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Editorial

The Role of Some Environmental Factors in the Manifestation of Iodine Deficiency Disorders

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Editorial

The environment of the Balkan countries, including Bulgaria, is known for its low content of iodine. Although the most of Bulgarian territory is considered as iodine deficient, the iodine intake of Bulgarian population was improved during the last years by using iodized salt in the households, bakeries and food-processing industries. National surveys undertaken in 2000-2003 and during the last years confirmed the successful putting into practice of the National Strategy for Prevention and Control of Iodine Deficiency Disorders (IDD) in Bulgaria and indicated general normalization of the iodine supply [1]. Despite this, a considerable part of at-risk population groups of children and pregnant women still has Iodine Deficiency (ID) [2,3]. Therefore, the influence of other factors, besides iodine nutrition, has been proposed to play role in the iodine status of these at-risk population groups.

Several chemical substances found in the environment, e.g. thiocyanate and nitrate ions, act as goitrogens and suppress the function of the thyroid gland by interfering with iodine uptake. Thiocyanate ions are detoxification products of hydrogen cyanide, detected in the exhaust of internal combustion engines and tobacco smoke, and may contribute to body thiocyanate loading.

There are various ways in which smoking is thought to influence thyroid function [4]. Thiocyanate level in blood is related to the amount of cigarettes smoked [5]. An epidemiologic survey conducted by German research group revealed an association between urinary iodide and thiocyanate ions on the one hand, and goitre prevalence, on the other hand [6]. Iodine deficiency may enhance the antithyroid action of thiocyanate and iodide excess may diminish this effect. Thereby, thiocyanate may be responsible for the goitrogenic effect of cigarette smoke seen in some iodine deficient areas [7]. Since the typical Bulgarian diet is not rich in thiocyanate-containing foods, we suppose that tobacco smoke might be the major source of urinary thiocyanates.

The higher values of urinary thiocyanates (compared to the mean concentration 3.94 mg/L) in 30.97% of the cases in our study of pregnant women [8] corresponded to low urinary iodine (iodine deficiency).

Several observations suggest that thiocyanate crosses the human placenta and may cause both, goitre and neonatal hypothyroidism [9]. Around 70% of the inspected in our study pregnant women exposed to passive smoking in their living conditions had higher urinary thiocyanate levels in comparison with the mean value [8]. Similar were the results from our previous study in schoolchildren, where 60% of the children, exposed to passive smoking in their living conditions were with higher urinary thiocyanate values compared with the non-exposed [10].

Nitrate is the most common chemical contaminant in the world's groundwater aquifers harmful to human health [11]. Its incorporation in humans takes place via drinking water and food. Increased nitrate intake might affect the thyroid gland function. The reason is that the nitrate ion (NO^{3-}) inhibits iodide (I^-) transport into the thyroid gland, because it shares the same transport mechanism. This inhibition could lead to a decrease in thyroid hormone (T4, T3) secretion, followed by an increase in TSH. This could cause a thyroid gland enlargement (goiter) to occur [12].

Nitrates in the drinking water and food are discussed as stimulating factors in the etiology of endemic goiter incidence in terms of iodine deficiency [13]. Numerous experimental [12,14,15] and epidemiological studies have been performed in order to elucidate the strumigenic effect of nitrates in drinking water or food, as during the recent years, a particular attention has been paid to their impact on vulnerable population groups - children and pregnant women [16,17].

In our study of pregnant women, we found that the risk of iodine deficiency is increased more than 4-fold at higher nitrate levels in the serum compared to the levels below the median value [8].

The goitrogenic effect of thiocyanate and nitrate is more evident in the presence of ID. Studies on the interplay between thiocyanate and nitrate levels and thyroid function have indicated that a combination of iodine deficiency and increase in thiocyanate and nitrate level may co-contribute to thyroid dysfunction [9,18].

Several trace elements are essential for normal metabolism of thyroid hormones - iodine, iron, selenium and zinc. Combined deficiency of these elements can disrupt thyroid function [19]. Selenium as essential trace element plays a key role in the thyroid hormone metabolism. The selenium deficiency has negative effect on thyroid function in the conditions of iodine deficiency.

Normally, in the thyroid gland there is a high concentration of selenium, even under conditions of selenium deficiency. In thyroid gland, several important selenocysteine-containing enzymes are expressed, such as Glutathione Peroxidase (GPX), deiodinase and thioredoxin reductase [19]. Three different selenium-dependent iodine-thyronin deiodinases (types I, II, and III) can activate or inactivate thyroid hormones, while GPX detoxifies the Reactive

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Oxygen Free Radicals (ROS) in the thyroid gland. Thus, selenium deficiency may enhance the risk of iodine deficiency.

The effects of selenium deficiency are comparable with those of iodine deficiency and are expressed as strumigenic stimulation and triggering of immunological processes, leading to a reduction in the functional capacity of the thyroid gland and pathological changes. There are contradictions in the literature concerning the combined iodine and selenium deficiency, arising probably from the severity of selenium deficiency [20].

Pregnancy is characterized with particularly high risk of selenium deficiency, due to the enhance requirement of selenium for the growth of the fetus and increased tissue metabolism of the mother's body. This issue is important, relevant and insufficiently elucidated worldwide. According Tzachev, K, 1997 [21]. Bulgaria was among the countries with the lowest content of selenium in the soil, which determined relatively lower intake via food and drinking water in our population.

So far, only two studies have been conducted in Bulgaria focusing on the issue by Pehlivanov, 1993 and Lozanov al. 2008 [22,23]. Our results for plasma selenium in pregnant women are similar to those of Lozanov al. 2008 [23] and demonstrate the presence of selenium deficiency in pregnant women from the Rhodope endemic area in Bulgaria. It is noteworthy that the serum values of selenium in the last third trimester is lower in pregnant women, which is in line to the data reported by other research groups [24,25] suggesting a progressive reduction of serum selenium during pregnancy. The results of our study raise the question of the appropriateness of the supplementation of pregnant women with moderate doses of selenium-containing additives in the conditions of adequate iodine prophylaxis [8].

These findings demonstrate the necessity for more adequate prophylactic steps for improvement of iodine status of vulnerable population groups - children and pregnant women. Thiocyanate levels should be carefully controlled in cases of severe iodine deficiency to avoid a competitive inhibition of iodine intake. The results of numerous studies confirm the potential role of high nitrate level as an environmental factor stimulating the manifestation of iodine deficiency. Selenium as essential trace element plays a key role in the thyroid hormone metabolism. Combined selenium and iodine deficiency have negative influence on the thyroid hormone regulative functions, especially during pregnancy.

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