Prevalence of goiter and urinary iodine status of 7-11-year-old children in Malatya province, Turkey

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SUMMARY: Eğri M, Bayraktar N, Temel İ, Ercan C, Ilgar M, Pehlivan E, Karaoğlu L, Güneş G, Genç M. Prevalence of goiter and urinary iodine status of 7-11-year-old children in Malatya province, Turkey. Turk J Pediatr 2006; 48: 119-123.

Goiter prevalence and urinary iodine excretion levels were assessed in 568 schoolchildren (317 boys and 251 girls), aged 7-11 years, living in the Malatya province, a well-known endemic goiter area in Turkey. Five hundred sixty-eight children aged 7-11 years consented to thyroid gland palpation and provided a urine sample on the day of examination in April 2004.

Median urinary iodine concentration for the total group was 66 μg/L. There was an association between presence of goiter or not and urinary iodine levels (67 μg/L versus 62 μg/L, p=0.000). The median urinary iodine concentration was lower in rural areas than in urban areas (54.6 μg/L versus 59.7 μg/L, respectively) and schoolchildren living in rural areas had significantly lower urinary iodine levels (p=0.000). In conclusion, the present study reports mild iodine deficiency in the Malatya province, despite a mandatory iodization program in Turkey which has been in force since 1998.

***Key words:** urinary iodine status, schoolchildren, Malatya, Turkey, endemic goiter.*

Iodide is present in soil and seawater and is oxidized by sunlight to iodine, which is vaporized into the air. Some of this iodide is returned to the soil by rain, but much is lost in the stratosphere. These events account for the continued depletion of iodine in soil, its lack of capture by plants, and continuing iodine deficiency in humans, particularly at higher altitudes in countries where salt is not fortified with iodide[1]. The mineral iodine is missing from the soil in many parts of world. This is the same soil used to grow the food for the animals and humans which live within the region. So, the iodine level is reduced in both animal and planted foods[2-3].

Iodine is a crucial nutrient for production of the thyroid hormone, which plays an important role in brain development. Iodine deficiency disorders (IDD) are disorders caused by iodine deficiency that is primarily the result of deficiency of iodine in soil and water. A large proportion of the people living in the region are at risk of IDD, due to inadequate amounts of iodine in soil, water and food[4-8].

The Malatya province is a known iodine deficiency endemic area. A study conducted in 1995 reported a goiter prevalence of 46.2% in the district[9]. In order to ensure adequate availability and use of iodized salt, the Ministry of Health issued a ban on the production of non-iodized salt for human consumption in 1998. During 1998-2004, the Health Directorate of Malatya province implemented intensive efforts to increase availability of iodized salt to the entire population. No survey has been conducted since 1998 on the status of iodine deficiency in the Malatya province. Therefore, the objective of the present study was to evaluate the status of iodine nutrition in schoolchildren after salt iodization by measuring their concentrations of urinary iodine.

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Material and Methods

Study Population

The sample included 568 schoolchildren (317 boys and 251 girls) aged 7-11 years. Schoolchildren of this age category are a useful target group for IDD surveillance because of their combined high vulnerability. In addition, schoolchildren as a group are useful for assessing iodine deficiency, as they are easy to access and reflect current rather than remote iodine nutrition in the general population[10-11].

Schools were randomly selected from the list of schools for the target age group in both urban (7 schools and 21 clusters) and rural (4 schools and 9 clusters) areas. Each cluster consisted of 20 students. Thus, the sampling size was 600 students aged 7-11-years. Every 10th student among the target group was enrolled in the study. There were no exclusion criteria but 32 students in the sampling group did not provide urine samples; participation rate was thus 94.5%.

Clinical Assessment

Clinical neck examination was done and goiter was ascertained and classified as per the modified World Health Organization (WHO) criteria for goiter assessment[11]. Neck examination of all students was done by one investigator (ME) who was blinded to the individual urinary iodine concentration. Grading of goiter was performed according to the criteria recommended by the joint WHO/UNICEF/International Council for Control of Iodine Deficiency Disorders (ICCIDD) (grade 0=no goiter; grade 1=thyroid palpable but not visible; and grade 2=thyroid visible with neck in normal position). When in doubt, the immediate lower grade was recorded. The results were recorded in a predesigned questionnaire. The sum of grades I and II provided the total goiter rate in the study population[11].

Urinary Iodine

Children provided first-morning urine samples with a 40 ml plastic urine sample container labelled with their identification code. Samples were placed immediately into 5 ml polyethylene tubes with tight lids. Every 40 samples were put into opaque boxes and then all sample boxes were immediately transported to the laboratory where they were stored in a deep freezer (-20°C) until just before analysis.

Most available methods for urinary iodine determination include an initial step in which the urine is either digested in a strong acid or ashed at a high temperature. The iodide is then measured by its catalytic action on the reduction of cerium (IV) by arsenic (III) in the Sandell-Kolthoff reaction. The reaction can detect iodine levels down to several nanograms[12,13]. WHO/ICCIDD recommends that the median urinary iodine concentration (UIC) for a population should be >100 µg of iodine per liter of urine. Mild iodine deficiency is a median UIC in the range 50–99 µg/L; moderate iodine deficiency in the range 20-49 µg/L; and severe deficiency less than 20 µg/L. No more than 20% of samples from a population should have a UIC below 50 µg/L[10,11].

Statistical Analysis

Urinary iodine data were analyzed using an SPSS statistical software. UIC is not considered normally distributed, and therefore the median is used as the measure of central tendency. Data are presented as median, quantiles and percentages in the table. Chi-square, Mann-Whitney U and Kruskal-Wallis analyses of variance were implemented when necessary for categoric or non-parametric variables.

Results

Goiter Rates

Of the 600 children in the sampling group, 568 (94.5%) underwent neck palpation (317 boys and 251 girls). Total goiter rate was 26.8% and it was not significantly different between boys and girls (26.0% and 27.3%, respectively).

Urinary Iodine Concentration

Of the 600 children in the sampling group, 568 (94.5%) provided first-morning urine samples. Table I shows the overall median UIC for the schoolchildren was 66 µg/L (interquartile range, 58–72 µg/L). UIC values were not related to age or sex ($p=0.26$). Median urinary iodine excretions were 67 µg/L in urban and 63 µg/L in the rural areas. UIC values were significantly different between urban and rural settlements ($p<0.0001$). Furthermore, UIC values were significantly different between students who did or did not have goiter ($p<0.0001$).

Fifty-six (9.8%) urine samples had UIC of less than 50 μg/L, 89.1% between 50-100 μg/L, and only 2.1% above 100 μg/L (Fig. 1).

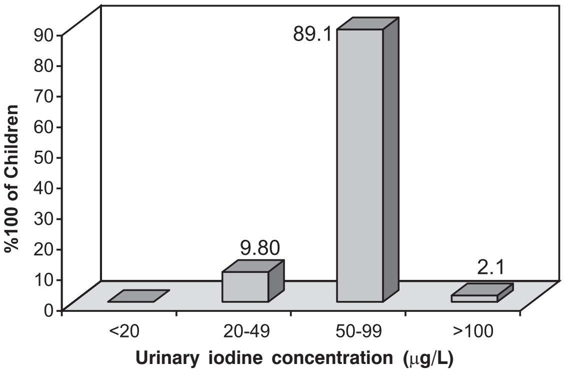

Fig. 1. Distribution of urinary iodine concentration in 568 schoolchildren in Malatya province, Turkey.

Discussion

Urinary iodine levels reflect dietary iodine intake, as 90% of ingested iodine is eventually excreted in the urine. WHO guidelines recommend use of spot urinary specimens to provide an adequate assessment of a population's iodine status[14]. Thyroid gland palpation is a quick, easy and acceptable method to assess the presence of goiter. All subjects were assessed by one trained investigator (ME) to reduce the incidence of interobserver bias, which has been reported in previous studies to affect 16%–40% of assessments[15,17].

Table I shows that the median UIC level for the entire surveyed group of 568 schoolchildren was 66 μg/L. The median values below 100 μg/L, 50 μg/L and 20 μg/L indicating mild, moderate and severe iodine deficiency, respectively, have been established for the population[11]. Therefore, iodine deficiency in Malatya province in Turkey can be categorized overall as mild.

The frequency distribution of UIC values shows that only 2.1% of the samples had adequate levels of iodine in urine (more than 100 μg/L). The majority of urine samples (89.1%) had between 50-99 μg/L, and 9.8% had below 50 μg/L, indicating mild and moderate iodine deficiency, respectively (Fig. 1). Consequently, this work establishes that schoolchildren in Malatya province are iodine deficient, as has been recently demonstrated in many parts of Turkey[18-24].

Table I. Percentage and Median Urinary Iodine Values by Sex, Settlement, Goiter Assessment and Age in a Sample of Malatya Province Schoolchildren

	Urinary iodine excretion (μg/L)					
Category (number of subjects)	25th quantile	Median	75th quantile	<50 μg/L	50-59 μg/L	100 μg/L
Sex						
Male (n=317)	56.7	64.9	72.1	35 (11.0%)	277 (87.4%)	5 (1.6%)
Female (n=251)	58.8	65.9	65.9	21 (8.4%)	229 (91.2%)	1 (0.4%)
Overall (n=568)	57.7	65.9	72.0	56 (9.8%)	506 (89.1%)	6 (2.1%)
Grade of goiter*						
0 (n=416)	58.7	66.9	74.9	36 (8.6%)	374 (89.2%)	5 (1.2%)
1 (n=148)	54.6	61.8	68.9	19 (12.8)	128 (86.4)	1 (0.6)
2 (n=4)	56.7	61.3	64.3	0 (0.0)	4 (100.0)	0 (0.0)
Age						
7 (n=104)	56.9	63.4	71.0	13 (12.5)	88 (84.6)	2 (1.9)
8 (n=111)	55.7	64.9	71.0	16 (14.4)	94 (84.6)	1 (0.9)
9 (n=111)	59.7	66.9	72.0	9 (8.1)	102 (91.9)	0 (0.0)
10 (n=113)	58.8	66.9	74.6	5 (4.4)	107 (94.6)	1 (0.9)
11 (n=129)	58.7	64.9	74.0	13 (10.0)	115 (89.1)	2 (1.6)
Settlement**						
Urban (n=347)	59.7	66.9	75.1	24 (6.9)	321 (92.5)	2 (0.6)
Rural (n=221)	54.6	62.8	70.0	32 (14.5)	185 (83.7)	4 (1.8)

* Median urinary iodine concentration (UIC) significantly higher in non-goitrous children.
** Rural areas had a significantly lower UIC.

Although urban areas had higher levels of UIC (67 and 63 μg/L, respectively) than rural regions, the present study has indicated the presence of mild iodine deficiency in Malatya province schoolchildren living in both urban and rural areas. A difference between rural and urban areas is not common in developed countries due to similar pattern of fortifying foods[25].

WHO/ICCIDD recommends that the total goiter rate (TGR) for a population should be less 5%. Mild iodine deficiency is TGR in the range 5.0–19.9%; moderate iodine deficiency in the range 20.0–29.9 μg/L; and severe deficiency more than 30%[11]. The present study showed a TGR of 27% among schoolchildren, thereby indicating a moderate iodine deficiency. UIC and TGR may indicate a different severity of iodine deficiency. UIC is a good marker of very recent dietary iodine intake, but the size of the thyroid gland changes inversely in response to alterations in iodine intake, with a lag interval that varies from a few months to several years, depending on many factors[11].

Salt iodization is the preferred means of correcting iodine deficiency in the long run[26]. In Turkey, iodization of salt was initiated in 1968 on a voluntary basis. Currently, iodization of salts in Turkey has been mandatory since 1998 and recommended iodine concentration should be 50-70 mg/kg potassium iodide or 25-40 mg/kg potassium iodate. Although salt iodization is now legally enforced[27], it seems impossible to implement it country-wide in the short run, since the majority of manufacturers are small traditional producers. Alternative sources of iodine should be considered in addition to expanded and more efficient salt iodization programs.

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