

## CORRELATIONS BETWEEN SHORT STATURE IN CHILDREN AND IODINE DEFICIENCY IN SIBIU COUNTY

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**Abstract:** Iodine is an essential element in forming thyroid hormones with an important role in the growth and development of the body. In this study, we evaluated and we collected anthropometric data from 1946 children aged 6-14, students of schools in some areas of Sibiu County known as iodine deficient. A relatively small percentage of the assessed children were found with short stature (height less than -2SD), most of them being males and in terms of weight status, 11% were obese and 13% with malnutrition. Results can be compared with recent studies carried out in China, India and Italy. Permanent and prompt collaboration is needed between family physician, endocrinologist and pediatrician in order to timely detect the abnormal growth and development, and to intervene with appropriate treatment.

### INTRODUCTION

Iodine is a microelement found in nature whose essential role for the human body is to be the main substrate in the formation of thyroid hormones. As a component of thyroid hormones, iodine is involved in all their actions: role in metabolism of all body cells, role in the growth and differentiation of all organs, especially the brain. The decisive step in human brain development is the fetal life and the first post-natal three years. Iodine deficiency in this critical period of time causes irreversible alterations in brain development, the clinical consequence being mental retardation.(1)

World statistics show that: 1.6 billion people are at the risk of being affected by nutritional iodine deficiency; iodine deficiency disorders affect 50 million children, and every year, 100.000 children worldwide are born with cretinism.(2)

The most important factor responsible for iodine deficiency is a low dietary intake of microelement.(3) It is found in mountainous regions where, following the last ice ages, iodine was washed by large waters and oceans, leaving these areas deficient in iodine. Several areas throughout the world are known to have this problem, among which many regions of Central Africa, South America and North Asia, and although on the decrease, iodine deficiency is present in Europe, USA or Australia. In Romania, iodine deficient areas consist of various regions situated on the slopes of the Carpathian Mountains and Transylvania Plateau, of which some parts of Sibiu County, as well: Gura Rîului, Sadu, Poiana Sibiului being some of them.

Taking into account the continuous incidence of iodine deficiency at national level and the impact that it has on the intellectual development and the future educational outcomes of newborns, on the health of pregnant women and in fact, on the health of the entire population, the Ministry of Health considered necessary to develop a national strategy to eliminate iodine deficiency disorders, which were considered one of the major public health problems in Romania. "National Strategy for 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 drafted and submitted

for approval to the Government of Romania by the Ministry of Health - General Directorate for Public Health and State Sanitary Inspection. In developing the strategy, the Ministry of Health has received technical and financial support from the United Nations Children's Fund – UNICEF.(2)

Currently, about 70% of households worldwide have access to proper iodized salt, from just 10% in 1990, when the "World Summit of the United Nations for Children" set the objective to eliminate iodine deficiency worldwide.(4)

In a small portion of children with short stature, there can be identified pathologies that could have possible etiological causes.(5) It is estimated that in approximately 1 in 5 children with a height less than 2 SD below the mean, and in about half of children with a height of less than 3 SD below the mean, short stature is pathological.(6)

Thyroid hormones, whose main substrate is represented by iodine, are essential in children in the process of maturation of the cartilage growth by stimulating the chondrocytes to the action of the growth hormone, which play a part in the maturation of the central nervous system, as well as in the maturation of the surfactant with a view to provide a good mechanical ventilation. Thus, through the complex metabolic roles and through the intervention of thyroid hormones in growth and development processes, thyroid dysfunction has important consequences in children.

Deficiency of thyroid hormones that occurs in newborns is represented by congenital myxedema. Children under study who have been identified with growth retardation will be further evaluated to search for pathological causes, if any, of their short stature. Among endocrine causes of growth failure, an important part is played by thyroid gland pathology or thyroid insufficiency caused by iodine deficiency. Low dietary intake of iodine is associated with severe pathologies, especially goiter and cretinism, affecting quality of life.(7)

### MATERIALS AND METHODS

In this study, there were evaluated 1946 children aged 6 to 14 years old, belonging to different social backgrounds,

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## CLINICAL ASPECTS

students of schools in the county of Sibiu located in regions where there has been demonstrated the presence of a certain degree of iodine deficiency, according to area. Localities in mountain regions have a higher iodine deficiency compared with those situated in lowlands and plains. These localities included in the study are: Cislădie, Sadu, Rîul Sadului, Poiana Sibiului, Jina, Gura Rîului și Șeica Mare.

With the consent of Sibiu County School Inspectorate and of teachers and parents, we have visited 7 schools from the above-mentioned localities, and anthropometric data were collected of pupils in 0-XII grades.

To assess growth failure of these children, we used the following measurement and guidance tools:

- A stadiometer with sliding horizontal headpiece mounted on the wall and properly calibrated scales, the same for all children;
- Growth charts to help us focusing on those children who have retarded stature, as they would need further evaluation to detect pathological cause, if any, of their short stature.

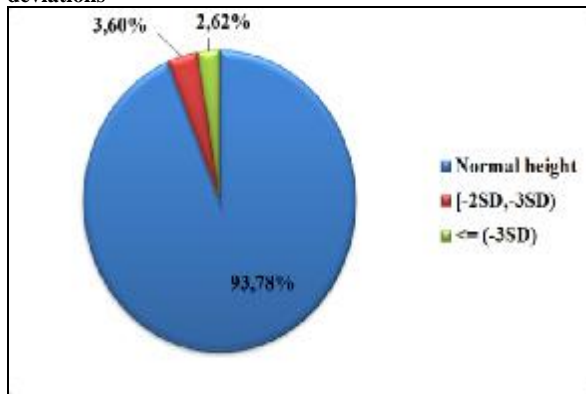
Considering that in our country, we do not have recent data about somatometric parameters, the last dating back to 1980, for this study there were used tables with standard heights and standard deviations for age and gender of countries with characteristics similar to our country regarding anthropometric data, respectively Switzerland.(8,9)

### RESULTS

Of the 1946 assessed children, 1015 (52.16%) were females and the remaining 931 (47.84%) were males. Depending on the area of origin, 1543 (79.29%) children were residing in rural areas, 403 (20.71%) were urban residents.

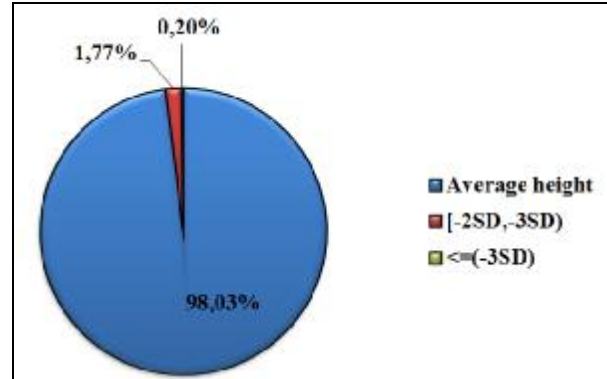
By comparing the heights of all assessed children with the standard heights for age and gender, we obtained the following results taken from the diagrams and tables of growth: 1825 (93.78%) fall in the average values of height for age and gender; 70 (3.60%) of children are in the range of -2SD and -3SD, with growth failure; 51 (2.62%) children are less than or equal to -3SD therefore, with significant short stature. Research has identified a total of 121 (6.22%) of children with growth failure (figure no. 1). It is to be mentioned that the group of children with short stature also included those who were at around -2SD.

**Figure no. 1. Distribution of children according to standard deviations**



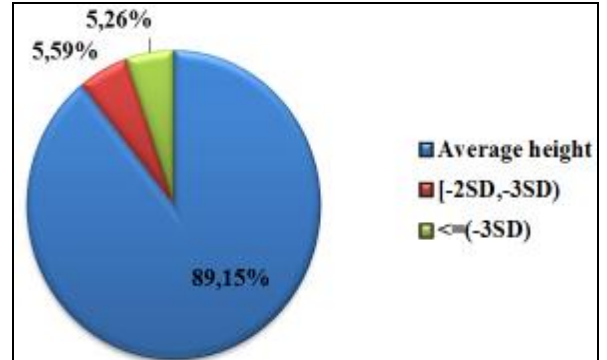
As for gender, of the total of 1015 girls, 995 (98.03%) were in the range of average height appropriate to their age, 18 (1.77%) of them recorded short stature, being in the range of -2SD and -3SD, and 2 (0.20%) girls recorded severe short stature below -3SD (figure no. 2).

**Figure no. 2. Distribution of female children according to standard deviations**



Of the 931 boys, 830 (89.15%) were of average height, 52 (5.59%) recorded a growth failure being below -2SD to -3SD, the remaining 49 (5.26%) recorded significant short stature below -3SD (figure no. 3).

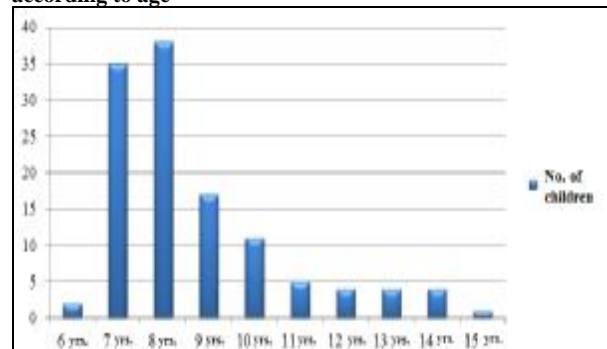
**Figure no. 3. Distribution of male children according to standard deviations**



Of the 121 children who were identified with short stature, 101 (83.47%) were males and 20 (16.53%) were females.

The figure below illustrates the children with growth failure by age groups (figure no. 4). Making reference to female children, it is noted approximately the same distribution by age groups, with a higher prevalence in identifying hypotrophy in the age of 7 years (7 girls with short stature) or 8 years old (7 girls with short stature). In boys, the age at which stature hypotrophy was highlighted in most of them was also at the age of 8 years old (31 boys), followed by the age of 7 (28 boys).

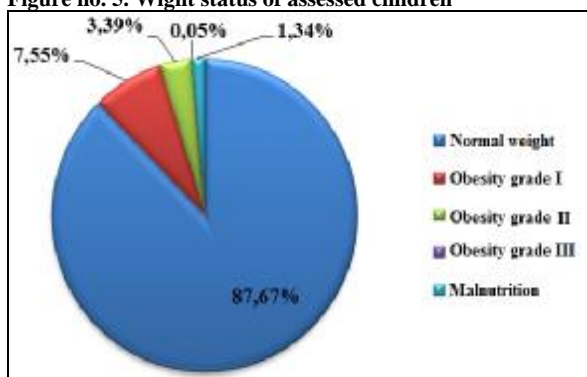
**Figure no. 4. Repartition of children with short stature according to age**



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Weight status is an important element in assessing the health of children in iodine deficient areas, considered in this study. Analyzing the weight of children based on the diagrams and tables representing the weight curves, there were found the following results: 1706 (87.67%) of children had normal weight, 147 (7.55%) of them were obese, grade I, 66 (3.39%) were obese grade II; a child was found with obesity class III, and 26 (1.34%) were classified in the category of malnutrition (poor nutrition) (figure no. 5).

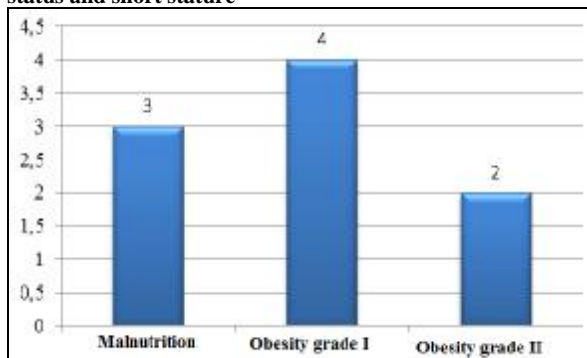
**Figure no. 5. Wight status of assessed children**



In female children, out of 1015, 884 (87.09%) girls had normal weight, 75 (7.39%) were obese grade I, 35 (3.45%) with obesity grade II, one girl with obesity grade III and 20 (1.97%) girls with poor nutrition. In male children, results showed that: of the total of 931, 822 (88.29%) of them had normal weight, 72 (7.73%) were obese degree I, 31 (3.33%) of boys had obesity grade II and 6 (0.64%) boys were malnourished.

Of children with short stature -2SD or less, three of them were malnourished, 4 showed obesity grade I and 2 children were obese grade II. The remaining 112 children had normal weight according to their age and gender (figure no. 6).

**Figure no. 6. Number of children with modified weight status and short stature**



### DISCUSSIONS

In this study, there were evaluated children of some schools in several places in Sibiu County, a county situated in the south of Transylvania, in the plateau with the same name, to the north of the Carpathians Mountains. In this area, endemic goiter is known as the main disease with mass distribution, especially in mountains and foothills areas of the county, as confirmed by multiple studies conducted since 1924.(10,11,12)

According to the World Health Organization, the results obtained classify Gura Rîului area in a region with moderate iodine deficiency. It is to be noted the persistence of

iodine deficiency after putting into force the universal salt iodization Ordinance.(13)

Studies related to iodine deficiency have been performed worldwide, both before and after implementation of prevention methods, the most important being the universal iodization of salt for human consumption and the manufacture of bread. Although national and international efforts in recent decades have been effective, almost a third of children worldwide remain at risk for iodine deficiency and iodine deficiency is considered the main cause of mental retardation which can be prevented.(14)

Regarding the anthropometric data aimed at in our study, of the 1946 children evaluated in terms of increased stature, aged 6 to 14 years old, we have obtained a prevalence of 3% of children with short stature or height below - 2SD. Data can be compared with those of a recent study in China, Anhui Province, which included a number of 12.009 rural and urban students aged 7-18, where there has been highlighted an average detection rate of short stature of 3.16%, respectively short stature was found in 380 subjects.(15) Another study in India on a total of 755 children aged 4 to 16 years old revealed a much higher percentage of occurrence of stature deficit in 30.3% of children using the CDC growth charts, and a percentage of 9.5% of children with short stature using the Agarwal diagrams.(16)

Regarding the gender of the subjects evaluated in our study, we revealed a much higher prevalence of stature deficit in males; of the total of 121 children found with short stature, 83.47% were boys. Data obtained differ from those in the literature; in the study conducted in India, the incidence of short stature was similar in both genders.(16) No statistically significant differences were found between females and males nor in the study made in China in Anhui Province, located in the eastern part of the country.(15) The same data were found in a study conducted in Sri Lanka in 2000, which revealed a rate much higher of occurrence of stature deficit in school-age boys from 4 primary schools in Moneragala region.(17)

The age at which we identified most children with short stature in our study was 7-8 years old in both genders. The data correlate with those obtained in women in China, where the highest rate of detection of short stature was set in girls aged 7 to 9 years old. Unlike females, males have registered the highest rate of detection of stature deficit in the age group 13-15 years old.(15)

Weight status is another important parameter to follow in the children evaluated in our study. Of the 1946 children evaluated, 87.67% had normal weight, 10.99% were obese, that a small percentage of children were found malnourished, 1.34%. A comprehensive study was done in Italy, Tuscany, over a long period of time, i.e. three years 2002, 2004 and 2006, on a large number of subjects: 4478 children aged 9, 2255 children aged 11, 2396 children aged 13 years and 2338 children aged 15 years. Study revealed in children aged 9 years a prevalence of obesity of 31.7% in 2002 with slight growth in 2006 of 33.4%, higher than that obtained in our study.

Also, regarding malnutrition, the percentages obtained in the Italian study malnutrition exceed the percentages obtained in our study; in 2002, 4.6% of children were found malnourished, the percentage dropping slightly in 2006 to 4.2%, as compared to our study, where we found 1.34% children weighing less the lower limit of normal.(18) Another recent study on 352 children aged 6-11 years old conducted in Greece, the island of Tinos, revealed a rate of 8.2% of children with obesity.(19) The prevalence of childhood obesity in Mediterranean countries (Italy, Spain, Portugal) was demonstrated to be much increased (8-22%) than in the countries in Northern Europe.(20,21,22,23)

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Another study conducted in South Africa, in KwaZulu-Natal rural area, which included 579 children aged 8-10 years old, revealed a rate of 3.1% of children with obesity, lower prevalence of obesity compared to our study results, and a percentage of 0.7% children with malnutrition, slightly lower 1.34% obtained in the children in our study.(24) The same study revealed a percentage of 7.3% of children with short stature for their age and gender, much increased compared to the percentage obtained in our study (3%), more than double.(24)

### CONCLUSIONS

1. This study included children residents of regions of Sibiu County, which revealed varying degrees of iodine deficiency, deficiency that can cause physical and mental growth disorders of these children.
2. Most children evaluated in this study belonged to the rural areas (80%); an equal ratio girls/boys, the number of girls being slightly increased by 2%.
3. Of all the children included in our study, a relatively small percentage, 6%, had short stature (height equal to or below -2 SD).
4. Analyzing children with short stature, it was found that a percentage of 83.47% were males and the rest, females.
5. In terms of the age of the children identified with growth failure, most of them belonged to the age group of 7-8 years old.
6. Referring to another important parameter to assess, weight status, 7.5% children were found obese with grade I, and a much lower percentage (1.34%), children with malnutrition.
7. Most of the children with short stature had normal weight.
8. Height gain and weight status are important elements to assess in children; a relatively small proportion of children evaluated in our study were found with short stature, mainly boys; a higher percentage recorded obesity, and through good collaboration between family doctor, pediatrician and endocrinologist, these problems could be detected and treated to ensure an appropriate health status of these children.

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