUSION: Despite the active implementation in the Bryansk region of various preventive programs of IDD and social activities to promote the use of iodized salt, in the absence of mass prevention with the help of iodized salt to date, their unsatisfactory results should be noted.

KEYWORDS: iodine deficiency; goiter; iodine deficiency diseases; iodized salt.

ЙОДОДЕФИЦИТНЫЕ ЗАБОЛЕВАНИЯ: ТЕКУЩЕЕ СОСТОЯНИЕ ПРОБЛЕМЫ В БРЯНСКОЙ ОБЛАСТИ

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ОБОСНОВАНИЕ. Брянская область относится к регионам Российской Федерации, в наибольшей степени пострадавшим в результате аварии на Чернобыльской атомной электростанции 26 апреля 1986 г. В условиях хронического некомпенсированного дефицита йода в питании в первые месяцы после аварии происходил активный захват радиоактивного йода тканью щитовидной железы (ЩЖ), что неизбежно реализовалось в росте заболеваний ЩЖ у населения в последующем. В статье представлены результаты проведенного в мае 2021 г. специалистами ФГБУ «НМИЦ эндокринологии» Минздрава России контрольно-эпидемиологического исследования, направленного на оценку современного состояния йодной обеспеченности населения Брянской области.

ЦЕЛЬ. Оценка йодной обеспеченности населения Брянской области.

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МАТЕРИАЛЫ И МЕТОДЫ. Исследование проводилось в общеобразовательных школах трех районов Брянской области (гг. Брянск, Новозыбков и Клинцы). В исследование были включены 337 школьников допубертатного возраста (8–10 лет), всем детям выполнено: измерение роста и веса непосредственно перед осмотром врача, включавшим пальпацию ЩЖ; ультразвуковое исследование (УЗИ) ЩЖ с использованием портативного аппарата LOGIQe (China) с мультичастотным линейным датчиком 10–15 МГц; определение концентрации йода в разовых порциях мочи. Качественное исследование на наличие йодата калия в образцах пищевой поваренной соли (n=344), полученной из домохозяйств и школьных столовых, осуществлялось на месте экспресс-методом.

РЕЗУЛЬТАТЫ. По результатам обследования 337 детей допубертатного возраста медианная концентрация йода в моче составляет 98,3 мкг/л (диапазон от 91,5 до 111,5 мкг/л, доля проб мочи со сниженной концентрацией йода составила 50,1%). По данным УЗИ ЩЖ у 17% обследованных детей был выявлен диффузный зоб, частота которого варьировала от 9,4 до 29% по областям исследования. Доля йодированной соли, употребляемой в семьях школьников районов исследования, составила 17,8% (диапазон значений от 15,6 до 19%), что свидетельствует о крайне низком уровне потребления йодированной соли населением. Вся соль, используемая для приготовления пищи в школьных столовых районов исследования, была йодированной, что подтверждает соблюдение требований СанПиН 2.4.5.2409-08.

ЗАКЛЮЧЕНИЕ. Несмотря на активное проведение в Брянской области различных профилактических программ йододефицитных заболеваний и социальных мероприятий по пропаганде использования йодированной соли, в условиях отсутствия по настоящее время массовой профилактики при помощи йодированной соли, следует констатировать их неудовлетворительные результаты.

КЛЮЧЕВЫЕ СЛОВА: йодный дефицит; зоб; йододефицитные заболевания; йодированная соль.

BACKGROUND

Iodine deficiency diseases (IDDs) are among the most widespread non-infectious conditions globally. They pose a global danger to public health and their treatment consumes a significant amount of the healthcare system resources [1–3]. A most obvious manifestation of iodine deficiency is endemic (diffuse, non-toxic) goitre, which is a contributory cause of various node-positive thyroid gland diseases. Iodine deficiency-related pathologies are very diverse, and their range is not limited to thyroid gland diseases only. The most prominent among these pathologies are those affecting the central nervous system formation and development in foetus; first and foremost, this concerns brain anomalies resulting in various defects of cognitive and morphologic/functional development in children, all the way to apparent mental deficiencies [1, 2].

It has become crystal clear that the key success factor in overcoming iodine deficiency is public authorities' taking ownership of tackling IDDs and supporting their decisions by issuing appropriate laws and regulations [1–3].

In the early 20th century, overcoming iodine deficiency was a priority objective of the USSR healthcare system. Building on that effort, serious advances in tackling endemic goitre were made in 1950s–1970s. However, the once well-developed system of anti-goitre activities was subsequently abandoned and thus a systemic control over IDD propagation was lost [1, 2].

The Bryansk Region is one of the areas that have suffered a deficiency of several minerals, including iodine, in their soil and water. Following the Chernobyl nuclear power plant disaster (26 April 1986), the region has been exposed not only to iodine deficiency in the biosphere, but also to a technogenic radionuclide contamination. In the first month after the Chernobyl accident, ^{131}I was the most significant source of internal irradiation. It entered human bodies with the air and with contaminated food. Several factors prevented the affected regions' authorities from initiating a timely preventive campaign to curb human intake of iodine isotopes which attacked people's thyroid glands. These areas had already been exposed to natural iodine deficiency, and therefore radioactive iodine was especially harmful as it rapidly accumulated in the thyroid gland. This factor determined a confirmed upward trend of thyroid gland diseases in the population, and that trend affected the Bryansk Region stronger than any other in the country [4–6].

Already in 1995, based on the results of examinations and studies of iodine availability to the population in the regions affected by the Chernobyl disaster, moderate-to-severe endemic goitre caused by both iodine deficiency and technogenic contamination was confirmed in the Bryansk, Kaluga, Tula and Orel regions. Despite the fact that the iodine deficiency in question was minor (median urinary iodine concentration ranged from 69 to 84 μg/L), diffuse goitre frequency in children amounted to 38.6%; the disease also occurred at quite an early age, even at 3 [4, 7, 8].

A few years after the Chernobyl disaster, healthcare authorities in Belarus, and later in Russia and the Ukraine as well, registered an upward trend of thyroid cancer in the contaminated areas' population. The most remarkable feature of this trend was a relatively high share of children. Thus, in 1994, 7.0% of thyroid cancer patients in the Bryansk Region were children under 14, whereas that ratio was 1.3% for Russia in general [9]. The thyroid cancer trend in children under 14 was also alarming: within 1990–1994, it rose from low baseline values to 10 cases per million population across the Bryansk and Kaluga regions [10]. The steepest rise occurred in the Bryansk Region: here, 21 children were diagnosed with thyroid cancer between 1986 and 1994, and that trend persisted thereafter. From 1986 to 2001, 49 children in the Bryansk Region were diagnosed with thyroid cancer; among them, 32 were residents of the region's south-western parts. That number was 24.5 times higher than that for 1975–1986 (2 cases) [9–11]. For the Bryansk Region in general, the ratio of children cancer rose from 0 in 1986 to 2.6 per 100,000 children in 1994–1995. In the region's south-western parts, the number rose from 0 to 10.9 per 100,000 children, respectively [4, 5].

In 1996, given that confirmed upward trend of thyroid pathologies across the entire Bryansk Region and inefficiency of the existing organisational activities to mitigate iodine deficiency's negative impact on public health, the region's authorities began to develop and consistently to introduce several targeted programmes aiming at reducing thyroid gland diseases: Prevention and Protective Treatment of Thyroid Gland Diseases in the Bryansk Region (1996–2000); Prevention and Treatment of Thyroid Gland Diseases in the Bryansk Region (2001–2005); Mitigation of the Public Health Impact of Environmental Pollution in the Bryansk Region (2005–2009). These regional treasury-funded programmes included inquiries into the iodine deficiency degree across selected areas (ioduria tests), screenings for thyroid gland pathologies (laboratory tests to determine thyroid status, thyroid gland ultrasonography), and distribution of potassium iodate to prevent iodine deficiency in pregnant and lactating females.

In October 1999, the Government of Russia issued Directive 1119 – On Activities to Prevent Iodine Deficiency Diseases – and set up the current "voluntary" model of IDDs prevention. Regional authorities were recommended to ensure the local food market had plenty of iodine-enriched foods. In pursuance of this Directive, the Bryansk Region Administration introduced several regional ordinances in the 2000s: Directive 236 (dated 22 May 2000) – On Activities to Prevent Iodine Deficiency in the Bryansk Region Population; Directive 319 (dated 12 August 2002) – On Activities to Prevent Iodine Deficiency Diseases in the Bryansk Region; Directive 299 (dated 14 July 2003) – On Provision of Iodised Salt and Mineral-Enriched Foods to the Bryansk Region Population; and Directive 471 (dated 21 September 2004) – On Extra Activities to Prevent Iodine Deficiency Diseases in the Bryansk Region. In 2002, production of iodine-enriched bread and bakery products was launched. Thus, the region's consumption of iodine-casein-enriched bakery products amounted to 2,604.5 tonnes in 2002 (2.9% of the year's total bakery product consumption) and 5,294.2 tonnes in 2003 (4.8%, respectively). Since 2003, two of the regions milk factories have been iodising 5% to 7% of their products. In 2004, the region's government and parliament allocated funds to conduct free distribution of potassium iodate to pregnant females so as to prevent iodine deficiency among that population group.

As Bryansk Clinical and Diagnostic Centre stated in its report named On the Implementation Progress of the Programme for Prevention and Treatment of Thyroid Gland Diseases in the Bryansk Region in 2001–2002, the level of neonatal thyroid-stimulating hormone (TSH) in newborn babies through 1998–2002 corresponded to mild iodine deficiency: TSH level over 5 mU/L was found in 10.6% to 15.5% (epidemiological criterion of mild iodine deficiency is 3%–19%, see Table 1). Ultrasonography examinations revealed that goitre frequency was 1.3% to 27.3% (in the Novozybkov, Starodub and Kletnya districts and Klintsy city); median urinary iodine concentration ranged from 52 to 77 μg/L [5].

According to 2012 national statistics, diffuse non-toxic goitre and another euthyroid pathology accounted for the majority of thyroid gland diseases in Bryans Region adults (53.1%); a continuous upward trend of thyroid gland diseases was observed. Thus, the region's general frequency of diffuse non-toxic goitre in adults had risen 2.8 times since 2000 and reached 26.6 cases per 1,000 adult population in 2012. However, this rise had uneven geographical distribution: the frequency had risen 5.5 times in the south-western areas (to 92.2 cases per 1,000 adults) vs. 1.8 times elsewhere in the region (to 14 cases per 1,000). In 2012, the ratio of primary incidence of diffuse non-toxic goitre in all diffuse non-toxic goitre cases diagnosed in Bryans Region adults amounted to 10.9%; in the south-western areas the primary incidence ratio of diffuse non-toxic goitre in all cases of this disease was only 6.5% (6.4% in 2011 and 7.7% in 2010), whereas elsewhere in the region it amounted to 16.4%. More than 20 years after the Chernobyl disaster, such discrepancy between "clean-from-radiation" and contaminated areas of the region can be attributed to annual screening programmes that include thyroid gland ultrasonography and

Table 1. Data of neonatal screening for congenital hypothyreosis in the Bryansk Region: cases of diagnosed congenital hypothyreosis by year and percentage ratios of newborn babies screened

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Screened for congenital hypothyreosis	10,657	6,857	7,478	12,379	11,549	11,576	11,765	13,090	14,200	14,180	13,520
Screening coverage (%)	96.4	62.2	62.7	98.8	92.4	95.9	98	98.5	98.4	98.4	98
Diagnosed with congenital hypothyreosis	5	3	2	3	2	3	6	5	3	6	5

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Screened for congenital hypothyreosis	13,605	14,100	13,470	13,520	13,683	13,570	11,429	11,331	9,934	9,500
Screening coverage (%)	98	99	98.2	98	98.8	98	98	99	99	98
Diagnosed with congenital hypothyreosis	4	4	4	4	3	6	6	4	2	2

thus contribute to efficient diagnosis of diseases in the adult population [5, 12].

Among children in the Bryansk Region, diffuse non-toxic goitre accounts for most of thyroid gland diseases (78.6% in 2012). Just as with adults, some geographic discrepancy is observed in the frequency of thyroid gland diseases between the region's areas: in the south-western parts, diffuse non-toxic goitre frequency in 2012 amounted to 96.9 cases per 1,000 children vs. 19.1 cases elsewhere in the Bryansk Region. In 2012, the ratio of primary incidence of diffuse non-toxic goitre in all diffuse non-toxic goitre cases diagnosed in Bryans Region children amounted to 64.8%; values by area ranged from 56.4% to 74.1%. In the same year, congenital iodine deficiency syndrome was diagnosed in 8–10 children per 100,000; however, this frequency was 5 times higher in the region's south-western areas. The ratio of primary incidence of congenital iodine deficiency syndrome in all registered cases of this disease amounted to 25% [12].

Since 2015, the Bryansk Region has seen positive-looking downward trends of thyroid gland pathologies in general and of individual medical conditions within the category of thyroid gland diseases, both in adults and children. These data are presented in Table 2. However, as on 2017, the Bryansk Region still had the highest rate of thyroid cancer in Russia: 425.5 per 100,000 population per year [13].

Analytical report prepared by Endocrinology Research Centre in 2021 assesses the 2009–2018 epidemiological trend of thyroid gland pathologies in Russia's population. It states that within the decade in question, statistically significant increase of various forms of goitre and thyrotoxicosis was observed across all Russia's population. An upward trend of congenital iodine deficiency syndrome was identified (10-year incidence median value was 0.4 per 100,000 population; annual incidence growth median value was 0.04 per 100,000 population). Even though primary incidences of various forms of goitre became less frequent

Table 2. Bryansk Region official statistics: total thyroid gland pathologies (in adults and children by year) and nosological structure of thyroid gland diseases (in adults and children by year)

Individual diseases and disease classes	ICD-10 code	years				
		2016	2017	2018	2019	2020
Ages 0–14 (number of registered cases per 1,000 children)						
Thyroid gland diseases	E00–E07	36.9	34.3	29.7	31.3	27.9
including: Congenital iodine deficiency syndrome	E00	0.1	0.1	0.1	0.2	0.1
Endemic goitre caused by iodine deficiency	E01, E02	3.3	2.7	2.2	1.4	1.0
Subclinical hypothyreosis caused by iodine deficiency and other forms of hypothyreosis	E02, E03	5.8	5.1	3.3	3.8	3.3
Other forms of non-toxic goitre	E04	23.4	22.2	19.5	20.0	19.1
Thyrotoxicosis	E05	0.09	0.07	0.05	0.03	0.05
Thyroiditis	E06	2.2	1.8	1.7	1.8	1.5
Ages 15–17 (number of registered cases per 1,000 adolescents)						
Thyroid gland diseases	E00–E07	96.4	91.1	88.5	79.8	78.0
including: Congenital iodine deficiency syndrome	E00	0.1	0.1	0.1	0.03	0.03
Endemic goitre caused by iodine deficiency	E01, E02	8.5	8.2	6.7	5.3	5.4
Subclinical hypothyreosis caused by iodine deficiency and other forms of hypothyreosis	E02, E03	10.0	8.6	7.9	6.1	6.7
Other forms of non-toxic goitre	E04	55.0	55.3	54.4	51.7	49.9
Thyrotoxicosis	E05	0.4	0.3	0.2	0.1	0.2
Thyroiditis	E06	8.7	8.5	9.2	8.0	8.5
Adults (number of registered cases per 1,000 adults)						
Thyroid gland diseases	E00–E07	58.4	57.4	57.4	57.5	41.0
including: Congenital iodine deficiency syndrome	E00	-	-	-	-	-
Endemic goitre caused by iodine deficiency	E01, E02	7.5	7.1	6.6	6.4	4.6
Subclinical hypothyreosis caused by iodine deficiency and other forms of hypothyreosis	E02, E03	5.3	4.9	4.4	4.8	3.3
Other forms of non-toxic goitre	E04	31.7	32.8	33.5	33.9	24.0
Thyrotoxicosis	E05	1.4	1.5	1.4	1.5	1.0
Thyroiditis	E06	10.3	9.9	9.6	9.7	7.2

during the decade in question, the prevalence of goitre in Russia's population did not go down to a sporadic level but has remained quite high: 1.2% of the population as on 1 January 2019 [14].

Unfortunately, it must be said that organisational activities carried out to curb iodine deficiency diseases in the Bryansk Region have yielded poor results as relatively high frequency of goitre pathologies persists in both adults and children. Thus, such activities are inefficient unless mass-scale preventive consumption of iodised salt is promoted.

AIM

Assess the availability of iodine to Bryansk Region residents.

MATERIALS AND METHODS

The examination was conducted at public schools in three districts of the Bryansk Region (Bryansk, Novozybkov and Klintsy).

337 pre-puberty age pupils (ages 8–10) were examined. In each case, the examination included: height and weight measurements directly prior to in-person examination by a physician who performed, *inter alia*, thyroid gland palpation; thyroid gland ultrasonography using LOGIQe portable ultrasound system (China) with 10–15 MHz multi-frequency linear array transducer; and determining iodine content in urine samples collected once from each child.

The examination was a single-step one, conducted 18–20 May.

Every child's parents/legal guardians provided their informed consent to the examination and personal data processing. A permit by Endocrinology Research Centre's internal Ethics Committee was issued on 25 March 2020, official session record no. 5.

Examination venue and time

The examination was conducted 17–20 May 2021 in the following districts of the Bryansk Region:

1. Bryansk city
2. Klintsy city (Klintsy District)
3. Novozybkov city (Novozybkov District).

Examined population(s) (one or more)

One population

Sampling method with regard to examined population(s)

Communities and schools were selected based on the number of pupils: locations where at least 30 pupils aged 8–10 could be examined were selected.

Sampling method: systematic selection, given that each school both locally residing pupils and commuting pupils residing in other communities in the Bryans Region.

Examination design

Single-step examination of a population

METHODS

In total, 337 somatically normal pre-puberty age pupils (ages 8–10) were examined (see Figure 1). The examination was conducted 18–20 May 2021 at public schools in three districts of the Bryansk Region (Bryansk, Novozybkov and Klintsy); the examined group size was more or less the same in each locality.

The examination was conducted as per WHO recommendations [17] and included: anamnesis collection, anthropometric assessment (weight, height measurements), endocrinologist examination with thyroid gland palpation, thyroid gland ultrasonography, and determining iodine content in urine samples collected once from each child. Potassium iodate content in cooking salt samples obtained from the pupils' households and school dining rooms was also determined.

Weight and height measurements were taken as children were seen by an endocrinologist. Thyroid gland size and sonographic structure were determined in lying position through ultrasonography using LOGIQe portable ultrasound system (China) with 10–15 MHz multi-frequency linear array transducer. Assessment of thyroid gland size against standard values as per M. Zimmermann *et al*. was based on each child's body surface area and sex [15].

All urine samples (337 pieces) in Eppendorf micro test tubes were frozen at -20°C to -25°C directly after sampling. Ioduria was then assessed with cerium-arsenite technique (at the Endocrinology Research Centre's clinical laboratory).

Potassium iodate presence in 344 cooking salt samples was determined on the spot by using instant starch-iodine method: free iodine released from salt after contact with test solution changes the colour of starch solution. The degree of colour change was assessed visually.

Every child's parents/legal guardians provided their informed consent to the examination and personal data processing. A permit by Endocrinology Research Centre's internal Ethics Committee was issued on 25 March 2020, official session record no. 5.

Statistical analysis

Data are presented as absolute values and percentage shares. Median values and frequencies were used to describe the findings of ioduria statistical analysis.

Ethical review

Research protocol was approved by Endocrinology Research Centre's internal Ethics Committee on 25 March 2020 (official session record no. 5).

RESULTS

Median urinary iodine concentration in 337 primary school-age children was 98.3 µg/L; values ranged from 91.5 to 111.5 µg/L; 50.1% of urine samples had low iodine concentration (see Figure 2).

The share of iodised salt used in the pupils' families across the examined districts was 17.8% (values by district ranged from 15.6% to 19%), which indicates an extremely low level of iodised salt consumption in the population (see Figure 3a, Figure 3b).

All cooking salt used in school dining rooms across the examined districts was iodised, which confirms compliance with the requirements of SanPiN 2.4.5.2409–08 standard applicable to public schools (Chief Public Health Officer's Directive 45 issued on 23 July 2008, as amended on 25 March 2019).

Figure 1. Endocrinology Research Centre staff are examining children in the Bryansk Region

Thyroid gland ultrasonography revealed that 17% of children had diffuse goitre; values by district ranged from 9.4% to 29% of examined children.

Thyroid gland size determination through palpation is a valid method which, given an experienced physician, has a good sensitivity if goitre and/or high degrees of thyroid gland enlargement are widespread in a population. We found that thyroid gland palpation yielded a detectability of goitre comparable to that of ultrasonography, while slightly overstating goitre frequency: on average, goitre frequency determined through palpation was 23.3%.

Findings of the examinations conducted in Bryansk Region cities are presented in Table 3.

DISCUSSION

High IDD frequency in the Bryansk Region stems from poor iodine content in the soil [8]. Technogenic radionuclide contamination caused by the 1986 Chernobyl disaster has led to a substantial rise of thyroid gland diseases in the region, especially in children and adolescents. Since 1986, Bryans Region authorities have made efforts to curb iodine deficiency: several targeted programmes have been implemented, including thyroid pathologies screening, iodine enrichment of foods, preventive activities among pregnant and lactating females and promotion of iodised salt consumption. However, our findings tell that all the aforesaid

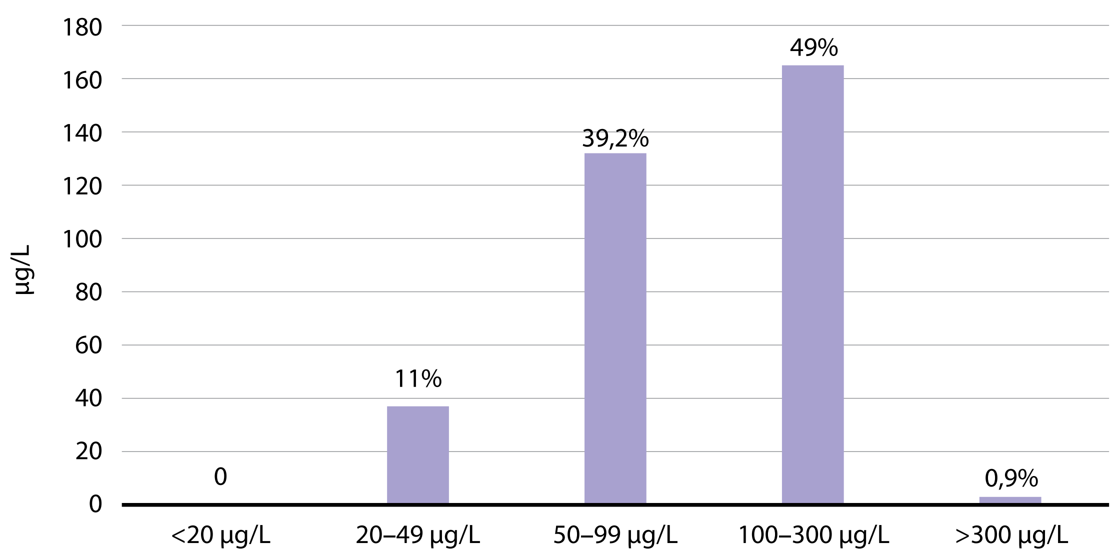
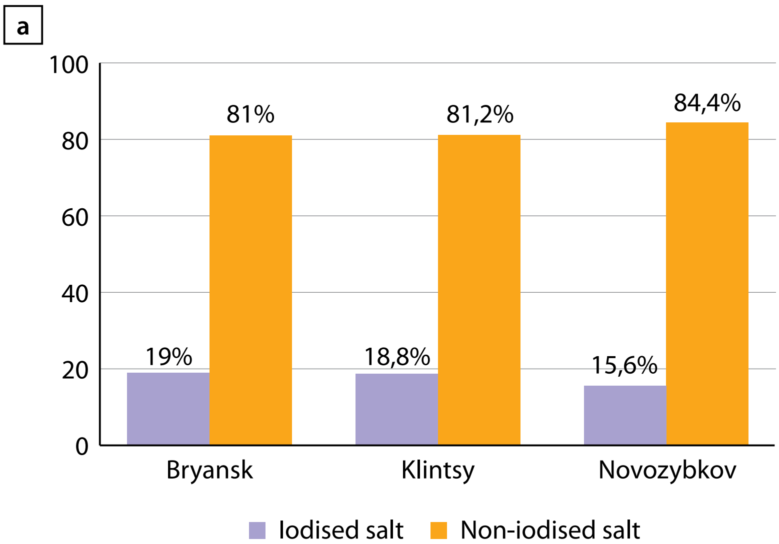


Figure 2. Urinary iodine concentration in examined school pupils



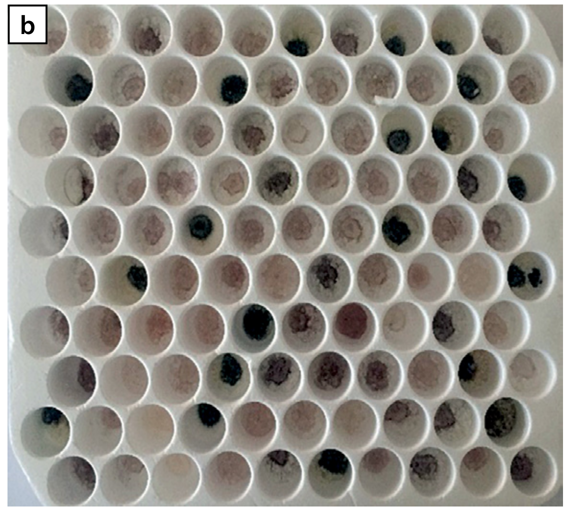


Figure 3a. Iodine presence in households' cooking salt
Figure 3b. Instant test of iodine presence in cooking salt (dark blue colouring indicates presence of potassium iodate)

activities have been rather inefficient as the IDD problem has not been resolved and at present the Bryansk Region has no active programme aimed at mass-scale IDD prevention.

The findings of this monitoring show that iodine deficiency in foods consumed by Bryansk Region population has persisted and generally corresponds to the trends identified and conclusions made by comparable research designed similarly to ours and conducted in 2020 in Crimea and Tuva republics [16, 17].

In the Bryansk Region, extremely low household consumption of iodised salt (17.8%) and moderately low median urinary iodine concentration (98.3 µg/L) indicate that iodine consumption in the population is insufficient. Compliance with the requirements of SanPiN 2.4.5.2409–08 standard as applicable to iodised salt consumption in public schools as of 2020 was confirmed through tests of salt samples taken from school dining rooms across the examined area. School-age children ioduria values we identified may be slightly overstated and thus may not be an accurate measure of iodine availability to the population in general.

The degree of IDDs in the Bryansk Region identified through ioduria analysis and goitre frequency in children (determined through thyroid gland ultrasonography) corresponds to mild epidemiological criteria (up to 99 µg/L and up to 19.9%, respectively). However, iodine deficiency in school pupils residing in smaller communities was higher than that of pupils residing in larger cities. Thus, the most adverse epidemiological trend was identified in the Klintsy District: median urinary iodine concentration at 91.5 µg/L and goitre frequency at 29%, whereas the same values in Bryansk residents were better: 111.5 µg/L and 9.4%, respectively. The most probable reason of such greater goitre frequency in Klintsy District children may be different diets in different areas. The diet of larger cities' residents mostly consists of mineral-rich food industry products and seafoods sourced from far away, while rural residents traditionally use locally grown foods (including those grown or produced by households themselves).

It is also notable that such goitre frequency in the Bryansk Region (up to 29%) is observed while the range of median urinary iodine concentration is 91.5 µg/L to 111.5 µg/L. Apparently, such goitre endemic is cause not only by iodine deficiency but other factors as well. Thus, further epidemiological studies need to be made on greater number of participants and districts, as well as more thorough benchmarking of the findings against data obtained from other regions of Russia [17].

It is obvious that thyroid gland palpation leads to overstated goitre size statistics in areas with mild iodine deficiency and thus cannot be deemed a sufficient method in further epidemiological studies. However, this method should not be discarded as it is valid and has a reliable sensitivity. Thus, it is a valuable tool for physicians as it may provide indications for the use of other examination methods.

Table 3. Findings of examinations conducted in Bryansk Region cities

City	Diffuse goitre frequency (%)		Median urinary iodine concentration (µg/L)	Iodised salt share (%)
	Ultrasonography	Palpation		
Bryansk	9.4	10.7	111.5	19
Novozybkov	12.5	15.3	92	15.6
Klintsy	29	44	91.5	18.8
Bryansk Region average	16.96	23.3	98.3	17.8

Design, implementation and regular follow-up of a new regional prevention programme, promotion of iodised salt consumption and raising public awareness about problems associated with iodine deficiency are believed to be vital components of medical and social activities aimed at elimination of iodine deficiency diseases in the Bryansk Region.

Practical significance of the findings

Practical significance of our findings consists of a comprehensive assessment of iodine availability and goitre endemic and identification of a need for new IDD prevention programmes in the Bryansk Region.

Areas of further studies

Building on this study, new examinations are being planned jointly with Bryansk Region Healthcare Department. They will involve other districts of the Bryansk Region and cross-referencing the data thus obtained with statistics of neonatal screening for congenital hypothyreosis, as well as monitoring of iodine availability among pregnant and lactating females simultaneously with mass-scale iodine deficiency prevention efforts.

TAKEAWAYS

The findings of this epidemiological study indicate insufficient availability of iodine to Bryansk Region residents: the median urinary iodine concentration is 98.3 μg/L, which is caused by a very low ratio of households using iodised salt (17.8%). This ratio is below the WHO recommendations for regions affected by natural iodine deficiency (at least 90%).

Generally in the Bryansk Region, mild IDDs in children are found; average ultrasonography-identified goitre frequency in children is 17% (values are ranging from 9.4% to 29%).

Analysis of data obtained through the examination revealed trends typical for iodine-deficient areas: higher degrees of iodine deficiency correlate with higher goitre frequency in primary-school-age children (the most adverse epidemiological trend was identified in the Klintsy District: goitre frequency at 29%, median urinary iodine concentration at 91.5 μg/L and iodised salt consumption ratio at 18.8%).

Goitre endemic is more prominent among children residing in smaller communities, compared to urban area residents (ultrasonography-identified goitre frequency in children is 29% and 9.4%, respectively). The same rural communities have lower ratios of iodised salt consumption.

CONCLUSION

Epidemiological monitoring examination conducted in 2021 by Endocrinology Research Centre in order to assess iodine availability to Bryansk Region population confirmed that dietary iodine deficiency has persisted despite all efforts taken to curb it. Thus, iodine deficiency is still negatively affecting children's health and thus causing highly adverse consequences for the entire population of this region which has been under the impact of the Chernobyl NPP accident.

Inadequate iodine consumption ratios identified in the Bryansk Region once again demonstrate inefficiency of Russia's present-day "voluntary" IDD prevention model: very low household consumption of iodised salt has caused mild iodine deficiency and goitre endemic in children.

Russian and international experience in IDD prevention unequivocally tells that mass-scale consumption of iodised salt is the only efficient way to overcome dietary iodine deficiency.

ADDITIONAL INFORMATION

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Authors' contribution. Every author has directly contributed to the examination of children in the Bryansk Region, the analysis of findings and the preparation of this article. Every author approved the final version of the text prior to publication and agreed to accept responsibility for all aspects of this study, which implies due investigation and resolution of any issue related to the accuracy or integrity of any part thereof.

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