Turkish Journal of Endocrinology and Metabolism, (1999) 3 : 103-107 **ORIGINAL ARTICLE**

Moderate to Severe Iodine Deficiency in Ankara and the Black-Sea Region

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Endemic goiter i s still an important and underestimated health concern in Turkey. The overall prevalence was calculated as 30.3 % by palpation in a national survey conducted in 1995. However direct evidence that iodine deficiency (ID) is the major cause of the endemics has been lacking until now.

We measured sonographic thyroid volumes (STV), urinary iodine concentrations (UIC), in 1226 SAC (9-11 years old) from Ankara and three highly endemic goiter areas of the Black-Sea region (i.e. Kastamonu, Bayburt, Trabzon). A considerable number of SAC were found to have STV exceeding the recommended upper normal limits for their age and gender obtained from iodine-replete European children. i.e 26.7 %, 40.3 %, 44.8 % and, 51.7 % of children from Ankara, Kastamonu, Bayburt and Trabzon respectively. UIC indicated moderate to severe ID in these areas with median concentrations of 25.5 μg/l, 30.5 μg/l, 16.0 μg/l and 14 μg/l respectively.

This study showed severe to moderate ID as the primary etiological factor for the goiter endemics observed in Ankara and the Black-Sea region of Turkey.

KEY WORDS Endemic goiter, iodine deficiency

Introduction

Iodine deficiency (ID) and related iodine deficiency disorders (IDD) are still major, yet unresolved health concerns for the world. Available data indicate that, in 1990 approximately 1.5 billion people were at risk of IDD and that 655 million, 12 % of the earth population, were affected by goiter (1). Endemic goiter, occasionally complicated by endemic cretinism, has been reported from Europe during the past century, especially from mountainous areas in central and southern parts of the continent (2-4). Iodine supplementation, mostly by iodinization of salt, has been used for decades. The situation has improved markedly during the past years, but in 1992, ID was under control in only five European countries namely Austria, Switzerland, Finland, Norway and Sweden (5,6). Consequently, additional measures were taken following an official document sent by WHO UNICEF and ICCIDD, to all European governments (7). However in 1997, ID was still found in an important number of European countries, or at least certain areas of these countries (8). A remarkable point about the ID in Europe has been very limited information on IDD from the Eastern part of the continent until 1992.

Although goiter has been known to be endemic in Turkey for decades, there has been no systematic national survey, evaluating iodine status until now (9). The aim of the current study was to evaluate the status of iodine nutrition and thyroid size in

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three areas in Turkey severely affected by goiter and to compare the situation with the situation in Ankara, the capital, by using urinary iodine concentrations (UIC) and the sonographic thyroid volumes (STV) and normative values recommended by the World Health Organisation-WHO and International Council for Control of Iodine Deficiency-ICCIDD.

Materials and Methods

Ankara, the capital of Turkey, has 2 984 099 inhabitants in the city center. Three cities from the Black-Sea region, Kastamonu, Bayburt, and Trabzon have central populations of, 59 145, 38 453 and 177 904 respectively. Goiter prevalence in Ankara was unknown at the beginning of the study. The prevalence levels of goiter determined by palpation during a survey conducted in 1995, in the three cities from the Black-Sea region, were 35.3%, 44.3% and 68.5 % respectively. They were reported as three of the most prevalent cities in Turkey (10). Since our aim was to simply confirm iodine deficiency in a clearly goitrous population we took an approximate of 300 samples from each area studied. Clusters of 40 children per cluster, including 9-11 year old school age children (SAC) were chosen since these age groups are more suitable for ultrasonographical examination. A total number of 1226 SAC (604 girls, 622 boys), from city schools were examined in their areas during September and October 1997. The research team consisted of two doctors and two nurses equipped with an ultrasonography and other required equipment.

The study included the determination of the following variables:

1) Weight and height of the children were measured with their standard school clothing and shoes.
2) Thyroid ultrasonography was performed by the same experienced physician, strictly obeying the recommendations of Vitti et al (11).
3) Morning urine samples from all of the SAC, for UIC determinations were taken, with the permission of local education and health authorities. Fifty random double-urine samples, from different study areas were taken, for quality control studies conducted in the International Council for Control of Iodine Deficiency- ICCIDD laboratory in Brussels, Belgium.

Thyroid volumes were estimated using real-time sonography with a General Electric® Logiq 100α apparatus, using a 7.5 MHz linear array transducer. Longitudinal and transverse scans were performed, 3 dimensions were obtained from each thyroid lobe and thyroid volume was calculated according to the formula of the ellipsoid model proposed by Brunn et al (12). Upper normal limits (percentile 97) for the age and gender match iodine-replete European children were used to define the goitrous SAC (13).

Urine samples were kept covered up and frozen at -20°C, in deionized tubes until the day of analysis. Urinary iodine concentrations were determined, by using the method recommended by WHO-ICCIDD (Calorimetric ceric ion arsenous acid wet ash method based on Sandell Kolthoff Reaction), using Fisher (reagents and Spectronic 20, Genesis auto-analyzer (14,15). Results were expressed as micro-grams per liter (µg/l). The correlation between the two sets of results obtained from 50 double-urine samples was reasonable.

Usual statistics, Chi-Square and Student-Newman-Keuls test, Levene test and correlation analysis were used for statistical analysis.

Results

Sex was equally distributed in the whole group which was made up of 622 boys (50.7 %) and 604 girls (49.3 %). Five hundred and fifty-two (45.0 %) of the SAC studied were 10 years old, 333 (27.2 %) and 341 (27.8 %) were 9 and 11 years old respectively. For all the age groups studied, SAC from Bayburt and Trabzon were found to be shorter and lighter in weight than their peers. The differences reached significant levels ($p<0.05$) when some of the areas were compared (Table 1).

Table 1, presents the median STV, UIC and percentage of goitrous children. Goiter prevalence was slightly higher in males than in females in this prepubertal age group. Goiter prevalence found was concordant with the moderate to severe ID,

Table 1. Mean±s.d. Height and Weight, Median Thyroid Volumes (TV), Urinary Iodine Concentrations (UIC), and percentage of School Age Children (SAC) with thyroid volumes exceeding 97 percentile of iodine replete SAC for the same age and gender.

AGE n = number of SAC	ANKARA n= 303	KASTAMONU n= 303	BAYBURT n= 306	TRABZON n=314
9 year old	n= 41	n= 96	n= 63	n= 133
Height (cm) mean±s.d.	132.0±5.1	130.9±5.9	126.9±6.5	129.8±6.7
Weight (kg) mean±s.d.	28.8±6.1	30.3±5.3	26.0±4.0*	28.4±9.9
TV median (ml)	6.26	6.65	6.38	8.15
% Goitrous male	25	41	40	64
% Goitrous female	24	40	36	55
10 year old	n= 156	n= 134	n= 130	n= 133
Height (cm) mean±s.d.	134.7±6.3	135.3±6.3	131.2±5.9**	133.3±6.7
Weight (kg) mean±s.d.	30.5±5.26	32.1±5.32	28.8±4.6*	30.1±4.9
TV median (ml)	7.12	7.52	8.10	9.0
% Goitrous male	27	41	47	48
% Goitrous female	24	35	45	40
11 year old	n= 106	n= 73	n= 113	n= 48
Height (cm) mean±s.d.	138.6±6.4	141.0±6.3	136.8±6.1	137.8±8.7
Weight (kg) mean±s.d.	33.2±5.6	34.2±5.6	31.8±4.8	33.2±7.39
TV median (ml)	7.49	10.04	9.97	8.73
% Goitrous male	27	65	58	50
% Goitrous female	28	34	46	22
UIC Median (µg/l)	25.50	30.50	16.00	14.00

* Significantly lower than Kastamonu using Student-Newman-Keuls test ($p< 0.05$).

** Significantly lower than Ankara, Kastamonu and Trabzon using Student-Newman-Keuls test ($p< 0.05$).

indicated by the UIC (Table 1). A relatively low percentage of 11-year-old, goitrous girls in Trabzon was recognised but the number of SAC studied in this particular age group was also low, probably misrepresenting the females in this age group. Figure 1 shows notched box-plot presentation of UIC of SAC from different study areas. Median UIC, indicates moderate to severe iodine deficiency in these endemic goiter areas. Standard deviations were considerably high and median values from Kastamonu were higher than in the other areas studied, although it this city still showed moderate iodine deficiency (Table 1).

Discussion

This study attempted to evaluate iodine nutrition in highly endemic areas of Turkey and in the capital by using two standardized methods in school age children (SAC), namely sonographic thyroid volumes (STV) measured by ultrasonography and urinary iodine concentrations (UIC). Although the study was not designed to find the exact goitre prevalences in the study areas it also gives an approximate prevalence especially in the areas examined in the Black-Sea region due to the lower number of inhabitants and the high goiter prevalence observed. The prevalence of iodine deficiency goiter is critically influenced by age and sex with a maximal frequency in females during puberty and child bearing age (16,17). Interestingly we found goiter slightly more prevalent in boys. Even though the mean STV are systematically higher in girls in all areas studied, when 97 percentile upper limit values for the age and gender criteria were used boys stayed on the slightly more goitrous side than the girls (13) (Table 1). We compared the heights of the genders in this prepubertal to pubertal age group and found no significant differences in any of the study areas indicating that most of the girls did not experience their growth spurt during the ages observed.

Moderate to severe iodine deficiency was noticeable in all 4 of the study areas. The relatively higher median UIC, larger standard deviations, but still high goiter prevalence observed in Kastamonu seems to be a consequence of a weak iodine supplementation program started 5 years ago by iodinization of table salts in this region. UIC of

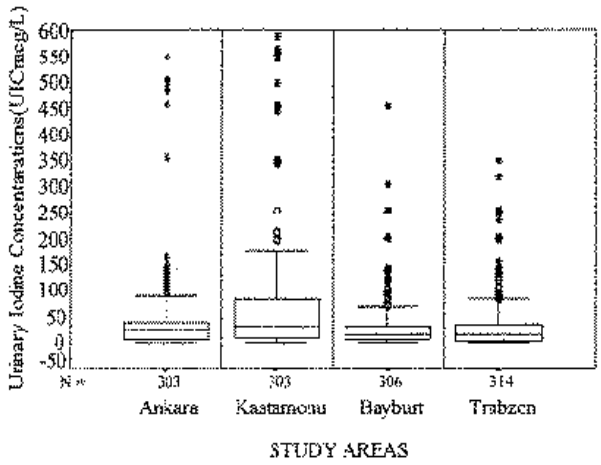

Figure 1. Box-plot presentation of Urinary Iodine Concen-trations (UIC) in 1226 School Age Children from Ankara, Kastamonu, Bayburt and Trabzon.

individual urine samples from the same area could be as low as 1 µg/l and reach 600 µg/l, and the large standard deviations obtained from all four areas shows iodine contamination in some of the SAC studied, but as a whole the population observed in the study areas was obviously moderate to severely iodine deficient. Low median UIC between the ranges of severe to moderate ID (15), the percentage of goitrous children determined by using sonographic normative values (Table 1) clearly and directly showed that iodine deficiency is the major cause of goiter endemics observed in Turkey.

Turkish children living in severe to moderately iodine deficient areas seems to exhibit not only a similar intellectual pattern but are also physically impaired with the lowest mean heights and weights in severely iodine deficient areas (Bayburt, Trab-zon) and a significant difference is seen in Bayburt, when compared to moderately iodine deficient areas (Ankara, Kastamonu) (Table 1). Escobar et al and Felt et al showed similar growth retardation amongst SAC from severely iodine deficient endemic areas of Spain and Czecho-slovakia (17,18). Although Fenzi et al showed no significant difference between height, and weight of SAC compared to the iodine sufficient areas, their study area had only moderately iodine deficient mean UIC reaching 39 µg/g creatinine (19).

In conclusion, this survey showed that severe to moderate iodine deficiency is the major cause of the goiter endemics observed in the Black-Sea region of Turkey. Goiter is also endemic in Ankara the capital, which is moderately iodine deficient Iodine deficiency seems to affect the physical development of Turkish children and may lead to other consequences of iodine deficiency not studied in this survey. A controlled and effective iodine supplementation program is mandatory for the regions studied. Considering the 30.3 % nationwide goiter prevalence observed in 1995 it is obvious that additional surveys and effective measures are needed for the other endemic regions throughout the country.

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Abbreviations: iodine deficiency (ID), iodine deficiency disorders (IDD), school age children (SAC), school success (SS), sonographic thyroid volumes (STV), urinary iodine concentrations (UIC).

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