TÜBİTAK

Original Article

Turk J Med Sci
2012; 42 (4): 675-680
© TÜBİTAK
E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-1101-1474

Iodine deficiency in pregnancy and in women of reproductive age in Erzurum, Turkey

Kadir ÇETİNKAYA[1], Metin İNGEÇ[2], Semra ÇETİNKAYA[3], İbrahim KAPLAN[4]

Aim: Iodine deficiency (ID) is an important public health problem and the most common cause of preventable mental retardation. The aims of this study were to determine the urinary iodine concentration (UIC) of pregnant women living in Erzurum, to assess the ID rate, and to find out whether iodine supplementation is necessary in pregnancy.

Materials and methods: Spot urine was obtained from pregnant and nonpregnant women with no functional or organic thyroid disease. The UIC was studied using the Sandell-Kolthoff method.

Results: The median UIC values of pregnant women in the first, second, and third trimesters and of the nonpregnant women were 126.0, 134.6, 132.7, and 137.3 μg/L, respectively. The total ID rate was 72.6% and 18.0% in the pregnant and the nonpregnant women, respectively.

Conclusion: The ID rate in pregnancy was found to be high in Erzurum. ID rates were highest in the first trimester, when fetal neurodevelopment is most affected. ID is still a serious problem in Erzurum despite mandatory salt iodization. However, the fact that the deficiency is mild to moderate is promising as regards the potential response to iodine supplementation in pregnant women.

Key words: Iodine deficiency, urinary iodine concentration, pregnancy

Erzurum'da yaşayan gebelerde ve üreme çağındaki kadınlarda iyot eksikliği

Amaç: İyot eksikliği (İE) önemli bir toplumsal sağlık sorunu olup, önlenebilir zihinsel geriliğin en yaygın sebebidir. Erzurum'da yaşayan gebelerde idrar iyot konsantrasyonu (İİK) ile İE oranını belirlemek ve gebelere iyot desteği gerekip gerekmediğini araştırmak.

Yöntem ve gereç: Fonksiyonel veya organik tiroid hastalığı bulunmayan, gebe olan ve olmayan kadınlardan spot idrar temin edildi. Sandell-Kolthoff yöntemi ile İİK çalışıldı.

Bulgular: Ortanca İİK'nu trimesterler ve gebe olmayanlarda sırasıyla (126,0), (134,6), (132,7) ve (137,3) μg/L idi. Gebelerde ve gebe olmayanlarda İE oranı sırasıyla % 72,6 ve % 18,0 idi.

Sonuç: Erzurum'da İE oranı gebelerde yüksek olarak saptandı. İE oranları fetal nöro gelişimsel etkilenmenin en yoğun olduğu ilk trimester de en yüksekti. Zorunlu tuz iyotlamasına rağmen İE, Erzurum'da hala ciddi bir sorundur. Ancak eksiklik derecesinin hafif ve orta düzeyde olması gebelere iyot desteğine alınabilecek yanıt açısından umut vericidir.

Anahtar sözcükler: İyot eksikliği, idrar iyot konsantrasyonu, gebelik

Received: 29.01.2011 – Accepted: 10.06.2011

[1] Department of Obstetrics and Gynecology, Ankara Oncology Education and Research Hospital, Ankara - TURKEY
[2] Department of Obstetrics and Gynecology, Faculty of Medicine, Atatürk University, Erzurum - TURKEY
[3] Department of Pediatric Endocrinology, Sami Ulus Pediatric Health, Obstetrics, and Gynecology Education and Research Hospital, Ankara - TURKEY
[4] Department of Biochemistry, Faculty of Medicine, Atatürk University, Erzurum - TURKEY
Correspondence: *Kadir ÇETİNKAYA, Department of Obstetrics and Gynecology, Ankara Oncology Education and Research Hospital, Ankara - TURKEY*
E-mail: kacetinkaya@gmail.com

Introduction

Iodine deficiency (ID) is a general health problem that has a negative effect on hormonal balance and body metabolism (1-3). Iodine requirements increase in certain periods of life, such as pregnancy and lactation (2,3). ID may cause anovulation and infertility in nonpregnant women (1), while ID in pregnant women can lead to an increased risk of spontaneous abortion, recurrent loss of pregnancy, gestational hypertension, fetal growth retardation, low birth weight, neonatal hypothyroidism, newborn mortality, and, especially, neuromotor, behavioral, and cognitive retardation (1-4). Pregnant women and their fetuses are the worst affected by ID due to its effect on cerebral development (5). Normal mental development, together with the development of learning capacity and the ability to understand, requires the intake of a certain amount of iodine in the intrauterine period and within the first year (6). This makes it essential to know the iodine levels of pregnant and lactating women among the general population.

Although it has been claimed that North American populations do not suffer from ID, 36% of the reproductive-age female population was found to have this condition (7,8). It is known that about 30% of the general population in Turkey suffers from ID, with this number varying by region (9). Studies done after salt iodization became mandatory in Turkey in 1998 found a urinary iodine concentration (UIC) value of less than 100 μg/L in 90% of mothers who had newly given birth in Kayseri (10), while the UIC was less than 100 μg/L in 83.3% of pregnant women in Malatya (11).

The aim of our study was to evaluate the rate of ID in pregnant women or women of childbearing age in Erzurum Province, and to provide guidance for the development of methods and relevant strategies to protect pregnant women and their fetuses from ID and ID disorders.

Materials and methods

A cross-sectional study was performed at the Atatürk University Obstetrics and Gynecology Outpatients Department in June 2009. The study populations were pregnant and nonpregnant women of reproductive age. Pregnant women with a single, normal pregnancy and no personal history of thyroid disease were included. All volunteer subjects included in the study claimed to use iodized salt liberally, were apparently healthy, and had no reports of past or present thyroid disease, recent exposure to iodine, or intake of goitrogenic drugs or thyroid hormones. Complicated pregnancies such those with diabetes mellitus or preeclampsia, multiple pregnancies, and assisted reproduction pregnancies were excluded from the study. A 20-mL sample of early morning urine was collected from each woman.

Pregnant women with antenatal follow-up (30, 49, and 34 women in the first, second, and third trimesters, respectively) and nonpregnant and nonlactating healthy women (n = 39) were included in the study. Of the 193 subjects, 152 who agreed to participate in the study were aged 19-33 years. All subjects lived in Erzurum. Consent for the study was obtained from the Atatürk University Medical Faculty Ethic Committee.

The severity of ID in nonpregnant, nonlactating women (Table 1) was classified according to World Health Organization (WHO) criteria with a median UIC value of 99-50 μg/L being a mild deficiency, 49-20 μg/L being a moderate deficiency, and <20 μg/L being a severe deficiency (12). For the pregnant women, a UIC median value of <150 μg/L was defined as ID (Table 2). A median UIC value of 100-199 μg/L was considered adequate for nonpregnant, nonlactating women, and 150-249 μg/L was considered adequate for pregnant women. Table 3 shows the ages and UIC values of pregnant and nonpregnant, nonlactating women. Table 4 shows the distribution of the severity of ID in pregnant women based on trimester. We define the values for ID in pregnancy as a median UIC value of 149-100 μg/L being a mild deficiency, 99-50 μg/L being a moderate deficiency, and <50 μg/L being a severe deficiency.

The urine collection tubes were washed with distilled water. Morning urine collected in washed containers from the patients and the control group was placed into the tubes. The samples were centrifuged for 10 min at 1500 rpm. The supernatant was obtained and stored at –80 °C until the time of measurement. All measurements were performed at the same time. The Sandell-Kolthoff method (13) was used for iodine

Table 1. Epidemiologic criteria for assessing iodine nutrition in a population of nonpregnant, nonlactating women based on median UICs.

Median urinary iodine, µg/L	Iodine intake	Iodine status
<20	Insufficient	Severe iodine deficiency
20-49	Insufficient	Moderate iodine deficiency
50-99	Insufficient	Mild iodine deficiency
100-199	Adequate	Adequate iodine nutrition

UIC: urinary iodine concentration.

Table 2. Epidemiologic criteria for assessing iodine nutrition in a population of pregnant women based on median UICs.

Median urinary iodine µg/L	Iodine intake
<150	Insufficient
150-249	Adequate

UIC: urinary iodine concentration.

measurement. The results were expressed in µg/L. The principle of the method is based on the oxidation of As^{+3} to As^{+5} and the reduction of a Ce^{+4} ion to a Ce^{+3} ion. Ce^{+4} is reduced to Ce^{+3} in the presence of As^{+3} and the Ce^{+4} concentration is measured with a spectrophotometer at 405 nm.

Statistical analysis

Demographic data and UIC values were expressed as percentages, medians, and means with their standard deviations. Data were analyzed using SPSS 15.0. Student's t-test was used to identify the difference between the pregnant group and the nonpregnant, nonlactating group. One-way ANOVA was used to identify the differences among the first, second, and third trimesters. In both statistical contrasts, the differences were considered to be significant when $P < 0.05$.

Results

The ages and UIC values of the women participating in the study are presented in Table 3. The mean values of UIC do not show a significant difference among the trimesters ($P = 0.343$) or between pregnant and nonpregnant, nonlactating women ($P = 0.159$). ID values based on median UICs in pregnant women per trimester are presented in Table 4. The severity of ID based on the median UIC in nonpregnant, nonlactating women of reproductive age is shown in Table 5.

The median UIC values of women in the first, second, and third trimesters and nonpregnant women were 126.0 (n = 30), 134.6 (n = 49), 132.7 (n = 34), and 137.3 (n = 39) µg/L, respectively. UIC was measured as 118.5 ± 37.2, 124.5 ± 46.3, and 133.1 ± 62.6 µg/L in the first, second, and third trimesters of pregnancy, respectively. The ID rate according to WHO criteria in the pregnant women (UIC < 150 µg/L) and the nonpregnant women (UIC < 100 µg/L)

Table 3. Ages and UIC values of pregnant and nonpregnant, nonlactating women.

	n	Age (years): mean ± SD (range)	UIC (µg/L): mean ± SD (range)	UIC (µg/L): median
Pregnant	113	26.5 ± 2.8 (19-33)	125.5 ± 49.6 (15.1-291.6)	132.8*
First trimester	30	26.8 ± 2.2 (22-32)	118.5 ± 37.2 (34.0-206.8)	126.0**
Second trimester	49	27.1 ± 2.9 (19-33)	124.5 ± 46.3 (15.1-201.3)	134.6**
Third trimester	34	25.4 ± 2.9 (19-32)	133.1 ± 62.6 (17.6-291.6)	132.7**
Nonpregnant	39	25.9 ± 3.1 (20-33)	138.7 ± 52.1 (30.0-228.0)	137.3*

UIC: urinary iodine concentration, n: number.
*Pregnant vs. nonpregnant: $P = 0.159$, **first, second, and third trimesters: $P = 0.343$.

Table 4. ID based on MUIC in pregnant women according to trimester.

	Adequate n (%)	Total ID n (%)	149-100 n (%)	99-50 n (%)	<50 n (%)
First trimester n = 30	5 (16.7)	25 (83.3)	17 (56.7)	7 (23.3)	1 (3.3)
Second trimester n = 49	16 (32.6)	33 (67.4)	20 (40.8)	9 (18.4)	4 (8.2)
Third trimester n = 34	10 (29.4)	24 (70.6)	14 (41.2)	8 (23.5)	2 (5.9)
All pregnant patients n = 113	31 (27.4)	82 (72.6)	51 (45.1)	24 (21.3)	7 (6.2)

ID: iodine deficiency, MUIC: median urinary iodine concentration, n: number.

Table 5. Severity of ID based on MUIC in nonpregnant, nonlactating women of reproductive age.

	Adequate n (%)	Total ID n (%)	Mild ID n (%)	Moderate ID n (%)	Severe ID n (%)
Nonpregnant n = 39	32 (82.0)	7 (18.0)	4 (10.3)	3 (7.7)	0 (0.0)

ID: iodine deficiency, MUIC: median urinary iodine concentration, n: number.

was 72.6% and 18.0%, respectively. The ID rate was 83.3%, 67.4%, and 70.6% in the first, second, and third trimesters, respectively, with the first trimester having the highest rate.

Discussion

In August 1998, mandatory iodization of salt was finally implemented in Turkey; however, even since the mandatory iodization, several studies have been published about ID (9-11). More than 30% of the general population suffers from ID in Turkey with this number varying by region (9), and the ID level in Erzurum is unknown. Moreover, despite mandatory salt iodization, we encountered patients of different ages with elevated thyroid-stimulating hormone levels, such as cases of transient neonatal hypothyroidism, goiter, thyroid nodules, and thyroid disorders in pregnant women and neonates. These problems could be related to ID. According to WHO recommendations, several indicators are used to assess the iodine status of a population. Therefore, we carried out the present study to reveal the status of ID via the UIC level, which is an indicator for the assessment of ID.

The WHO states that iodine intake during pregnancy and for the general population should be at least 250 and 150 μg per day, respectively, and the median urinary iodine during pregnancy and for the general population should be in the daily range of 150-249 and of 100-199 μg, respectively (12). In this study, we found an ID rate of 83.3%, 67.4%, 70.6%, and 18.0% in the first trimester, second trimester, third trimester, and nonpregnant groups, respectively. This seems to be associated with the unmet need for increased iodine during pregnancy. Evaluation of adequate urinary iodine levels gave values of 82.0% and 27.4% for the nonpregnant and pregnant women, respectively. The presence of ID in the pregnant women shows that it should be mandatory to achieve a significant rate of adequate levels with some iodine supplementation in pregnancy. Iodization of salt is generally done globally as it is not possible to ingest enough iodine through food in many regions. Iodized

salt ensures a daily iodine intake of approximately 100-150 μg if a normal amount of salt is consumed (12). This amount of daily iodine intake is nearly enough for nonpregnant, nonlactating women. It is obvious that if this level of intake remains constant during pregnancy, ID is to be expected. This expectation is supported by our findings. Moreover, in some circumstances, salt intake can be restricted, such as in cases of gestational hypertension or hyperemesis. In addition, iodized salt is not a stable food and can be degraded if boiled or exposed to direct light.

Turkey has a continuing problem of ID despite mandatory iodization of salt (9-11). Additionally, the multivitamin preparations commonly used in Turkey during pregnancy do not contain iodine. Even more important is the fact that midwives, nurses, and even obstetricians are not fully aware of the matter and cannot provide preventive health services to pregnant and fertile women regarding iodine intake. However, it has been possible to develop such awareness for preventing situations like folic acid deficiency in Turkey.

Iodine is required for the production of thyroid hormones, which are essential for normal fetal brain development (2,4). Maternal thyroxine crosses the placenta to support neural development before the onset of fetal thyroid function at 10-12 weeks (1-5). The ID rates were found to be highest in the first trimester, when the influence on fetal neurodevelopment is the most pronounced. The National Health and Nutrition Examination Survey III study from the United States found a mean UIC value of 141 μg/L in pregnant women and 127 μg/L in nonpregnant women, while the percentage of women with values under 50 μg/L was 6.9% and 15.3%, respectively (7). A study from Boston found a UIC value of less than 150 μg/L in 50% and less than 50 μg/L in 9% of pregnant women (14). We found the percentage of pregnant women with UIC values under 50 μg/L to represent the lowest percentage in all trimesters, while 7.7% of nonpregnant women were found to have moderate ID. Adequate UIC levels were seen in 16.7%, 32.6%, and 29.4% of women in the first, second, and third trimesters, respectively (27.4% in all pregnant women), and 82.0% of nonpregnant, nonlactating women. Although this study has the limitation of a relatively small sample size, these data show that mandatory iodization has been partially successful in Turkey while the ID problem continues.

Iodine support during pregnancy was at the 13%-50% level in European countries (15). Randomized controlled studies have found UIC values to increase several-fold and reach normal values following 50-230 μg/day of iodine supplementation in pregnant women who were found to have marked ID according to their first UIC levels (16-18). Glinoer et al. saw increased UICs from 36 μg/L to 80-90 μg/L with 100 μg/day of iodine supplementation (17), while Pedersen et al. reported increases from 55 μg/L to 90-110 μg/L following 200 μg/day of iodine supplementation (18). The results of this study confirm that iodine supplementation in pregnancy is necessary.

The iodine levels of pregnant women need to be monitored. However, measurement of the urinary iodine level is not of clinical utility in individual patients and it does not currently seem feasible to use it in the routine follow-up of pregnant women.

The UIC levels of pregnant women living in Erzurum are far from ideal. Taking all these data into account, it is estimated that the additional iodine that should be added to the daily adult requirement during pregnancy is at least 100-150 μg in this region of Turkey. Although salt iodization has been mandatory in Turkey since 1998, the pregnant women living in this part of the country and their fetuses are not adequately protected from ID. We believe that it should be compulsory to add iodine to the multivitamin supplement support used during pregnancy so that the increased requirement can be met.

References

1. Patrick L. Iodine: deficiency and therapeutic considerations. Altern Med Rev 2008; 13: 116-27.

2. Delange F. Iodine requirements during pregnancy, lactation and the neonatal period and indicators of optimal iodine nutrition. Public Health Nutr 2007; 10: 1571-80.

3. Zimmermann MB. The impact of iodised salt or iodine supplements on iodine status during pregnancy, lactation and infancy. Public Health Nutr 2007; 10: 1584-95.

4. Azizi F, Kalani H, Kimiagar M, Ghazi A, Sarshar A, Nafarabadi M et al. Physical, neuromotor and intellectual impairment in non-cretinous schoolchildren with iodine deficiency. Int J Vitam Nutr Res 1995; 65: 199-205.

5. Delange F. Iodine deficiency as a cause of brain damage. Postgrad Med J 2001; 77: 217-20.

6. Glinoer D, Delange F. The potential repercussions of maternal, fetal, and neonatal hypothyroxinemia on the progeny. Thyroid 2000; 10: 871-87.

7. Hollowell JG, Staehling NW, Hannon WH, Flanders DW, Gunter EW, Maberly GF et al. Iodine nutrition in the United States. Trends and public health implications: iodine excretion data from National Health and Nutrition Examination Surveys I and III (1971-1974 and 1988-1994). J Clin Endocr Metab 1998; 83: 3401-8.

8. Caldwell KL, Jones R, Hollowell JG. Urinary iodine concentration: United States National Health and Nutrition Examination Survey 2001-2002. Thyroid 2005; 15: 692-9.

9. Yordam N, Ozön A, Alikaşifoğlu A, Ozgen A, Ceren N, Zafer Y et al. Iodine deficiency in Turkey. Eur J Pediatr 1999; 158: 501-5.

10. Kurtoglu S, Akcakus M, Kocaoglu C, Gunes T, Budak N, Atabek ME et al. Iodine status remains critical in mother and infant in Central Anatolia (Kayseri) of Turkey. Eur J Nutr 2004; 43: 297-303.

11. Egri M, Ercan C, Karaoglu L. Iodine deficiency in pregnant women in eastern Turkey (Malatya Province): 7 years after the introduction of mandatory table salt iodization. Public Health Nutr 2009; 12: 849-52.

12. WHO, UNICEF, ICCIDD. Assessment of iodine deficiency disorders and monitoring their elimination. 2nd ed. Geneva: World Health Organization; 2007.

13. Sandell EB, Kolthoff IM. Micro determination of iodine by a catalytic method. Microchemica Acta 1937; 1: 9-25.

14. Pearce EN, Bazrafshan HR, He X, Pino S, Braverman LE. Dietary iodine in pregnant women from the Boston, Massachusetts area. Thyroid 2004; 14: 327-8.

15. Nohr SB, Laurberg P, Borlum KG, Pedersen KM, Johannesen PL, Damm P et al. Iodine deficiency in pregnancy in Denmark. Regional variations and frequency of individual iodine supplementation. Acta Obstet Gyn Scan 1993; 72: 350-3.

16. Romano R, Jannini EA, Pepe M, Grimaldi A, Olivieri M, Spennati P et al. The effects of iodoprophylaxis on thyroid size during pregnancy. Am J Obstet Gynecol 1991; 164: 482-5.

17. Glinoer D, De Nayer P, Delange F, Lemone M, Toppet V, Spehl M et al. A randomized trial for the treatment of mild iodine deficiency during pregnancy: maternal and neonatal effects. J Clin Endocr Metab 1995; 80: 258-69.

18. Pedersen KM, Laurberg P, Iversen E, Knudsen PR, Gregersen HE, Rasmussen OS et al. Amelioration of some pregnancy-associated variations in thyroid function by iodine supplementation. J Clin Endocr Metab 1993; 77: 1078-83.