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Research Article

Iodine Deficiency in Central Siberia, Russia

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Abstract

Introduction: Iodine deficiency is associated with goiter and impaired brain function. Neonatal thyroid-stimulating hormone (TSH) screening for congenital hypothyroidism used as an indicator of the degree of iodine deficiency and of its control. An increased frequency of thyroid-stimulating hormone (TSH) measurements above 5 mIU/L in newborn screening corresponds to the an impaired iodine status of the population.

The aim: To estimate the iodine deficiency and the effectiveness of iodine prophylaxis in Krasnoyarsk territory, Republics of Tuva and Khakassia according the results of neonatal TSH_screening.

Methods: A 18-year analysis was performed in 34,980 newborns participating in the national thyroid newborn screening program. The TSH concentration was measured in dry blood spots collected by heel stick on filter paper, 96 hours after birth, using DELFIA method.

Result: According to the data of the congenital hypothyroidism screening the rate of TSH < 5 mU/1 was 11.8% in Krasnoyarsk territory (23.9% in 2000) and corresponded to mild iodine deficiency. In different regions of Krasnoyarsk territory the rate of TSH < 5 mU/1 in the newborn varied from 3.5% to 23.7%. The highest values were marked in the Arctic peninsula Taimyr, in cities Zheleznogorsk (nuclear facility) and Sosnovoborsk, in Irbeysky, Suchobuzimsky, Eniseysky, Tuchtetsky, Novoselovsky regions (20.9–23.7%). In the Republic of Khakasia the rate of TSH < 5 mU/1 was 12.5%. In the Republic of Tyva the rate of TSH < 5 mU/1 was – 6.6% (38.6% in 1997; 11.5% in 2000). These results indicate mild iodine deficiency.

Conclusion: Our investigations show mild iodine deficiency in Central Siberia demanding continuous adequate iodine prevention. Additional assessment of the iodine intake in the regions with mild iodine deficiency is needed to prevent suboptimal cognitive and psychomotor outcomes.

Keywords: Iodine Status; Neonatal Screening; Thyroid-Stimulating Hormone

Introduction

Neonatal thyroid screening using thyroid-stimulating hormone (TSH) as the primary screening test detects not only permanent sporadic congenital hypothyroidism, but also transient hypothyroidism, which main cause is iodine deficiency. Elevated serum TSH in the neonate indicates insufficient supply of thyroid hormones to the developing brain, and therefore, constitutes the only indicator that allows prediction of possible impairment of mental development at a population level. Therefore, WHO included neonatal TSH as one of the indicators for assessing Iodine Deficiency Disorders (IDD) and their control. In the absence of iodine deficiency, the frequency of neonatal TSH above 5 mU/L whole blood is less than 3%. A frequency of 3%-19.9% indicates mild IDD. Frequencies of 20%-39.9% and above 40% indicate moderate and severe IDD, respectively. Along with urinary iodine concentrations (UIC), it has been proposed that neonatal thyroid-stimulating hormone (TSH) concentrations are a good indicator for the prevalence of iodine deficiency disorders (IDD) in the population [1-3].

Siberia traditionally belonged to iodine-deficient regions. Cessation of iodine prevention in the 1990-s, migration of the population, worsening of social and economic situation promoted the increase of iodine deficiency disorders (IDD) in Siberia. Our epidemiological studies of IDD, conducted in the 1994-2000, revealed a moderate iodine deficiency in the northern regions the Krasnoyarsk territory and the Republic of Khakasia. In the Republic of Tyva we found the pocket of severe iodine deficiency in 1997 [4-8].

The objective of the present study was to analyze the results of neonatal screening for congenital hypothyroidism to assess iodine status in Central Siberia (Krasnoyarsk territory, Republics of Tuva and Khakassia).

Methods

A 18-year analysis was performed in 54,980 newborns participating in the national thyroid newborn screening program. The TSH concentration was measured in dry blood spots collected by heel stick on filter paper, 96 hours after birth, using fluorimmoassay DELFIA method.

We analyzed data of thyroid-stimulating hormone (TSH) screening for 1997, 2000 and 2015 years in Krasnoyarsk territory, in the Republic of Tyva and in the Republic of Khakassia.

Since 1994 all neonates born in Russian Federation are screened for congenital hypothyroidism on 4th day after birth. Absorbing cards are distributed to the obstetric clinics by the screening centres. Venous blood is collected directly on the cards by the nurses via a heel stick. All cards contain a unique identification code for each child. Following parameters are collected on the blood card for each newborn: identification of the clinic, unique number of the child, hospital of birth or general practitioner/midwife if born out of hospital, sex of the child, birth date of the child, type of feeding, medications, duration of pregnancy and birth weight. Blood cards are dried at room temperature and transported within 24 hours to the screening center for the analysis.

Results and Discussion

Analysis of neonatal TSH screening in the Krasnoyarsk region has shown that, in whole, the frequency of neonates with TSH >5 μU/ml was 11.8%. Based on WHO criteria, it corresponds to mild iodine deficiency. Compared to 2000, this rate has decreased (in 2000 - 23.9%).

The frequency of TSH > 5 Med/l less than 3% not detected in any of the regions. In different regions of Krasnoyarsk territory the TSH > 5 mU/1 in neonates varied from 3.2% to 23.7%. The highest frequency of TSH > 5 Med/l (more than 20%) were marked in the north peninsula Taimyr, in Eniseysky, Suchobuzimsky, Tuchtetsky, Novoselovsky regions, in towns Zheleznogorsk (nuclear facility) and Sosnovoborsk (Table 1).

In the Northern Turukhansky region frequency of TSH > 5 Med/l was 12.2%, which corresponds to the mild iodine deficiency. In the 1994 we have identified here the serious iodine deficiency (median urinary iodine concentrations was 28 μg/l). The iodine prophylaxis was condacted (iodized salt, bread, lipiodol capsules and iodine pills). In 1998 the median urinary iodine concentration among prepubertal schoolchildren was 115 μg/l [5-8].

Regions	Frequency of TSH >5 μU/ml		Frequency of TSH >20 μU/ml	
	2000	2015	2000	2015
Evenkiysky AO	44.1	17.2	11.8	–
Taymyrsky AO	29.9	23.7	2.4	0.4
Turukhansky region	9.2	12.2	1.0	0.9
Boguchansky region	32.3	10.3	3.4	0.3
Yeniseysky region	21.9	20, 4	3.1	0.3
Zheleznogorsk	41.0	21.5	6.4	1.0
Sosnovoborsk	42.2	20.9	4.44	0.7
Krasnoyarsk	23.5	9.2	3.25	0.2
Krasnoyarsk territory	23.9	11.8	2.87	0.4

Table 1: Distribution of neonatal TSH in the Krasnoyarsk region in 2000 and 2015yrs.

In the Republic of Khakassia, the frequency of neonatal TSH >5 μU/ml was 12.5%, which corresponds to the mild iodine deficiency. In most regions there is mild iodine deficiency, in Sayanogorsk town the frequency of neonatal TSH >5 μU/ml is 1.7%, it corresponds to the adequate iodine sufficiency. In Tashtypsky region of Khakassia frequency of TSH > 5 Med/l was 7.1%, which corresponds to the mild iodine deficiency. In 2000, we revealed here moderate iodine deficiency (median urinary iodine concentration was 24 μg/l) [4-8].

In the Republic of Tuva in 1997 we have first found the extremely severe iodine deficiency in the Western part of Tuva. The iodine prophylaxis was conducted (iodized salt, bread, lipiodol capsules and iodine pills) and in 2000, iodine deficiency in the Tuva Republic was eliminated [4-8]. In 2002 KIWANIS International built salt iodination factory in capital Kyzyl. Analysis of 8025 neonatal TSH in 2015 showed that the frequency of TSH > 5 μU/ml is 6.6%, which corresponds to the mild iodine deficiency (Table 2).

Regions	The frequency, %					
	1997		2000		2015	
	TSH >5 μU/ml	TSH >20 μU/ml	TSH >5 μU/ml	TSH >20 μU/ml	TSH >5 μU/ml	TSH >5 μU/ml
Buy-Tajginskij	40.4	13.6	8.6	1.1	6.1	0.1
Baruun-Hemtchikskij	53.4	25.9	21	1.3	8.9	0.1
Dzun-Hemtchikskij	26.5	8.1	14	1.0	6.4	0.2
Kyzylskij	25.1	3.1	7.1	1.4	1.7	0
Kaa-Hemskij	26.9	8.2	9.5	4.2	4.1	0.1
Mongun-Tajginskij	31.6	8.6	12.1	5.8	3.5	0.1
Ovurskij	15.3	2.6	7.4	0	2.1	0
Sut-Holskij	55.9	15.6	16	5.4	9.1	0.1
Tandynskij	26.7	3.1	17	4.3	6.5	0.2
Tes-Hemskij	16.7	14.4	9.1	1.1	1.4	0.01
Todzhinskij	25.0	4.0	21	4.4	3.1	0
Ulug-Hemskij	74.6	34.2	18	3.8	9.3	0
Chaa-Holskij	66.1	10.3	16	2.7	7.5	0.1
Chedi-Holskij	44.7	15.0	15	3.1	6.8	0
	43.3	7.6	12	1.7	6.1	0.1
Tyva Republic	37.6	8.48	9.1	1.8	6.6	0.1

Table 2: The results of neonatal thyroid screening in the Republic of Tuva.

The using the results of newborn screening for congenital hypothyroidism has allowed us to assess the status of iodine deficiency in Central Siberia. Here necessary always to conduct universal iodine prophylaxis.

Figure 1: Krasnoyarsk region map on the map of Russia.

Figure 2: Krasnoyarsk region, the Republics of Khakasia and Tuva map on the map of Russia.

Figure 3: Iodine deficiency disorders survey in Central Siberia.

Conclusion

Our investigations shown that in Central Siberia there is a serious natural iodine deficiency influencing the health and mental development of the population, demanding continuous adequate iodine prevention and monitoring of iodine deficiency. Medical and socio-economic significance of iodine deficiency consists in essential loss of intellectual potential. Iodine deficiency results in the loss of 10 to 15 IQ points at a population level and constitutes the single cause of preventable brain damage and mental retardation. Consequently additional assessment of the iodine intake in Central Siberia is needed to prevent cognitive and psychomotor outcomes.

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