



Urinary and Milk Iodine Status in Neonates and Their Mothers during Congenital Hypothyroidism Screening Program in Eastern Azerbaijan: A Pilot Study

Majid MOBASSERI¹, Neda ROSHANRAVAN², Naimeh MESRI ALAMDARI²,
Alireza OSTADRAHIMI², Mohammad ASGHARI JAFARABADI³, Farideh ANARI⁴,
* Mehdi HEDAYATI⁵

1. Bone Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

2. Nutrition Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

3. Road Traffic Injury Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

4. Rouh Zنده Health and Therapeutic Center 2, Shabestar, Iran

5. Cellular and Molecular Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tebran, Iran

*Corresponding Author: Email: hedayati@endocrine.ac.ir

(Received 21 Mar 2014; accepted 15 Aug 2014)

Abstract

Background: Iodine is essential element in thyroid hormones synthesis and normal growth and development of the brain. Milk and iodine concentrations can be appropriate indicator of body iodine status; in this study, we evaluated the concentrations of urine and milk iodine in newborns and their mothers.

Methods: In a cross-sectional study conducted in 2013, urine and milk iodine in 106 neonates and their mothers referred to healthcare center in Shabestar, Eastern Azerbaijan for congenital hypothyroidism screening program were determined. Median urinary iodine < 100 µg/L and milk iodine < 50 µg/L was considered as iodine deficiency.

Results: The median urine iodine concentrations (UIC) in mothers and infants were 142.31 µg/L (.0 - 1260) and 306.76 µg/L (23.56-1020) respectively. Urine iodine concentrations were < 100 µg/L in 33.9% of mothers and 14.2% of neonates. The median milk iodine concentration (MIC) was 58.23 µg/L (20.31- 425) and in 41.9% of mothers was <50 µg/L. A positive significant correlation was found between milk iodine and maternal urinary iodine concentration ($r=0.533$, $P= 0.000$). There was significant correlation between neonatal UIC and maternal UIC ($r=0.462$, $P= 0.000$), neonatal UIC and MIC ($r=0.414$, $P= 0.000$).

Conclusions: Urinary and milk iodine concentrations in mothers and infants were within acceptable range, which indicates adequate iodine intake. However, there were moderate and marginal iodine deficiencies in about half percentage of participants. Insufficient amount of milk iodine in about half of the mothers can result in iodine deficiency in breast-fed infants.

Keywords: Iodine, Milk, Urine, Congenital hypothyroidism, Iodine deficiency

Introduction

Iodine as an essential trace element is important in the synthesis of thyroid hormones and normal brain growth and development and reproduction (1). Proper cerebral development and most other

tissues in embryonic and early childhood are dependent on adequate level of thyroid hormones. Impaired thyroid hormone synthesis can result in irreversible neurological complications, especially

in the early stages of infancy. Iodine deficiency affects thyroid gland functions and hormones synthesis (2).

Thyroid hormone deficiency at birth is most commonly cause of preventable mental retardation (3). Incidence of disease is one per 3000-4000 live births in the world (4). According to the reports of CH screening in Iran incidence rate is 1:914 in Tehran (5), 1:370 in Isfahan (6), 1:1433 in Fars (7) and 1:600 in Eastern Azerbaijan.

Although iodine deficiency has already been resolved with effective iodized salt programs and WHO has reported Iran as iodine sufficient areas, but the high incidence of congenital hypothyroidism in some areas of the country necessitate revising iodine statues and its association with the incidence of hypothyroidism (5,6). The International Council for the Control of Iodine Deficiency Disorders (ICCIDD) recommends urinary iodine concentration as a suitable marker of iodine statues (8). Moreover, milk iodine is used for determination of iodine deficiency and iodine status of breast-fed infants depends largely on milk iodine (9).

There have been studies in various parts of Iran, which have indicated that urine, and milk iodine concentrations are within the acceptable range (10,11), but in Eastern Azerbaijan at the time of CH screening, the statues of iodine in newborns and their mothers had not been studied. Since the early detection and elimination of iodine deficiency in infancy can prevents subsequent irreversible complications.

The aim of this study was to determine the urine and milk iodine concentrations in neonates and their mothers.

Materials and Methods

The present cross - sectional study was performed among subjects referred to centralized health care center in Shabestar at Eastern Azerbaijan Province during April to September 2012. Neonates between two and five days of age and their mothers attended for CH screening program included in the study. Mothers with a history of taking iodine-containing drugs or thyroid affecting medica-

tions, thyroid disorder, preterm infants (<37 weeks gestation), infants consuming formulas and unwillingness to cooperate in the study was excluded. One hundred fifteen neonates and their mothers based on inclusion and exclusion criteria's by a simple sampling method were selected.

Written informed consent was obtained from all participants. Permission was obtained from the Ethics Committee of Tabriz University of Medical Science.

To determine urinary and milk iodine concentrations, 2-3 ml spot urine and milk samples were taken from newborns. Urine and milk samples were also collected from mothers of newborns. TSH levels was determined based on national screening program for congenital hypothyroidism using whole blood from a heel-prick collected on special filter paper cards. Urine and milk samples were collected in gamma tubes (sterile disposable tubes) and were kept at -20 °C until the time of measurements. After acid digestion of urine and alkaline incineration of milk samples, iodine concentrations were determined by the Sandell-Kolthoff method. Lower, mid and upper ranges of UIC and MIC for neonates and lactating mothers was considered based on the recommendations of the WHO, UNICEF, ICCIDD (8, 12). UIC < 100 µg/L and MIC < 50 µg/L was considered as iodine deficiency respectively.

Statistical analysis

All statistical analyses were performed using (SPSS ver.16 Inc, IL, and Chicago, USA). Normality of data was assessed by Kolmogorov-Smirnov test. As some variables have non-normal distribution, reported as median (min-max). Qualitative data was reported as frequency (percent). In order to determine any correlation among infant TSH, MIC and UIC Spearman correlation (for non-normal data) test was used. $P < 0.05$ was considered as significant.

Results

In this study, from the 115 selected neonates and mothers according to inclusion and exclusion criteria's, 106 subjects participated in the study. Six

cases were excluded due to diagnosis of congenital hypothyroidism and starting treatment process and 3 of cases were unwilling to cooperate. Mean maternal age were 26.2 ± 6.1 years and 61.3% of them were in age range of 20 -30 years. Characteristics and laboratory data of subjects are presented in Table 1.

In 85.8% of neonates, median UIC was ≥ 100 $\mu\text{g/L}$ and in 14.2% of newborns, UIC was ≤ 100 $\mu\text{g/L}$. In 45.3% of mothers UIC was in normal range (100-199 $\mu\text{g/L}$) and severe, mild and marginal iodine deficiencies were seen in 33.9% of

mothers. MIC was < 50 $\mu\text{g/L}$ in about 41.9% of mothers.

According to the Spearman test, there was significantly strong positive correlation between MIC and maternal UIC. ($r = 0.533$, $P = 0.000$)

There were significantly moderate positive correlation between neonate UIC and maternal UIC ($r = 0.462$, $P = 0.000$) and between neonate UIC and MIC ($r = 0.414$, $P = 0.000$)

UIC did not correlate with whole blood TSH in newborns. ($r = -0.167$, $P = 0.04$)

Table1: Anthropometric and laboratory data

Anthropometric data	(min- max)	Median
Birth Weight (g)	(2500-4000)	2954
Birth Height (cm)	(46- 51)	49
Whole blood TSH (mIU/L)	(0.10- 175)	1.20
Urinary iodine of newborn ($\mu\text{g/L}$)	(23.56-1020)	306.76
Urinary iodine of mother ($\mu\text{g/L}$)	(.00- 1260)	142.31
Milk iodine of mother ($\mu\text{g/L}$)	(20.31-425)	58.23

Discussion

In this study, concentrations of urinary and milk iodine in newborns and their mothers during CH screening program in Eastern Azerbaijan (Shabestar) was studied. The findings of our study indicated that the median of UIC and MIC was within the acceptable range. Since ICCIDD recommends UIC ≥ 100 $\mu\text{g/L}$ as the indicator of adequate iodine in the population, according to our results neonates and their mothers in this study did not have severe iodine deficiency, although some degrees of mild and marginal deficiency diagnosed.

The median breast milk iodine level in 37 U.S women was 178 $\mu\text{g/L}$ (13) and 155 $\mu\text{g/L}$ in another study in Australia (14). In our study MIC was too lower (58.23 $\mu\text{g/L}$) than mentioned studies and previously done studies in Iran which were 93.5 $\mu\text{g/L}$ in Bazrafshan et al. (11) investigation. This may be because unlike the other studies, we considered only one sample from each subject and different biochemical, clinical and epidemiological

methods have been applied especially for iodine measurement.

Various studies in different regions of Iran show that UIC and MIC in pregnant and lactating women and newborns after the salt iodization program are adequate (11, 15). However, NHANES study and one study in china reports that, despite an effective iodized salt program, pregnant and lactating women in some areas may still risk deficiency and need supplementation (16, 17). According to classifications of WHO UIC ≥ 200 $\mu\text{g/L}$ are considered as iodine excess, so more than half of neonates (63.2%) and about 20.7% of mothers in this study indicated iodine excess. These findings are consistent with other studies carried out in Tehran and Isfahan (1, 15).

In the study of Bazrafshan et al. (11), maternal UIC ≤ 100 $\mu\text{g/L}$ and MIC < 50 $\mu\text{g/L}$ was presented in 16% and 19% of studied population, respectively but in our study was 33.9% and 41.9%, which indicated that iodine statues especially in milk samples were much lower than previous studies done in Iran. The proportion of different neonatal UIC ranges was almost similar to

those seen in Hashemipour et al. study (1). The difference between our results and other studies in Iran may be due to applying different classifications of iodine statuses. Despite increasing numbers of studies examining UIC and MIC, no consistent recommendations have been made for optimal levels of iodine especially in breast milk and urine in infants, pregnant and lactating women (9). In this study, there was significantly positive correlation between maternal UIC and MIC, which was in accordance with the study of Bazrafshan et al. (11). It suggests the hypothesis that appropriate maternal iodine statuses can provide adequate iodine intake in infants via breast milk. There was no correlation between neonatal whole blood TSH and UIC, which was in accordance with the study of Ordoorkhani et al. (15), and Hashemipour et al. (1). Therefore, it does not seem that increased or decreased levels of urinary iodine result in congenital hypothyroidism. However, in the study of Nishihama et al. (18) positive association identified between TSH and UIC levels. A reason for these differences is using whole blood TSH instead of serum TSH. In addition, UIC in spot urine samples are not a good indicator of neonatal thyroid function, which we used it. There were positively strong correlations between neonatal UIC and MIC neonatal UIC and maternal UIC, which demonstrates, iodine status of breast-fed infants largely depend on breast milk iodine content.

To our knowledge, it was the first investigation that assessed the iodine levels of urine and milk in neonates and their mothers during CH screening program in Eastern Azerbaijan province in Iran.

Not measurements of serum levels of TSH and T_4 as indicator of neonatal thyroid function and application of spot urine samples and using convenient sampling method, which inhibit generalizing our findings, were limitations of our study. Therefore, we recommended further studies with larger sample size, using 24-hour urine samples to determine iodine concentrations and assessing serum TSH and T_4 to draw any conclusion about iodine status in populations.

Conclusion

Our findings demonstrate that concentration of urinary iodine in neonates and mothers are nearly within acceptable range. However low levels of milk iodine in our study Compared to other populations, will expose breast-fed infants at risk of iodine deficiency. Therefore, intake of iodine through iodized multivitamins in mothers can help overcome the problem.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgments

This study was supported by a research grant from the Bone Research Center, Tabriz university of Medical Sciences. The authors are indebted to kind of collaboration of several endocrinologists. They express their gratitude to the staff of Endocrine Research Center, Shahid Beheshti University of Medical Sciences for their technical assistance in measurement of iodine. The authors thank study participants for their cooperation and the Rouh Zende 2 health care center staff, including Mrs. Talebi, Mrs. Nezafati for their assistance in gathering data. The authors declare that there is no conflict of interests.

References

1. Hashemipour M, Nasri P, Hovsepian S, Hadian R, Heidari K, Attar HM, et al. (2010) . Urine and milk iodine concentrations in healthy and congenitally hypothyroid neonates and their mothers. *Endokrynol Pol*, 61(4): 371-6.
2. Kostoglou-Athanassiou I, Ntalles K. Hypothyroidism-new aspects of an old disease (2010). *Hippokratia*, 14(2):82.
3. Park S, Chatterjee V (2005). Genetics of congenital hypothyroidism. *J Med Genet*, 42 (5):379-89.

4. Simpser T, Rapaport R (2010). Update on some aspects of neonatal thyroid disease. *J Clin Res Pediatr Endocrinol*, 2(3):95.
5. Ordookhani A, MIRMIRAN P, Hedayati S, Hajipour R, Azizi F (2002). Screening for congenital hypothyroidism in Tehran and Damavand: an interim report on descriptive and etiologic findings, 1998-2001. *IJEM*, 13(2):24-7.
6. Hashemipour M, Amini M, Iranpour R, Sadri GH, Javaheri N, Haghghi S, et al. (2004). Prevalence of congenital hypothyroidism in Isfahan, Iran: results of a survey on 20,000 neonates. *Horm Res Paediatr*, 62(2):79-83.
7. Karamizadeh Z, Amirhakimi G (1992). Incidence of congenital hypothyroidism in Fars Province, Iran. *Iran J Med Sci*, 17(1-2):78-80.
8. Anonymous (2001). Assessment of the iodine deficiency disorders and monitoring their elimination. WHO, Geneva .Available from: www.who.int.
9. Semba RD, Delange F (2001). Iodine in human milk: perspectives for infant health. *NUTR REV*, 59(8):269-78.
10. Azizi F, Aminorroya A, Hedayati M, Rezvanian H, Amini M, Mirmiran P (2003). Urinary iodine excretion in pregnant women residing in areas with adequate iodine intake. *Public Health Nutr*, 6(1):95-100.
11. Bazrafshan HR, Mohammadian S, Ordoookhani A, Abedini A, Davoudy R, Pearce EN, et al (2005). An assessment of urinary and breast milk iodine concentrations in lactating mothers from Gorgan, Iran, 2003. *Thyroid*, 15(10):1165-8.
12. Anonymous (2001). Assessment of iodine deficiency disorders and monitoring their elimination. A guide for programme managers. WHO, Geneva .Available from: www.who.int
13. Gushurst CA, Mueller JA, Green JA, Sedor F (1984). Breast milk iodide: reassessment in the 1980s. *Pediatrics*, 73(3):354-7.
14. Pearce EN, Leung AM, Blount BC, Bazrafshan HR, He X, Pino S, et al. (2007). Breast milk iodine and perchlorate concentrations in lactating Boston-area women. *JCEM*, 92(5):1673-7.
15. Ordoookhani A, Pearce EN, Hedayati M, Mirmiran P, Salimi S, Azizi F, et al. (2007). Assessment of thyroid function and urinary and breast milk iodine concentrations in healthy newborns and their mothers in Tehran. *Clinical endocrinology*, 67(2):175-9.
16. Caldwell KL, Makhmudov A, Ely E, Jones RL, Wang RY (2011). Iodine status of the US population, National Health and Nutrition Examination Survey, 2005–2006 and 2007–2008. *Thyroid*, 21(4):419-17.
17. Yan YQ, Chen Z-P, Yang XM, Liu H, Zhang J, Zhong W, et al. (2005). Attention to the hiding iodine deficiency in pregnant and lactating women after universal salt iodization: A multi-community study in China. *J Endocrinol Invest*, 28(6):547.
18. Nishiyama S, Mikeda T, Okada T, Nakamura K, Kotani T, Hishinuma A (2004). Transient hypothyroidism or persistent hyperthyrotropinemia in neonates born to mothers with excessive iodine intake. *Thyroid*, 14(12):1077-83.