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Correlative Interrelationship of Environmental Mineral Impurity and Thyroid Pathology of the Population of the Penza region

Abstract

We studied causation of frequency of thyroid gland pathology in the population of Penza and the Penza region and content of iron, nitrites and fluorine in water; cadmium, copper, zinc and lead in soil. High correlation of microelements in the water and in the soil is noted with the prevalence rate of diffusion craw, hypothyroidism and thyrotoxicosis. Effect of mineralization is manifested not only within the same year, but also there is a delayed effect.

Keywords: thyroid gland, thyroid pathology, ecology, soil mineralization, water mineralization, correlation.

The main role in the formation of thyroid function is given to the level of iodine sufficiency. However, despite the large-scale activities on providing the population with iodine, worldwide increase of prevalence rate of endemic goiter is marked. Moreover, there is evident tendency of leveling indicators of goiter in the male and female population, among the inhabitants of seaside and mountain regions, among the rural and urban population, and people living in non-black and black soils [1,2].

Not previously revealed endemic accidents in Tambov and Voronezh regions have the prevalence of goiter at 15-40% of schoolchildren in rural areas nowadays. In the Arkhangelsk region the frequency of pathology reaches 80-98%. Higher iodine deficiency is found in large areas of the Western (Tyumen region) and Eastern Siberia (Krasnoyarsk Territory, Yakutia), the Republic of Buryatia, the Republic of Tyva [3].

The Penza region, along with many others, can be considered a zone of endemic goiter, as the number of children with iodine deficiency reaches 85.9% [4].

The severity of endemic goiter can be resulted from (in the mode of plus or minus) excess or shortage of a microelement not as an etiological factor [5]. Imbalance of microelements caused by inadequate or excess intake contributes to the development of goiter: selenium (a component of the enzyme iodothyronine deiodinase - enzyme responsible for peripheral conversion T4 to T3 in liver and

kidneys), zinc (effect on thyroid stimulating hormone secretion, suppresses lead and copper toxicity), chromium, bromine, cobalt, copper, iron (involved in conversion of phenylalanine into tyrosine) molybdenum, cadmium, calcium, fluorine, phosphorus, potassium, lead (violates conversion of T4 to T3), mercury (violates metabolism of thyroid hormones), lithium, chlorine. In particular, it was found that the larger the indices of microelements in association links are: Mn: Co: Zn: Cr: Pb, the higher the prevalence of goiter in the population is. And people with increased thyroid gland in urine had higher parameters of I: Mn, I: Co , I: Zn, I: Pb, indicating worsening imbalance of trace elements [6,7].

The aim of this work was to study the relationship between frequency of thyroid pathology of residents of the Penza city and the Penza region and content of microelements in water and soil.

MATERIALS AND METHODS

Materials of the research included statistical data on incidence rates of thyroid disorders of residents of Penza city and the Penza region and the level of mineral contamination of the environmental components from 2000 to 2013. The analysis of the content of iron, nitrites, fluorine in the water; cadmium, copper, lead and zinc in the soil was conducted. All cases of thyroid pathology were divided into 5 groups: diffuse goiter, multinodular goiter, hypothyroidism, hyperthyroidism, thyroiditis.

Quantitative data were processed by variational-statistical methods, using the non-parametric correlation and dispersion factorial analysis using the software package IBM SPSS Statistics v22.

RESULTS AND DISCUSSION

The analysis of the incidence of thyroid pathology showed that the incidence of diffuse goiter was maximal in Bessonovsky and Nikolsky districts in 2006 (240.8 and 214.2 cases per 100 thousand population, respectively), Gorodishchensky (39.7) and Kamensky (327 1) districts - in 2008, in the Kuznetsky - in 2002 (285.9), Penza - 2001 (168.2).

The incidence of multinodular goiter was maximal in Bessonovsky district in 2004 (28.6) in Gorodishchensky - in 2009 (27.9), in Kamensky district - in 2008 (492.8) in Kuznetsky and Nikolsky district - in 2010 (115.2 and 153.2, respectively), in Penza - 2007 (52.63 cases per 100 thousand. population).

The incidence of hypothyroidism was maximal in Bessonovsky district in 2006 (114.5 cases per 100 thousand population) in Gorodishchensky district and the city of Penza - in 2009 (41.8 and 85.8, respectively), in Kamensky district - in 2008 (170.3) in Kuznetsky and Nikolsky districts - in 2011 (76

and 175.5, respectively).

The incidence of hyperthyroidism in Bessonovsky, Nikolsky districts and the city of Penza was maximum in 2004 (38.2, 67.3 and 23.1, respectively), Gorodishchensky district - in 2007 (77.1), in Kamensky region - in 2008 (80.6), in Kuznetsky - in 2000 (52.7 cases per 100 thousand population).

The incidence of thyroiditis reaches its maximum value in Bessonovsky district in 2008 (77.1) in Gorodishchensky - in 2011 (30), in Kamensky district - in 2008 (313.6) in Kuznetsky and Nikolsky districts and Penza - 2007 year (175.61, 97.06 and 35.4 cases per 100 thousand. population, respectively).

The analysis of the mineral composition of the environment showed that the content of iron in drinking water in Bessonovsky district reached its maximum value in 2011 was 0.88 mg / l, Gorodishchensky district - in 2013 (0.21 mg / l), in Kamensky - in 2007 (0.21 mg / L) in Kuznetsky - in 2012 (0.87 mg / l), in Nikolsky district - in 2008 (0.22 mg / l), Penza - 2003 (0.56 mg / l)..

Nitrite content in water of Bessonovsky district was the most in 2002 (1.74 mg / l), in Gorodishchensky district and Penza - 2007 (0.07 and 0.05 mg / L, respectively), in Kamensky district - in 2008 (0.12 mg / L) in Kuznetsky district - in 2006 (0.04 mg / l), and in Nikolsky districts - in 2010 (0.18 mg / l).

The level of fluoride in drinking water was maximal in Bessonovsky district in 2008 (2.56 mg / l), in Gorodishchensky district - in 2013 (0.16 mg / l), in Kamensky and Nikolsky districts - in 2011 (0, 88 and 0.17 mg / L, respectively), in Kuznetsky district and the city of Penza - 2009 (0.38 and 0.26 mg / L, respectively).

The content of cadmium in the soil reaches the highest value in Bessonovsky district in 2006 (0.12 mg / kg) in Gorodishchensky - in 2013 (0.2 mg / kg) in Kamensky and Nikolsky districts - in 2005 (0.11 and 0 12 mg / kg, respectively), in Kuznetsky district - in 2008 (0.19 mg / kg) in Penza - 2004 (0.19 mg / kg).

Copper levels in the soil was highest in Bessonovsky and Kamensky district and the city of Penza in 2007 (10.73, 9.48 and 9.75 mg / kg, respectively), in Gorodishchensky district - in 2009 (7.79 mg / kg) in Kuznetsky and Nikolsky districts - in 2012 (10.62 and 7.15 mg / kg).

The zinc content in the soil was maximum in Bessonovsky and Kuznetsky district in 2011 (27.93 and 56.69) mg / kg, Gorodishchensky district in 2010 (49.8 mg / kg) in Kamensky region - in 2008 (25 2 mg / kg 8), in Nikolsky districts - in 2012 (53.9 mg / kg) in Penza - 2009 (62.05 mg / kg).

The level of lead in soil is highest in Bessonovsky district and the city of Penza in 2008 (11.44 and 9.3 mg / kg) in Gorodishchensky and Kuznetsky districts - in 2009 (17.35 and 16.36 mg / kg,

respectively), in Kamensky district - in 2011 (10.19 mg / kg), in Nikolsky districts - in 2013 (19.2 mg / kg).

Analysis of the effect of the level mineralization of the water and soil on thyroid morbidity discovered that the zinc content in the soil in 2000 has a strong correlation with the incidence of diffuse goiter (r = 0,80), multinodular goiter (r = 0,75) and hypothyroidism (r = 0,81) 2000, cadmium content in soil in 2000 affects hypothyroidism morbidity in 2001 (r = 0,74) and 2002 (r = 0,72) year, and an influence on the incidence of diffuse goiter 2002 (r = 0,89) the level of copper in the soil in 2000 has a strong influence on the incidence of hypothyroidism in 2002 (r = 0,82).

The iron content in the water in 2001, has a strong correlation with the incidence of hypothyroidism in 2001 (r = 0,78). The fluorine content in the water in 2001 and 2002, has a strong correlation with the incidence of thyrotoxicosis in 2003 (r = 0,82). The iron content in water in 2004 relates to the incidence of hyperthyroidism in 2006 (r = 0,75), the concentration of iron in water, 2005 - with an incidence thyrotoxicosis 2007 (r = 0,85) the copper content in the soil in 2005 year has a proven relationship with the incidence of thyrotoxicosis in 2006 and 2007 (r = 0,75 and 0.78, respectively). The concentration of iron in the water in 2006, has a strong correlation with the incidence of thyrotoxicosis in 2006 and 2007 (r = 0,74 and 0.85, respectively). Nitrite content in the water in 2009 - with an incidence of hyperthyroidism in 2009 (r = 0,81). The lead content in the soil in 2011, is closely related to the level of hypothyroidism in 2012 (r = 0,86).

The One-way ANOVA test showed that there is significant effect of nitrite water and the soil cadmium on the incidence of hypothyroidism, as well as the iron content of water on the prevalence rate of thyrotoxicosis on 99% .

The identified patterns of influence of water salinity and soil on public health are consistent with the results obtained by Ya.G. Adamova (2003) in the Saratov region and L.M. Farkhutdinova (2007) in the Republic of Bashkortostan, in particular, confirmed the influence of copper and cadmium levels of hypothyroidism, fluorine and iron - to hyperthyroidism, which testifies to the unity of the pathogenetic processes occurring in thyroid gland of the inhabitants of different regions. Comparison of mineralization of water and soil of the Penza region with the state of the environment of the Saratov region and the Republic of Bashkortostan showed that the soil of the Penza region has a much higher zinc content than the soil of Bashkortostan (2 mg / kg), but approximately similar concentrations of iron, lead, zinc, copper of soil and water of Saratov region [8,9]. However, it should be noted that the dependence of the incidence of contamination was studied by Ya.G. Adamova and L.M. Farkhutdinova only within the same year, without taking into account long-term effects, which is undoubtedly present.

Conclusion

Thus, the study showed that there is direct relationship between the concentration of minerals in the water and soil and the incidence of thyroid disorders. It has been established that there is the strong correlation between the concentration of cadmium in the soil and the level of diffuse goiter and hypothyroidism, concentrations of iron, nitrite, fluoride of water and level of thyrotoxicosis. At the same time there is also a delayed effect of mineralization on the incidence of subsequent years.

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