ORIGINAL ARTICLE

IODINE DEFICIENCY AND GOITER PREVALENCE OF THE ADULT POPULATION IN ERZURUM

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Summary: It is believed that total goiter prevalence in Turkey is as high as 30.5%. The iodine deficiency is the distinct etiologic factor in the development of goiter. The aim of this study was to determine goiter prevalence and iodine deficiency in adults living in Erzurum (1659 m above sea level) for at least 10 year. The study involved 340 people (192 females, 148 males). The median age was 38.5 year (ranging from 20 to 76 years). Ultrasound-measured thyroid volume (TV) for men (TV>25 ml) and for women (TV>18 ml) was considered goiter indicator. By this evaluation, goiter was diagnosed in 94 (27.6 %) cases, whereas the goiter prevalence, based on the palpation method, was 5.6%. Urinary iodine concentration (UIC) was measured by ammonium persulfate method. UIC in subjects with goiter was significantly lower than that of the others (median values 5.0 vs 7.8 μg/dl, $p<0.0001$). While the value of UIC≥10 μg/dl (no. 121, 36.6%) was accepted normal, the extent of iodine deficiency in other subjects was classified as severe (UIC<2.0 μg/dl, no.53, 15.6%), moderate (UIC =2.0–4.9 μg/dl, no.75, 22%) and mild (UIC=5.0–9.9 μg/dl, no.91, 26.8%). TV values were found to be significantly different among the four groups ($p<0.05$). TV values were significantly correlated with body surface area and UIC ($r=0.15$ and $r= -0.16$, respectively, $p<0.005$). Also, the prevalence of thyroid nodules was estimated as 2.1% by palpation and 18% by ultrasonography. We conclude that goiter originating from iodine deficiency has been an important health problem in Erzurum. Besides taking measures at national level, local factors and risks which interfere with the nationwide efforts should also be dealt with for the eradication of the iodine deficiency problem. In the region, periodical evaluation of iodine level and iodine related disorders will guide the measures to be taken for the well being of people's general health.

Key words: *Iodine deficiency; Goiter; Thyroid nodule; Northeastern Anatolia*

Introduction

Disorders induced by iodine deficiency (Iodine Deficency Disorders –IDD) constitute a major nutritional problem throughout the world (9). It has been estimated that in 1990, at least 1,572,000,000 people in 118 countries worldwide were at risk of IDD, i.e lived in areas where the total goiter rate is at least 5%. At least 655 million people, ie, 12% of the global population of the world, were affected by goiter. Forty-three million were significantly mentally handicapped as a result of the deficiency, including 11.2 million with overt cretenism (WHO-UNICEF-ICCID/94.6). Iodine deficiency endemia is defined by goiter prevalence and the median urinary iodine concentration (UIC) in a population. According to the WHO, a region is considered endemic if more than 5% of the population have goiter or thyroid enlargement. The median UIC in iodine sufficient populations should be greater than 10 μg/dl, and no more than 20% of the population should have UIC below 5 μg/dl (WHO-UNICEF-ICCID., 94.6).

Iodine deficiency remains an important public health problem also in Turkey. It is believed that total goiter prevalence in Turkey is as high as 30.5%, and that of visible goiter 6.7% (13). On the other hand, it was demonstrated that there are regions in Turkey where iodine deficiency is more severe than was thought initially (18).

It seems that the optimal way of correcting iodine deficiency is by sufficient intake of iodine through iodized salt. Recently, In July 1998, codes related to iodized salt changed. Although iodization of table salt is now legally enforced, this is in fact impossible to establish country-wide (18).

In this study we investigated the goiter prevalence, sonographic thyroid volume and UIC in adults living in Erzurum, a city situated in northeastern Anatolia at a moderate altitude of 1659 m. above the sea level.

Materials and methods

Subjects

The subjects of the study were chosen among the people who were born in Erzurum and still living there. Study sample was drawn through cluster sampling method. Each

neighborhood in Erzurum province was considered a cluster and 7 clusters constituted the whole study sample. Total population was approximately 180.000 and, 9000–10.000 persons were living in each cluster. In each sample group 45–50 subjects, aged 20 to 76, were randomly selected from each cluster. Total number of subjects was 340, 192 female and 148 male.

Body weight, height and surface area (15)

Body weight of the subjects were evaluated with a thin dress, without shoes belts or any personal belongings, on them. Height was measured in standing position without shoes. BSA (m^2) was calculated according to the formula: $(weight^{0,425} \times height^{0,475} \times 71.84)/10000$.

Thyroid size

Thyroid size by palpation was scored according to the WHO criteria (17). In addition, all subjects were examined by real-time sonography (Toshiba® SSA-250A) with a 7.5 MHz linear array transducer (Toshiba® PLF-705S) in the supine position with minimal hyperextension of the neck. Longitudinal and transverse scannings and a 3-dimension vision were obtained from each thyroid lobe, and thyroid volume (TV) was calculated by the following formula for each lobe separately (3).

TV = depth x width x length x 0.479

Upper limits of thyroid volume accepted as normal were 18.0 ml for females, and 25.0 ml for males (11,14). Higher values were assessed as total thyroid hyperplasia, i.e. goiter.

Urinary iodine concentration

Spot urines were collected from subjects and kept covered up and frozen at –20 ºC, in deionized tubes until the day of analysis. Ammonium persulfate was used as the oxidizing agent to eliminate the interfering subtances in urine before the colorimetric measurement through the Sandell-Kolthoff reaction. The subsequent procedures to the oxidation in the ammonnium persulfate method were the same as in Sandell-Kolthoff reaction. Iodine was detected from its catalytic reduction of ceric ammonium sulphate in the presence of arsenious acid. Extremely close correlation (r= 0.994) is suggested between the persulfate method and reference chloric acid method (10).

Probands were stratified into 4 groups with respect to UIC (11,14).

Groups	**UIC (µg/dl)**
Normal	> 10.0
Mild iodine deficiency	5.0–9.9
Moderate iodine deficiency	2.0–4.9
Severe iodine deficiency	< 2.0

Probands were also stratified into three groups according to their age (Group 1: 20–30 yr, Group 2: 40–60 yr and Group 3: 60 yr and above). Among the groups, the measured TV and UIC values were compared.

Statistical analysis was performed via SPSS 10.0 version. All data were tested for normality using Lilliefors test. Mann Whitney U test, Chi square test and Kruskal Wallis test were used in comparisons. Linear regression analysis was employed where appropriate.

Results

Table 1 shows the distribution of male/female, mean age, and goiter prevalence in different UIC groups.

The median UIC for the whole sample was 6.54 µg/dl (range 0.03–45.7 µg/dl). Iodine deficiency was found in 64.4% of the whole sample. It was mild, moderate, and severe in 26.8%, 22.0%, and 15.6%, respectively (Tab. 1). In iodine-deficient subjects, there was a higher prevalence of goiter than in iodine-saturated ones (Tab. 1). As seen in table 1, similar changes were found in goiter percentage in various groups of UIC whether it is detected with sonography or palpation method. Furthermore this changes were relatively noticable for sonography (χ^2: 7.2, p:0.065) than palpation method(χ^2: 2.8, p:0.41). Also, the UIC level was significantly lower in patients with goiter than in non-goitrous ones (medians 5.0 vs 7.8 µg/dl, p<0.0001). No statistically significant difference was found with respect to age and F/M ratio between the UIC groups.

Not surprisingly, ultrasonography was more sensitive in finding goiter and thyroid nodules than palpation. Whereas palpation detected goitre in 5.6%, ultrasound revealed enlarged thyroid in 27.6% (χ^2:18, p<0.001). As for the thyroid nodule detection the respective values were 2.1% and 18% (χ^2:14, p<0.001).

Tab. 1: Goiter prevalence, female/male distrubution and age in different urinary iodine concentration (UIC) groups.

UIC		Females/Males	Age	Goiter*	
(µg/dl)	No.		(yr)	Palpation**	Sonography
<2	51	32 / 19	39.9 ± 12.9	4 (8)	18 (35)
2–5	75	40 / 35	39.7 ± 14.0	6 (8)	22 (29)
5–10	91	46 / 45	38.3 ± 13.5	5 (6)	30 (33)
>10	123	74 / 49	36.9 ± 12.2	4 (3)	24 (20)
Total	340	192 / 148	38.3 ± 13.1	19 (5.6%)	94 (27.6%)

*Number in paranthesis shows percentage of subjects with goiter in the respective group.
**Goiter scores of the cases with palpation method according to WHO criteria (WHO-UNICEF-ICCID., 94.6):
Grade 1(n=4) 1.2%; Grade 2(n=8) 2.3%; Grade 3(n=7) 2.1%.

TVs of men were significantly higher than that of women (median 17.0 ml. and 11.7 ml, respectively and z=-3.3, p<0.001). Either in palpation or sonographic measurements, the ratio of goiter patients in male and female groups appeared to be similar (approximately 1.4); F/M 54/40 in sonographic measurements, and 11/8 in palpation.

TVs of the cases having different UIC were significantly different from each other (Fig. 1, Kruskal Wallis test; χ^2=8.7, p<0.05). On the other hand, TVs of the cases were significantly correlated with UIC and BSA (r= -0.16 p<0.05 and r= 0.15 p<0.05, respectively). There was no significant correlation between the TV and BMI, height and age. In the different age groups, the median values of TV were not significantly different: 20–29 years:12.9 ml, 40–59 years: 15.3 ml, and above 60 years: 11.9 ml (Kruskal Wallis test; χ^2:2.1, p>0.05).

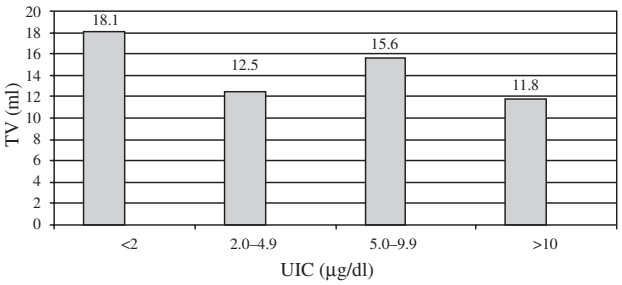

Fig. 1: Median thyroid volume in different urinary iodine concentration groups.

Discussion

In an iodine sufficent population, the value of UIC<50 µg/l would not be common and persistently present. In 1994, percentage of the risk of persistent iodine deficiency in an iodine sufficient population was assumed to be about 20%, whereas the recent studies have revealed that 4.8% could be accepted as the risk level (11). The value (38%) for the iodine deficiency risk in the region, where the study was conducted, is far beyond the value mentioned above.

Our findings have thus shown that sufficient iodine intake in diet was not achieved to the reasonable extent in Erzurum province and probably in Northeastern Anatolian region as a whole. While the iodine deficiency problem is also seen in different regions of Turkey (5), it seems to be a much more serious problem in some mountain villages when compared with the metropolitan areas in the same region. Furthermore iodine deficiency in such areas is comparable with those of the severe iodine-deficient regions of Africa (18).

It is obvious that sonographical detection of thyroid enlargement is more sensitive and accurate than palpation method (1,2,4,7,12). Indeed, it has been reported that the discordance between sonography and palpation were 23.9% (8). The correct interpretation of thyroid sonography depends mainly on the standardized reference criteria taken from an iodine sufficient population. The proposed reference values for the upper limit of thyroid volume are 18 ml for females and 25 ml for males (11,14). In our measurements, the discordance between the sonography and palpation was very close to the values in the literature (8). The prevalence of thyroid nodules in our country is believed to be highest in Blacksea Region and lowest in the Eastern Anatolia. However, these results were obtained by palpation method (13). Although our values obtained through palpation are in general agreement with the mentioned above results, the values detected by sonographic method indicate that the problem is much more serious than previously assumed.

UIC in sonographically detected goiter patients was found to be significantly lower than those of the average individuals surveyed during the study (p<0.0001). Thyroid volumes of different UIC groups varied greatly, with the highest volume found in the severe iodopenia group (Fig. 1). Thyroid volumes also were inversely correlated with UIC. These findings are consistent with the available literature (3,15,18).

It was emphasized that regional data should be taken for the interpretation of goiter and iodine deficiency (6). In a nationwide study conducted in Turkey, a discordant relationship was suggested between the scale of goiter problem and the ratio of female/male patients with goiter, i.e. the higher the ratio is the lower the goiter problem or versa. While the nationwide ratio is 3 (13), the ratio of the present study was found to be 1.4 for Erzurum. The results of this study affirms that goiter is still a crucial problem in Erzurum. However, the optimal comparison of these ratios may be done in the future after providing an iodine sufficient population in the region.

Berghout et al. (1), also observed that TV of men was higher than that of women. On the other hand, they suggest a positive relation between the TV and BSA, not between TV and age. Our results are in accord with their findings.

In conclusion, the iodine deficiency and goiter continues to be an important problem in Erzurum, the biggest city of Northeastern Anatolia. Although the production of iodinated salt is required by law, the habit of the non-iodinated salt consumption persists in the region. The reason for this may be that iodinated salt is only supplied by trademark companies whereas many people obtain non-iodinated salt from other sources. This seems to be the biggest obstacle for the efforts to eradicate the iodine deficiency problem. In the regions, where the nationwide "general purpose programs" remain insufficient, region-specific initiatives may contribute, a lot more, to the solution of the iodine deficiency problem in the years to come.

References

1. Berghout A, Wiersinga WM, Smits NJ, Touber JL. Determinants of thyroid volume as measured by ultrasonography in healthy adults in a non-iodine deficient area. Clinical Endocrinology 1987;26:273–80.
2. Brander A, Viikinkowsky P, Tuuhea J, Voatilanen L, Kivisaari L. Clinical versus ultrasound examination of the thyroid gland in common clinical practice. J Clin Ultrasound 1992;20:37–42.

3. Brunn J, Block U, Ruf G, Bos I, Kunze WP, Scriba PC. Volumetric der Schilddrüsenlappen mittels Real-Time Sonographie. Dtsch Med Wochhenschr 1981; 106:1338–40.
4. Eastman CJ, Philips DIW. Endemic goitre and iodine deficiency disorders. Etiology, epidemiology and treatment. Balliere Clin Endocrinol Metab 1988:719–35.
5. Erdogan G, Erdogan MF, Delange F, Sav H, Güllü S, Kamel N. Moderate and severe iodine deficiency in Ankara and the Black-Sea region. Turkish J Endocrinol Metabol 1999;3:103–7.
6. Foo LC, Zulfiqar A, Nafikudin M, Fadzil MT, Asmah AS. Local versus WHO/ICCIDD recommended thyroid volume reference in the assessment of iodine deficiency disorders. Eur J Endocrinol 1999;140(6):486–8.
7. Gaitan E, Dunn JT. Epidemiology of iodine deficiency. Trens Endocrinol Metab 1992;3:170–5.
8. Hegedus L, Perrild H, Poulsen LR et al. The determination of thyroid volume by ultrasound and its relationship to body weight, age, and sex in normal subjects. J Clin Endocrinol Metab 1983;56:260–3.
9. Hetzel BS. Iodine Deficiency Disorders (IDD) and their eradications. Lancet ii: 1983;1126–9.
10. Pino S., Fang SL., Braverman LE. Ammonium persulfate: a safe alternative oxidizing reagent for measuring urinary iodine. Clin Chem 1996;42(2):239–43.
11. Smyth PPA, Darke C, Parkes AB et al. Assesment of goiter in an area of endemic iodine deficiency. Thyroid. 1999, 9 (9): 895–901.
12. Tonglet R, Boudoux P, Minga T, Ermans AM. Efficacy ov low oral doses of iodized oil in the control of iodine deficiency in Zaire. N Engl J Med 1992;326: 236–41.
13. Urgancioglu I, Hatemi H. Endemic goitre in Turkey (in Turkish). Istanbul: Cerrahpasa Medical School publication., 1996:5.
14. World Health Organization 1993. Indicators for assessing iodine deficiency disorders and their control programmes. WHO/NUT/93 1:12–5.
15. WHO&ICCIDD. Recommended normative values for thyroid volume in children aged 6–15 years. Bull WHO 1997;75:95–7.
16. WHO, UNICEF, ICCIDD. Assesment of the iodine deficiency disorders and monitoring their elimination. Geneva: World Health Organisation; 2001. WHO Document WHO/NHD/01.1.
17. WHO-UNICEF-ICCIDD. Indicators for assessing iodine deficiency disorders and their control through salt iodization. WHO/NUT/94.6.
18. Yordam N, Özün A, Alikasifoglu A et al. Iodine deficiency in Turkey. Eur J Pediatr 1999;158:501–5.

Submitted March 2004.
Accepted December 2004.

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