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URINARY IODINE AND THIOCYANATE CONCENTRATION IN BULGARIAN YOUNG MOTHERS

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ABSTRACT

Purpose: Thiocyanate or thiocyanate-like compounds primarily inhibit the iodine concentrating mechanism of the thyroid, and their goitrogenic activity can be overcome by iodine administration. The aim of this study was to evaluate the association between urinary iodine and thiocyanate concentration in young mothers. **Material and methods**: Subjects of study were 36 young mothers aged 26.44±5.92 years living in the town of Asenovgrad, Bulgaria. Iodine concentration in urine was measured by the Sandell-Kolthoff reaction. The method for thiocyanate quantification in urine was based upon the oxidation of thiocyanate ions in acid solution of potassium permanganate and reaction of the released HCN with picric acid. **Results:** The median urinary iodine of the inspected women was 113.50 µg/L, which is an indicator of adequate iodine intake. Almost 1/3 (30.6%) of the young mothers had iodine deficiency. The mean urinary thiocyanate concentration was 3.13±1.90 µg/mL. By the correlation between iodine and thiocyanate urinary concentrations in studied women was found negative statistically significance ($R = -0.717$, $p<0.0001$). **Conclusion**: An association between urinary iodine and thiocyanate excretion in the studied women was found in this report. Future researches are needed to evaluate the role of thiocyanate on the frequency of iodine deficiency disorders.

Key words: iodine -thiocyanate- thyroid- young mothers

INTRODUCTION

Iodine is an integral part of thyroid hormones and thus, plays a crucial role in foetal organogenesis, and in particular in brain development. This takes place during early gestation and involves delicate targeting throughout the central nervous system. Iodine uptake by the thyroid is higher in pregnancy and iodine reserve in the thyroid can decrease to approximately 40 % of preconception levels. The World Health Organization (WHO) has recently increased the recommended iodine intake during pregnancy to 200-250 micrograms/day (1).

Increased mother's need for iodine during pregnancy is a result of an increased requirement for synthesis of thyroxin (T_4), part of which maintains the normal mother's metabolism and another part is transferred to the foetus, on the one hand; and the increased iodine renal clearance during pregnancy (2), on the other hand. During lactation, the physiology of thyroid hormone production and urinary iodine (UI) excretion returns to normal, but iodine is concentrated in the mammary gland for excretion in breast milk. Thus, using the UI concentration to estimate intake may lead to an underestimate of requirements. But because of the need to ensure that the infant gets enough iodine from breast milk to build reserves in the thyroid gland, it was recommended that lactating women should continue to consume 250 mg of iodine per day. Although lactating women have the same requirements as pregnant women, the median urinary iodine is lower because iodine is excreted in breast milk (3).Although the most of Bulgarian territory is considered as iodine deficient, the iodine intake of Bulgarian population was improved during the last years through the successful putting into practice of

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the National Strategy for Prevention and Control of Iodine Deficiency Disorders (IDD) and indicated general normalization of the iodine supply (4). Despite this, a considerable part of at-risk population groups of children, pregnant and lactating women still has iodine deficiency (ID) (5). 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 perchlorate 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. The goitrogenic effect of thiocyanate is more evident in the presence of ID. Studies on the interplay between thiocyanate levels and thyroid function have indicated that a combination of iodine deficiency and increase in thiocyanate level may co-contribute to thyroid dysfunction (6, 7).

The **aim** of this study was to evaluate the association between urinary iodine as a reliable indicator of recent iodine intake and urinary thiocyanate concentration supposedly related to tobacco smoke exposure of young mothers. 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.

MATERIAL AND METHODS

Subjects of study were 36 young mothers aged 26.44±5.92 years living in the town of Asenovgrad, Bulgaria. The study was conducted during their stay in the clinic of obstetrics and gynecology of the hospital in Asenovgrad. Informed consent for participation in the survey was obtained from the women. Ethical Committee of the Medical University in Plovdiv, Bulgaria approved the research. The participants filled appropriate questionnaires by using "yes" or "no" answers concerning the iodine intake from other sources (e.g. supplementary tablets), familial thyroid disorders, smoking habits.

Iodine concentration was measured by the Sandell-Kolthoff reaction, (8) which comprised the reduction of ceric ammonium sulfate (yellow) to cerous form (colorless) by arsenious acid. The process was catalyzed by iodine in a concentration-dependent manner. Working protocol was based on the recommendations of the International Council for the Control of Iodine Deficiency Disorders (8, 9, 10). The method of thiocyanate determination in urine was based on the quantitative oxidation of thiocyanate in acid permanganate at room temperature in a closed vial with liberation of HCN, which reacted with a picrate paper. For semiquantitative analysis in the field, the colored picrate paper was matched with a color chart prepared using known amounts of KSCN. In the laboratory, a more accurate result was obtained by elution of the colored complex in water and measurement of the absorbance at 510 nm. Over the range 0–100 mg/L, there was a linear relationship given by the equation: thiocyanate content (mg/L) = 78 x absorbance (11).Data were analyzed statistically using SPSS for Windows computing program (SPSS Inc, Chicago, IL).

RESULTS AND DISCUSSION

The results of iodine and thiocyanate quantification in urine samples collected from the women are summarized in **Table 1**. The median urinary iodine of the inspected women was 113.5 μg/L, which is an indicator of adequate iodine intake.

Almost 1/3 (30.6%) of the young mothers had iodine deficiency (UI <100 μg/L). With optimal iodine nutrition were 69.4% of the women. Statistically significant differences were found by the comparison of the relative parts of women with different iodine status ($U=2.25$, $p<0.05$).

The data from the filled questionnaires showed that iodized salt had been used in all families of the participants in the study (100%). None of the women reported for additional iodine supplementation with iodine-containing tablets. For familiar thyroid disorders and chronic diseases reported 3 women (8.3%). On the **Figure 1** is presented the distribution of the urinary thiocyanate levels in the studied women. With high frequency were the urinary thiocyanate levels between 2-4 mg/L. Eight (22.2 %) of the women were smokers and 21 (58.3 %) were exposed to tobacco smoke.

Table 1. *Urinary iodine and thiocyanate concentration in studied women*

Indices	Urinary iodine concentration (μg/L)	Urinary thiocyanate concentration (mg/L)
Number of women	36	36
Mean ± SD	130.69 ± 78.12	3.13 ± 1.90
Median (50th percentile)	113.50	3.17
95% confidence interval	104.26–157.13	2.49–3.78
Min	6.0	0.15
Max	317.0	7.60

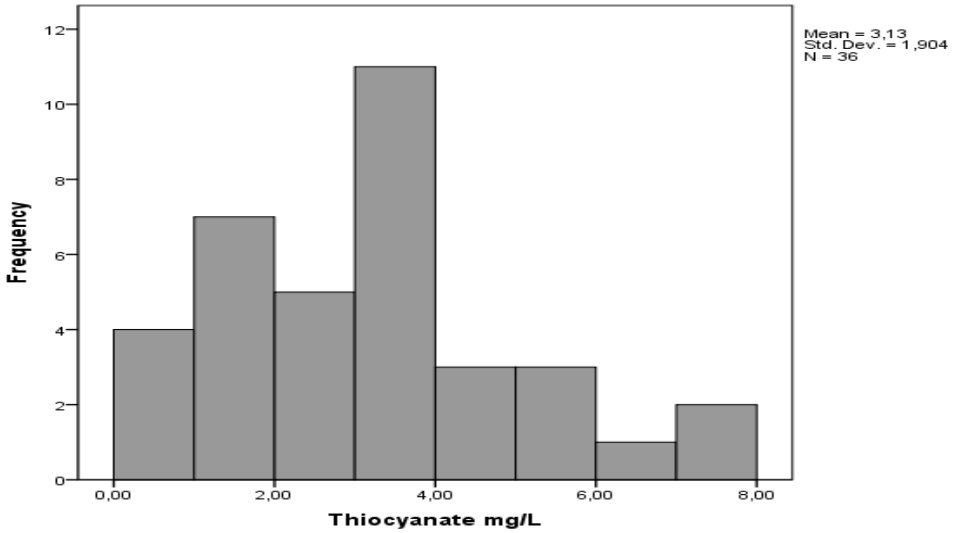

Figure 1. Distribution of urinary thiocyanate concentration (mg/L) in young mothers

The urinary thiocyanate levels of the half of smokers (n=4) and of 12 women, exposed to tobacco smoke were higher in comparison with the estimated mean value. Five (13.9%) of the young mothers, exposed to tobacco smoke had ioduria <100 μg/L, indicator for insufficient iodine intake. The urinary thiocyanate of the women with ioduria <100 μg/L (4.96 ± 1.82 mg/L) was statistically significant higher in comparison with those of women with ioduria >100 μg/L (2.33±1.3 mg/L); p<0.0001.

By the correlation between iodine and thiocyanate urinary concentrations in studied women was found negative statistically significance (R= – 0.717, p<0.0001) **(Figure 2):**

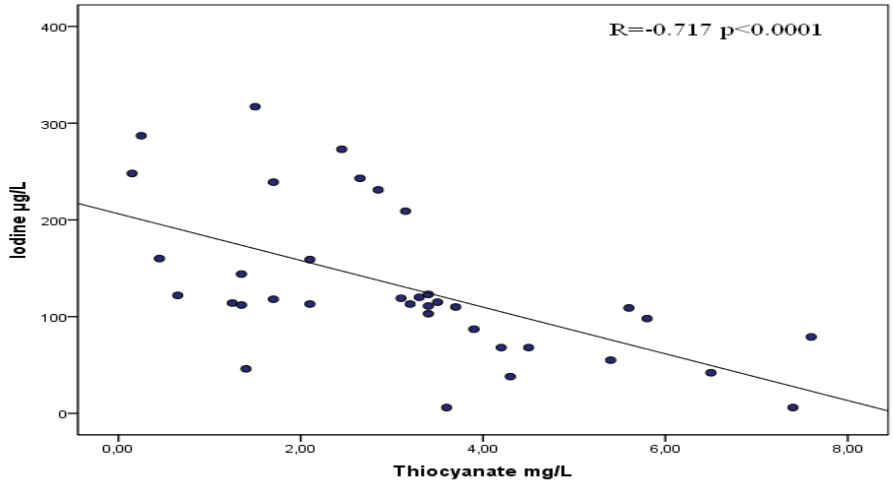

Figure 2. Correlation between urinary iodine and thiocyanate in young mothers

Thiocyanate or thiocyanate-like compounds primarily inhibit the iodine concentrating mechanism of the thyroid, and their goitrogenic activity can be overcome by iodine administration. Thiocyanate at low concentrations inhibits iodide transport by increasing the velocity constant of iodide efflux from the thyroid gland. At high concentrations, the iodide efflux is greatly accelerated, whereas the unidirectional iodide clearance into the gland is inhibited (6). Studies on the relation of thiocyanate levels and thyroid function have, however, indicated that a combination of iodine deficiency and increase in thiocyanate may co-contribute to thyroid dysfunction (7). In 52.6% (n=10) of the cases the higher values of urinary thiocyanates corresponded to low urinary iodine (iodine deficiency). Based on kinetic studies it has been proposed that a ratio iodide/thiocyanate (μg/mg) <3.5 highly increases the probability for thyroid dysfunction (12,13). Only two of the participants in our survey had such unfavorable ratio; it could be observed only in case of severe iodine deficiency combined with thiocyanate overload from diet or/and tobacco smoking.

CONCLUSION

Despite the normalization of iodine supply in the last years in risk population groups as young mothers, a considerable part of them are with iodine deficiency, assessed on the basis of urinary iodine excretion. In this report was found an association between urinary iodine and thiocyanate excretion in the studied women. Future researches are needed to evaluate the role of thiocyanate and other environmental factors on the frequency of iodine deficiency disorders.

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