

# Iodine nutrition in pregnancy and lactation in Iran

Fereidoun Azizi\*

Endocrine Research Center, Shaheed Beheshti University of Medical Sciences, Tehran, Islamic Republic of Iran

## Abstract

**Objective:** To describe studies evaluating urinary iodine excretion during pregnancy and lactation in women living in cities with adequate or more than adequate iodine intake.

**Design:** Cross-sectional study conducted between 1996 and 1998 in pregnant women and a study of lactating women conducted in 2003.

**Settings and Subjects:** Pregnant women attending prenatal clinics in four cities in the Islamic Republic of Iran. Urinary iodine excretion and thyroid volume was measured in 403 women. In a second study, 100 lactating women from Taleghani Hospital in Gorgan, Iran were evaluated for thyroid size, and both urinary and breast milk iodine concentrations were determined.

**Results:** In Rasht city, 84% of pregnant women had a urinary iodine concentration of  $\geq 200 \mu\text{g l}^{-1}$ , while in the other cities this percentage ranged from 45 to 55%. When data were combined for the cities of Ilam, Isfahan and Tehran, where women have an adequate or more than adequate median urinary iodine concentration, 51% of pregnant women had a urinary iodine concentration less than that recommended during pregnancy. In Rasht, where the median urinary iodine concentration indicates an excessive iodine intake, 15.4% of pregnant women had a urinary iodine concentration  $< 200 \mu\text{g l}^{-1}$ . The mean urinary iodine concentration in lactating women was  $250 \mu\text{g l}^{-1}$ , and 16% of women had a urinary iodine concentration  $< 100 \mu\text{g l}^{-1}$ . Grade 1 goitre was present in 8% of lactating women, and another 8% had grade 2 goitre.

**Conclusions:** Findings of this study call for further attention to iodine intake during pregnancy and lactation. The currently recommended intake of iodine through universal salt iodisation may not be adequate for pregnant and lactating women, and supplementation during pregnancy and lactation should be further considered in light of the latest recommendations.

**Keywords**  
Iodine  
Pregnancy  
Lactation  
Urinary iodine  
Goitre  
Iran

## Introduction

Pregnancy is accompanied by profound alterations in economy of the thyroid gland which may lead to a relative iodine deficiency<sup>1</sup>. In iodine-deficient populations, pregnancy therefore acts to disclose an underlying lack of iodine. This leads to goitre in the mother and neonate, and to subsequent physical and intellectual impairment of the child, but it can easily be prevented by iodine supplementation<sup>2–4</sup>. Studies have shown that many women are iodine deficient during pregnancy not only in iodine-deficient regions, but also in iodine-sufficient areas<sup>5</sup>.

In the Islamic Republic of Iran, an effective national programme of dietary iodine supplementation by means of universal salt iodisation has resulted in the sustained prevention of iodine deficiency disorders (IDD)<sup>6</sup> so that the Eastern Mediterranean Office of the World Health Organization has classified Iran as an IDD-free country<sup>7</sup>. This paper describes studies of urinary iodine concentrations during pregnancy and lactation in

women living in cities who have an adequate or a more than adequate iodine intake.

## Pregnant women and schoolchildren

A cross-sectional study was performed in the cities of Ilam, Isfahan, Rasht and Tehran, between 1996 and 1998. The study populations were pregnant women and schoolchildren. A total of 403 healthy pregnant women who attended prenatal clinics, and 438 schoolchildren, aged 8–10 years, randomly selected from primary schools of each city, were recruited to take part in this study. A sample of urine was collected in the morning from each subject to estimate the urinary iodine concentration using a digestion method. The criteria given by the WHO and the ICCIDD were used to classify the iodine content of each sample<sup>8</sup>. The volume of the thyroid was measured ultrasonically according to the method of Brunn *et al.*<sup>9</sup> using a scanner (Dornier, Germany) with a 7.5 MHz transducer.

\*Corresponding author: Email azizi@erc.ac.ir

Table 1 shows the median urinary iodine concentrations of pregnant women and schoolchildren in Ilam, Isfahan, Rasht and Tehran. In Rasht, 84% of pregnant women had a urinary iodine concentration of  $\geq 200 \mu\text{g l}^{-1}$ , while in the other cities this percentage ranged from 45 to 55%. This means that in the cities of Ilam, Isfahan and Tehran, 55, 45 and 54% of women, respectively, had a urinary iodine concentration of  $\leq 199 \mu\text{g l}^{-1}$ . When data were combined for the three cities of Isfahan, Ilam and Tehran, 4, 5, 18 and 24% of pregnant women had a urinary iodine concentration of  $< 50$ , 50–99, 100–149 and 150–199  $\mu\text{g l}^{-1}$ , respectively.

Table 2 shows the mean and median urinary iodine concentrations of women in each of the three trimesters of pregnancy, and in non-pregnant, control women. Table 2 also shows the mean thyroid volume of each of these groups of women. The urinary iodine concentration of women in the third trimester was significantly lower than in control women ( $P < 0.02$ ). However, there was no significant difference in urinary iodine concentration in pregnant women among the three trimesters of pregnancy.

Table 2 also shows that, of the non-pregnant women, only 10% had a urinary iodine concentration less than the minimum adequate level of  $100 \mu\text{g l}^{-1}$ , while 45% of pregnant women had values less than minimum recommended concentration during pregnancy of  $200 \mu\text{g l}^{-1}$ .

### Lactation

From April to June 2003, lactating mothers referred to the Taleghani Hospital in Gorgan were randomly selected.

The size of the thyroid was determined by palpation and was classified into grade 1 or 2 according to the WHO criteria<sup>8</sup>. Samples of urine and breast milk were collected from 100 women. After acid digestion of urine samples and alkaline incineration of milk samples, the concentration of iodine was determined using the Sandell–Kolthoff colorimetric method<sup>10</sup>.

The standard error of the mean (SEM) of the urinary iodine concentration was  $250 (12.3) \mu\text{g l}^{-1}$  with 96% CI of 226–274, the median was  $259 \mu\text{g l}^{-1}$ , and the range in values was 35–519  $\mu\text{g l}^{-1}$ . Table 3 shows that 16% of women had a urinary iodine concentration of  $< 100 \mu\text{g l}^{-1}$ , 13% were in the range 50–99  $\mu\text{g l}^{-1}$  and 3% were in the range 20–49  $\mu\text{g l}^{-1}$ . A goitre of grade 1 was present in 8% of women, and another 8% had a grade 2 goitre.

The SEM of the breast milk iodine concentration was  $117 (10.3) \mu\text{g l}^{-1}$  with 96% CI of 97–137, the median was  $93 \mu\text{g l}^{-1}$ , and the range in values was 17–696  $\mu\text{g l}^{-1}$ . The milk iodine concentration was  $< 50 \mu\text{g l}^{-1}$  in 19% of women, it ranged from 35 to 49  $\mu\text{g l}^{-1}$  in 13% of women; from 20 to 34  $\mu\text{g l}^{-1}$  in 3% of women and was  $< 20 \mu\text{g l}^{-1}$  in another 3% of women. The study found that 11% of women had a milk iodine concentration of 20–29  $\mu\text{g l}^{-1}$  and 3% had values  $\geq 30 \mu\text{g l}^{-1}$ . Of the women who had a milk iodine concentration of  $< 50 \mu\text{g l}^{-1}$ , 11% had a grade 1 goitre and 8% had a grade 2 goitre.

The Fig. 1 shows that there was a statistically significant correlation between the concentration of iodine in the breast milk and iodine in the urine of mothers ( $r = 0.44$ ,  $P < 0.001$ ).

**Table 1** Urinary iodine concentration ( $\mu\text{g l}^{-1}$ ) in pregnant women and schoolchildren of four cities in the Islamic Republic of Iran.

City	Pregnant women									Schoolchildren	
	<i>n</i>	Mean (SD) ( $\mu\text{g l}^{-1}$ )	Median ( $\mu\text{g l}^{-1}$ )	Percentage in ranges ( $\mu\text{g l}^{-1}$ )					<i>n</i>	Median ( $\mu\text{g l}^{-1}$ )	
				$< 50$	50–99	100–149	150–199	$\geq 200$			
Ilam	93	206 (98)	190	3	4	21	27	45	1400	202	
Isfahan	90	207 (69)	212	4	3	19	19	55	1400	250	
Rasht	104	344 (141)	338	0	1	7	8	84	1400	312	
Tehran	116	191 (55)	186	4	9	15	26	46	1400	193	

**Table 2** Urinary iodine concentration and thyroid volume in each trimester of pregnancy and in control, non-pregnant women in Isfahan.

Variables	Trimester of pregnancy			Non-pregnant women
	First	Second	Third	
Sample size	30	30	30	90
Age (SD) (years)	25.7 (5.4)	25.7 (4.9)	24.6 (4.9)	27.5 (7.8)
Mean (SD) ( $\mu\text{g l}^{-1}$ )	206 (70)	233 (63)	184 (67)	237 (76)
Median ( $\mu\text{g l}^{-1}$ )	205	238	150	255
$\geq 200 \mu\text{g l}^{-1}$ (%)	53	67	47	70
150–199 ( $\mu\text{g l}^{-1}$ ) (%)	17	23	17	13
100–149 ( $\mu\text{g l}^{-1}$ ) (%)	23	10	23	8
$< 100 \mu\text{g l}^{-1}$ (%)	7	0	13	9
Thyroid volume (SD) (ml)	8.8 (3.5)	7.0 (2.5)	7.6 (3.3)	7.8 (2.8)

**Table 3** Distribution of the concentration of iodine in urine according to the breast milk iodine concentration of 100 lactating mothers in Gorgan, Iran.

Breast milk iodine concentration ( $\mu\text{g l}^{-1}$ )	Urinary iodine concentration ( $\mu\text{g l}^{-1}$ )					Total
	<20	20–49	50–99	100–199	$\geq 200$	
<50	0	1	1	8	9	19
$\geq 50$	0	2	12	14	53	81
Total	0	3	13	22	62	100

## Discussion

The data presented here clearly show that in Ilam, Isfahan and Tehran, where women have an adequate or more than adequate median urinary iodine concentration ranging from 186 to 212  $\mu\text{g l}^{-1}$ , 51% of pregnant women have a urinary iodine concentration less than that recommended during pregnancy, and 9% have a urinary iodine concentration  $<100 \mu\text{g l}^{-1}$ , which might be considered to indicate a severe iodine deficiency during pregnancy. In Rasht, where the median urinary iodine was 338  $\mu\text{g l}^{-1}$ , indicating an excessive iodine intake according to the WHO criteria, 15.4% of pregnant women had a urinary iodine concentration  $<200 \mu\text{g l}^{-1}$ .

The results also indicate that, although the median urinary iodine concentration of lactating mothers indicated a sufficient consumption of iodine, the concentration of iodine in breast milk was still inadequate in some women, so their infants could be at risk of iodine deficiency. The median and 95% confidence intervals of the urinary iodine concentration in lactating women were within normal range, and a large proportion showed a more than adequate or excessive concentration of urinary iodine.

Although iodine is avidly concentrated by the mammary gland, unexpectedly, 19% of all mothers had low iodine

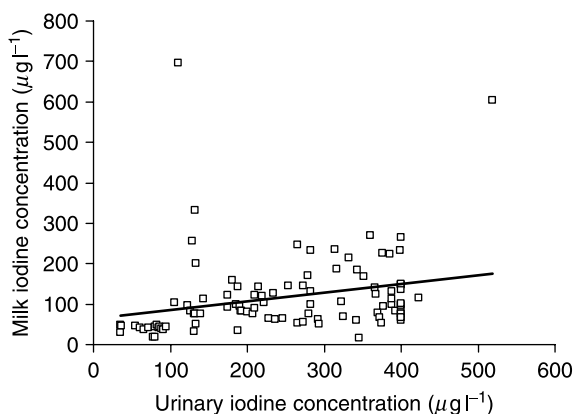
concentration in their breast milk. In addition, both the median and the mean concentrations of iodine in breast milk were lower than the newly recommended adequate iodine intake for infants i.e. 110–130 and 140–180  $\mu\text{g l}^{-1}$ , respectively.

The moderate correlation between the concentrations of iodine in breast milk and urine illustrates this discrepancy and suggest that an adequate maternal urinary iodine concentration cannot reliably indicate that an infant is getting enough iodine in breast milk. Therefore, it may be concluded that some breast-fed infants are still at risk of a low iodine intake and additional iodine supplements, other than salt iodisation, would be warranted in this population. Increasing the amount of iodine in salt seems not to be a reasonable method to achieve this because of the large number of urine samples that have adequate or excessive concentrations of iodine and previous reports that a high intake can increase the risk of side effects. Supplementation of individual infants using potassium iodine or iodine-including multivitamin preparations may be considered<sup>11</sup>.

In conclusion, the findings of this study call for further attention to iodine intake during pregnancy and lactation. The currently recommended intake of iodine through universal salt iodisation may not be adequate for pregnant and lactating women, and supplementation during pregnancy and lactation should be further considered in the lights of the latest recommendations<sup>12</sup>.

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**Fig. 1** Scatter plot of concentration of iodine ( $\mu\text{g l}^{-1}$ ) in paired urine and breast milk samples from 100 lactating women in Gorgan, Iran in 2003 and linear regression line ( $r = 0.44$ ,  $P < 0.001$ ).

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