



## EVALUATION OF IODATE STATUS IN A GROUP OF CHILDREN WITH STATURE DELAY FROM SIBIU COUNTY

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**Abstract:** Iodine deficiency in childhood can influence the mental and somatic growth and development of children by decreasing the thyroid hormone production. Iodine deficiency can be quantified by testing ioduria concentration. Our study has analyzed ioduria concentration of children detected with stature delay, coming from two distinct regions of Sibiu County, namely Gura Rîului, a known endemic area, and Șeica Mare, a lowland region. Approximately 60% of these children with iodine deficiency were detected in both regions, but a much lower average of ioduria was identified in the endemic area, where 23% of children presented severe iodine deficiency. The results are related to those published in other articles and call for their extension to larger group of children throughout the country, because iodine deficiency is still an issue of public health with multiple effects on the mental and somatic growth and development of children.

### INTRODUCTION

Iodine is an essential microelement in the formation of the hormones produced by the thyroid.(1) Iodine deficiency causes the occurrence of goiter with a decreased production of thyroid hormones that are vital to the growth and the development of the organism.(2) In 1980, WHO estimated that approximately 60% of the global population has iodine deficiency, and its consequences can be counteracted by an inexpensive operation that consists of universal iodization of salt made for consumption.(3)

Despite the tremendous progress that has been made, WHO estimated in 2007 that two billion individuals all over the world are still deficient in iodine, a third of them being school-aged children.(4)

Recent studies reveal that, at the present time, iodine deficiency remains the major preventable cause of mental delay worldwide, and the lack of iodine in food affects 1.6 billion people all over the world, out of which 50 million are children. Each year 100 000 children are born with cretinism.(5,6,7)

In Romania, the National Strategy on the elimination of Iodine Deficiency Disorders by universal iodization of salt intended for direct human use and for bread baking for the period 2004-2012 was developed and proposed for approval to the Romanian Government by the Ministry of Health, having financial and technical support from the United Nations Children's Fund – UNICEF.(2)

Due to the fact that the iodine is excreted through kidneys, iodine intake is quantified by determining the urinary iodine, one of the most important indicators used in the evaluation of iodine status at population level, along with the palpation of thyroid, with or without ultrasonography, TSH and thyroglobulin determination.(1,5,8)

### MATERIALS AND METHODS

In the first stage of the study we evaluated from an auxological point of view the pupils from different schools in Sibiu county: the Middle School from Gura Rîului, locality known for the pathology related to iodine deficiency and therefore labelled as endemic area; secondly, pupils from the Middle School of Șeica Mare, a lowland region with no documented problems related to iodine deficiency, and therefore not quantified as an endemic area. The second step of the study consisted of ioduria determination in pupils with stature delay, thus establishing the correlation between iodine deficiency and the short stature of the children.

The methodology for conducting the study was established in advance by obtaining the written approval of the Sibiu County School Inspectorate, the principles of schools and parents by written information notes regarding the coordinates of our study.

In order to collect the anthropometrical data we used a wall mounted height rod, the same for all the children, and growth charts used in our country to detect children with stature delay. For ioduria determination, urine samples were collected in accordance with the norms for collecting biological samples, and were transported in appropriate conditions in order to be processed in the laboratory of the Faculty of Medicine and Pharmacy from Sibiu.

The laboratory analysis of the iodine in the collected samples was performed by using an adapted titrimetric method, using the European Pharmacopoeia ed. 8.0. 1 mL of urine was treated with 6 mL of 15% potassium iodide solution and 5 mL of 1:3 sulfuric acid solution, left for 5 minutes to rest, covered and protected from light. After the time has elapsed, 50 mL of purified water were added, and the titration was performed by

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using freshly prepared sodium thiosulphate solution in the presence of 1% starch solution as an equivalence point indicator. The titration values obtained were used to calculate the concentration of iodine in the urine samples, by comparing them to the titration values of potassium iodate reference solutions. The analyses were made in triplicate.

Matching the epidemiologic criteria of the World Health Organization, the iodine deficiency is classified according to the following figure.(10)

The statistic processing of acquired data was elaborated using EXCEL and the statistic program MINITAB.

**Table no. 1. Classification of iodine intake according to WHO (10)**

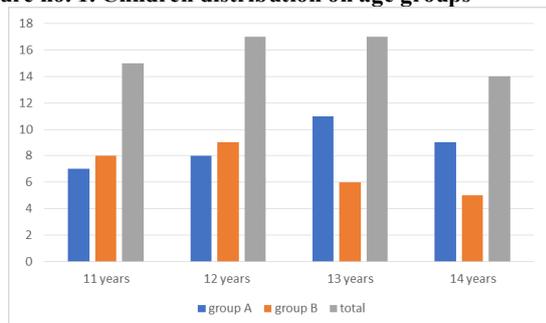
School-aged children	Iodine intake	Iodine nutrition
<20 µg/L	Insufficient	Severe iodine deficiency
20-49 µg/L	Insufficient	Moderate iodine deficiency
50-99 µg/L	Insufficient	Mild iodine deficiency
100-199 µg/L	Adequate	Optimum
200-299 µg/L	More than adequate	Risk of iodine-induced hyperthyroidism in susceptible groups
>300 µg/L	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid disease)

**RESULTS**

We evaluated from an axiological point of view 500 children aged 6-14, in grades ranging from 0-8<sup>th</sup> grade, from the two previously mentioned schools. 35 children with stature delay were detected (height below -2DS as compared to the normal age and gender values) belonging to the school from Gura Riului, known as an endemic area due to the previous studies conducted here, and also 28 children with stature delay in Şeica Mare, a lowland region not documented as iodine deficient. These results were obtained following the evaluation of the children's height values measured on the growth charts equivalent for our country, which were recently developed for Romania.(11)

All the 63 children included in the study range between 11-14 years old and their distribution was made according to the originating groups. In group A we included the children from the endemic area Gura Riului, while in group B we included children from the non-endemic area Şeica Mare. The total number of children distributed on age groups is represented in the following figure.

**Figure no. 1. Children distribution on age groups**

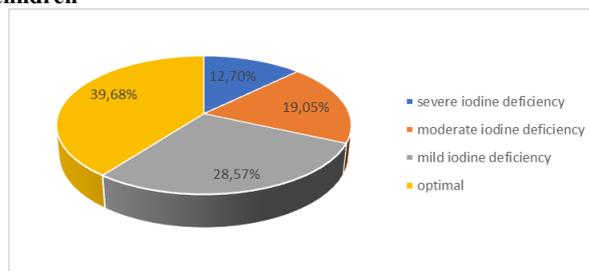


From the point of view of sex ratio, a predominance of the male sex can be observed with an 80% of the total number, while only 20% are females.

By determining the ioduria concentration of the 63 evaluated children with stature delay, we obtained the results described in figure number 2, which refers to the total number of the evaluated children from the two areas, and to the

classification of the iodine intake for group A, respectively group B.

**Figure no. 2 Classification of iodine intake in the evaluated children**



**Table no. 2. Classification of the two groups according to the values of ioduria concentration**

Iodine nutrition	Group A (Gura Riului)	Group B (Şeica Mare)	Total
Severe iodine deficiency	8 (22,86%)	0 (0%)	8 (12,70%)
Moderate iodine deficiency	10 (28,57%)	2 (7,14%)	12 (19,05%)
Mild iodine deficiency	3 (8,57%)	15 (53,57%)	18 (28,57%)
Optimum	14 (40%)	11 (39,29%)	25 (39,68%)

The following were used as statistical indicators for quantifying the iodine deficiency: media, median, the mean and standard deviation, as shown in table no 3.

**Table no. 3. Statistical indicators for the analyzed groups**

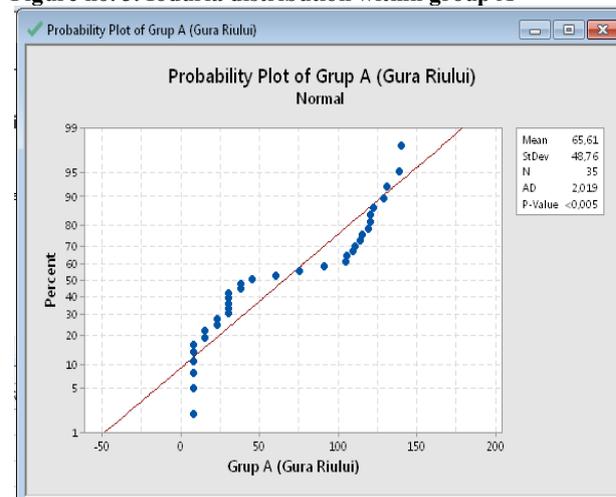
Descriptive Statistics: Grup A (Gura Riului)									
Variable	Total Count	Mean	StDev	Variance	Minimum	Median	Maximum	Mode	N for Mode
Grup A (Gura Riului)	35	65,61	48,76	2377,83	7,55	45,27	139,98	7,54575	6

Descriptive Statistics: Grup B (Seica Mare)									
Variable	Total Count	Mean	StDev	Variance	Minimum	Median	Maximum	Mode	N for Mode
Grup B (Seica Mare)	28	106,75	41,45	1718,32	48,39	87,47	176,34	84,679	4

There can be observed an average of ioduria values of 65,61 µg/ in pupils originating from the endemic area, which fall into the category of slight iodine deficiency, as compared to the average of ioduria concentration detected in pupils from the non-endemic area, which fall into an appropriate iodine intake (106,75 µg/L). The median of the ioduria values from group A is of 45,27 µg/L with a 7,54 µg/L mode and a standard deviation of 48,06. In group B, the median of ioduria values is of 87,48 µg/L with a 84,67 µg/L mode and a standard deviation of 40,70.

**Figure no. 3. Ioduria distribution within group A**



The normality of distribution of the two samples was verified (the Gauss-Laplace curve) using the Andreson-Darling test, as represented in charts no 3 and 4.

We checked for a significant statistical difference between the two samples, and since the data are not normally distributed we applied the Mann-Whitney statistical test to verify if there is a significantly statistical difference between the medians of the two groups, as shown in table no 4.

Figure no. 4. Ioduria distribution within group B

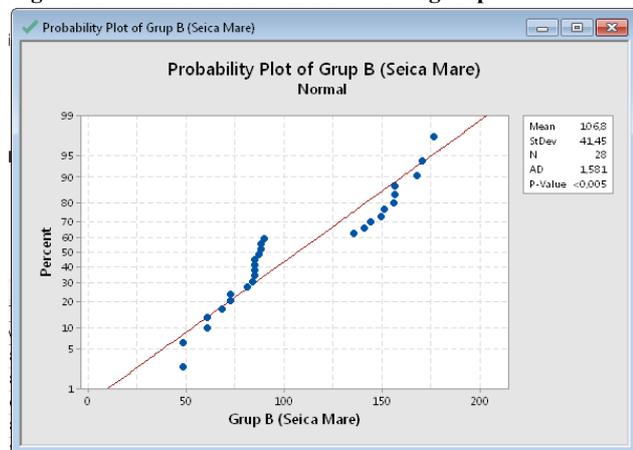


Table no. 4. Mann-Whitney test

Mann-Whitney Test and CI: Grup A (Gura Riului); Grup B (Seica Mare)	
N	Median
Grup A (Gura Riului)	35 45,27
Grup B (Seica Mare)	28 87,47
Point estimate for $\eta_1 - \eta_2$ is -44,90	
95,1 Percent CI for $\eta_1 - \eta_2$ is (-60,40;-25,01)	
W = 896,0	
Test of $\eta_1 = \eta_2$ vs $\eta_1 \neq \eta_2$ is significant at 0,0020	
The test is significant at 0,0020 (adjusted for ties)	

As a result of the statistical test that we used, it can be noticed that the p-value (the critical probability of the test) is 0.002, therefore lower than 0.05 (the chosen significant level), thus there is a significant difference between the medians of the two groups. These observations reinforce once again the hypothesis according to which Gura Riului is an endemic area, with considerable lower values of ioduria than in Seica Mare, situated in a lowland area.

DISCUSSIONS

Several studies on iodine deficiency have been carried out in Romania over time. In Mureş county, the studies conducted by Prof. Kun and his collaborators in 2013 revealed ioduria values under the normal limit in 68% of the evaluated pupils (135 pupils were from the mountain areas of the county), out of which approximately 40% had a severe iodine deficiency. These results correlate with the ones that we have been obtained.(12)

A study carried out in 2015 on a group of 241 pupils aged between 6-7 years old from schools in Bucharest shows a percentage of approximately 15% iodine deficient children, which indicates that the prophylaxis consisting in the universal iodization of salt actually led to certain improvement. The results were better than the ones we have acquired, but they were obtained in a lowland area where the iodine intake is considerably higher than the endemic and mountain areas and the study was performed on a group of younger children than those included in our research.(5) Compared to our study, although a higher percentage of children from the non-endemic area have iodine deficiency, yet they fall into a mild deficiency

and none of them was diagnosed with severe iodine deficiency.

In Gura Riului, where we investigated some of the children, several studies related to iodine deficiency have been carried out by determining ioduria values in pupils from this locality. The data published in 2003 by doctor Stanciu and Prof. Totoian revealed an average ioduria value of 39.53 micrograms /l in pupils from this area, lower than the average value that we have obtained, which is of 65.61 micrograms/l. Nevertheless, both values fall into iodine deficiency.(13) These data were supplemented in 2009 with another study conducted on a group of 130 pupils of this school, which revealed a higher percentage of over 90% of children with iodine deficiency, of whom 15% with severe deficiency and with an average ioduria value of 45.69 micrograms/l. In parallel, 132 pupils from a school from Slimnic (a locality with no iodine deficiency) were evaluated, and only 25% of children were detected with mild iodine deficiency, but with an optimum ioduria level. The results correlate with what we obtained in Şura Mare, another locality with no iodine deficiency, with an average of ioduria levels of 106.75 micrograms/l, but with an increased percentage of 50% children detected with iodine deficiency.(14)

CONCLUSIONS

Out of the total of 63 school children evaluated from the point of view of the ioduria values, about 60% have different degrees of iodine deficiency.

Out of the children from the endemic area, 22% have severe iodine deficiency, 28% have moderate deficit, compared to those from the non-endemic area, where over 50% have mild deficit, only 7% have moderate iodine deficiency, and none has severe deficit.

The values of ioduria certify that there are endemic areas in Romania, respectively that there is a correlation between the iodine deficiency and the somatic growth of children, as over 50% of the school-aged children with stature delay have different degrees of iodine deficit.

To acquire more accurate and eloquent results, we suggest that the study be extended to a larger group of children from Sibiu county and, why not, from the whole country, with the inclusion of more regions known as endemic or non-endemic areas.

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