Urinary Iodine Excretion as a Predictor of the Iodine Content of Breast Milk

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Abstract

Endemic goitre has re-emerged in Thailand. This is particularly dangerous for children since iodine deficiency disorders (IDDs) might negatively influence their intellectual and mental development. In order to assess the situation, the iodine content of breast milk was determined and a method is proposed on how to monitor IDDs in lactating mothers later on. Seventy-five lactating women aged from 15 to 45 years, from 12 villages of 3 districts, namely Chumpae, Srichompu and Pupaman within the mountainous areas of Khon Kaen province, Northeast of Thailand were investigated. The breast milk from 46.7 per cent of mothers was found to be below recommended standards. In addition, 52.0 per cent of the women investigated had low urinary iodine excretion. The risk of women with low iodine excretion was 15 fold higher in comparison to women with sufficient iodine excretion to provide breast milk for their babies with insufficient iodine content. It is concluded that urinary iodine excretion can be used to monitor the IDDs in lactating mothers.

Key word : Urine Iodine, Breast Milk, IDDs, Northeast Thailand

Endemic goitre has been controlled in North Thailand since 1967 through the introduction of iodinated salt[1,2]. Since then iodine deficiency disorders (IDDs) have been of concern for public health workers in other parts of Thailand as well. But IDDs have re-emerged as a health problem in

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Thailand even in those areas formerly under control probably due to maldistribution of iodinated salt[2]. The prevalence of endemic goitre in three districts of Khon Kaen province i.e., Chumpae, Srichompu and Pupaman were determined recently[3]. A baseline survey undertaken in 12 villages of these 3 districts estimated the prevalence of goitre among women of child bearing age to be 35.1, 58.4 and 71.6 per cent respectively[3]. Iodine deficiency is known to negatively affect especially the intellectual development of children[4]. To meet iodine requirements, therefore, should be of major concern. This investigation aimed to investigate iodine concentration in breast milk of lactating women in order to obtain more information about iodine concentration in breast milk of lactating mothers in the Northeast of Thailand and the possibility of predicting iodine concentration in breast milk by measuring urinary iodine excretion.

MATERIAL AND METHOD

Seventy-five lactating women aged from 15 to 45 years, from 12 villages of 3 districts, namely Chumpae, Srichompu and Pupaman within the mountainous areas of Khon Kaen province, Northeast of Thailand were investigated. Villages were selected through a proportional random selection process and all lactating women in the villages were asked to co-operate. Almost all lactating women, who at the time of the investigation were living in the villages co-operated. The ages of the mothers and their children were assessed by questionnaires. The socio-economic status and lifestyle pattern of the females has been described elsewhere.

Laboratory analysis

Urine samples and breast milk were collected in the morning from all subjects under investigation on the same day. Twenty-ml aliquots of urine samples were kept in a cool box upon collection and frozen within 18 hours and subsequently stored at -20°C. Urinary iodine concentrations were measured using acid digestion, a method recommended by WHO/ICCIDD/UNICEF[5,6]. Breast milk was diluted with deionized water and also determined for iodine concentration using the same method mentioned above[6].

Data analysis

Routine statistical methods were applied for data analysis. Medians and the achieved 95 per cent Confidence Interval (C.I.) were calculated by using the Minitab statistical software program[7]. The difference between the medians of groups was tested by the Mann-Whitney U-Wilcoxon Rank Sum test. For comparison of proportion the conventional Chi-square test was used. The Chi-square test and the odds-ratio together with the 95 per cent C.I. were calculated by the Epi-info software program[8].

When using urinary iodine excretion as an indicator for IDDs the following cut-off points according to the recommendation of WHO/ICCIDD were used[5] : severe <2.0 μg/ml; moderate 2.0-4.9 μg/ml; mild 5.0 - 9.9 μg/ml. The concentration of iodine in breast milk is supposed to be 6.4 to 17.8 μg/ 100 ml[9]. Therefore, the cut-off point for suboptimal iodine breast milk concentration was considered to be < 6.4 μg/100 ml[10].

RESULTS

The median age of mothers from the three districts, age of children, iodine concentration in breast milk and urinary iodine of the mothers are shown in Table 1. No statistically significant difference for the age of mothers and age of children as well as urinary iodine concentration was observed between the three districts. However, iodine in breast milk of mothers from Chumpae district was significantly lower compared to the other two districts. The prevalence of iodine deficiency disorders in the three districts was assessed by determining urinary iodine concentration as recommended by WHO/ICCIDD[7]. The results are shown in Table 2. The prevalence of iodine deficiency disorders in the Chumpae and Srichompu district was higher in comparison to Pupaman. The relationship between urinary iodine concentration as an independent variable and iodine concentration in breast milk as a dependent variable was plotted as shown in Fig. 1. A significant correlation between both variables was determined.

Table 3 shows the number of individuals with and without normal iodine concentration in urine and in breast milk. Women with a subnormal urinary iodine excretion also had a high risk of producing breast milk with an insufficient iodine content (OR = 15.48; C.I. 3.98 - 65.88).

DISCUSSION

Low urinary iodine excretion for lactating women can be taken as a clear indicator that their breast milk will also have a low iodine content

Table 1. Medians and ranges of age, iodine in milk and urinary iodine in the mothers from 3 districts of the Khon Kaen Province.

Parameter	Chumpae (N = 30)	Srichompu (N = 38)	Pupaman (N = 7)	Total (N = 75)	p-value
Age of Mother (years)	23.8 (16.0-36.0)	27.0 (17.0-44.0)	24.6 (17.0-28.0)	25.0 (16.0-44.0)	0.254
Age of Children (days)	240.0 (14.0-730.0)	220.0 (13.0-820.0)	240.0 (20.0-365.0)	233.3 (13.0-820.0)	0.664
Iodine in Mother's Milk (μg/100 g milk)	4.5 (0.0-80.0)	6.8 (0.0-26.0)	4.9 (1.80-7.80)	5.1 (0.0-80.0)	0.018
Urinary Iodine (μg/dL)	8.5 (0.0-37.0)	10.6 (1.7-41.0)	12.0 (5.0-19.4)	9.0 (0.0-41.0)	0.233

Table 2. Prevalence of iodine deficiency disorders using urinary iodine as the indicator as recommended by WHO/ICCIDD (1990).

Parameter	Chumpae (N = 30)	Srichompu (N = 38)	Pupaman (N = 7)	Total (N = 75)
Severe (urinary iodine <2.0 μg/dL)	3/30 (10.0%)	2/38 (5.3%)	-	5/75 (6.7%)
Moderate (urinary iodine 2.0-4.9 μg/dL)	1/30 (3.3%)	8/38 (21.0%)	-	9/75 (12.0%)
Mild (urinary iodine 5.0-9.9 μg/dL)	16/30 (53.3%)	7/38 (18.4%)	2/7 (28.6%)	25/75 (33.3%)
Normal (urinary iodine ≥ 10.0 μg/dL)	10/30 (33.3%)	21/38 (55.3%)	5/7 (71.4%)	36/75 (48.0%)

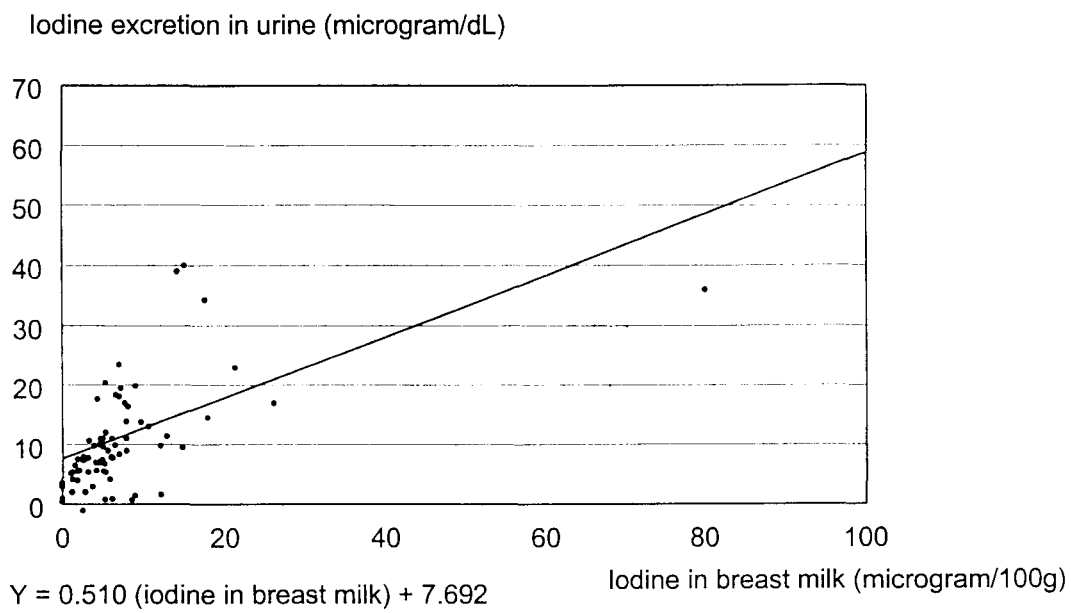

Fig. 1. Relation of urinary iodine to iodine concentration of breast milk.

Table 3. Number of individual with normal and sub-normal urinary iodine excretion in relation to adequate and inadequate concentration of iodine in breast milk.

Urinary iodine concentration	Iodine concentration in breast milk		Total
	<6.4 µg/100g milk	≥6.4 µg/100g milk	
< 10 µg/dL	35	4	39
≥ 10 µg/dL	13	23	36
Total	48	27	75

Chi-square = 23.37, p-value < 0.000
Odd ratio = 15.48, 95% C.I. 3.98-65.88

which will most probably not meet the iodine requirements of their babies. If the child has exclusively depended on iodine from the mother's milk, then the supply will most probably be insufficient especially for one of the districts, Chumpae, where the average iodine content of breast milk of 4.5 µg/100 g milk, was quite low. This corresponds with their urinary iodine excretion, which was also the lowest among the three districts investigated here. The prevalence of goitre as reported recently(3), however, did not correspond with the findings here, i.e., Chumpae had the lowest goitre rate of 35.1 per cent and Pupaman with the highest rate of 71.6 per cent. The goitre rate therefore cannot be taken as indicator for a sufficient or insufficient iodine content in the milk of lactating mothers but urinary iodine excretion could be used as such. A lactating mother with a low iodine excretion has a 15-fold risk above a lactating female with normal urinary iodine excretion, thus the iodine content of her breast milk will not be sufficient to assure the normal development of her child. Surprisingly, IDDs in infants and babies in the same area were found to be not as high as expected(11). This probably is due to the fact that mothers in this area tend to give supplementary feeding quite early after birth to their children. Probably the food used for supplementary feeding contributes to meet the requirements for iodine. Since it is the aim to feed infants at least within their first 4 to 6 months exclusively with mothers milk, it is desirable to assure that lactating mothers have the adequate iodine status. Therefore, it is desirable to closely monitor the areas prone to IDDs, the iodine status of lactating mothers and take immediate action if the situation proves to be insufficient by administering fortified salt or other essential food items such as fish sauce in the areas under investigation(12-13). Monitoring by estimating the goitre rate is insufficient and to collect breast milk on a more regular basis might be tedious and collaboration of lactating mothers might vanish over time. Thus, the collection of urine for the determination of iodine excretion seems to be the best and most feasible way of monitoring IDD in vulnerable areas.

SUMMARY

In this study, the iodine content of breast milk was found to be correlated with urine iodine excretion. Women with a subnormal urinary iodine excretion also had a high risk of producing breast milk with insufficient iodine content. Therefore, urinary iodine excretion can be used to monitor the IDDs in lactating mothers.

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ปริมาณสารไอโอดีนในปัสสาวะเป็นตัวคาดคะเนถึงปริมาณสารไอโอดีนในน้ำนมแม่

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โรคคอพอกได้กลับมาระบาดอีกในประเทศไทย การระบาดของโรคคอพอกเป็นอันตรายมากสำหรับเด็ก เพราะภาวะการขาดสารไอโอดีนจะมีผลโดยตรงต่อการพัฒนาทั้งทางด้านสมองและด้านจิตใจ คณะผู้วิจัยได้ทำการติดตามประเมินสถานการณ์การขาดสารไอโอดีนโดยใช้วิธีการตรวจวัดปริมาณไอโอดีนในน้ำนมแม่ที่เลี้ยงลูกด้วยนม จำนวน 75 คน อายุระหว่าง 15 ถึง 45 ปี และอาศัยอยู่ในพื้นที่ 3 อำเภอ คือ อำเภอ ชุมแพ สีชมพู และภูผาม่าน ซึ่งเป็นพื้นที่บริเวณภูเขาของจังหวัดขอนแก่นในภาคตะวันออกเฉียงเหนือของประเทศ ปรากฏว่าปริมาณไอโอดีนในน้ำนมแม่ร้อยละ 46.7 ต่ำกว่าเกณฑ์มาตรฐาน นอกจากนั้นแม่ร้อยละ 52.0 มีปริมาณไอโอดีนที่ขับถ่ายออกมาในปัสสาวะต่ำ ผู้หญิงที่มีปริมาณไอโอดีนในปัสสาวะต่ำจะมีอัตราเสี่ยงต่อการมีปริมาณไอโอดีนในน้ำนมต่ำด้วย สูงกว่าผู้หญิงที่มีปริมาณไอโอดีนในปัสสาวะอยู่ในเกณฑ์ปกติถึง 15 เท่า จึงอาจสรุปได้ว่า ปริมาณไอโอดีนในปัสสาวะสามารถที่จะใช้ในการติดตามภาวะการขาดสารไอโอดีนในมารดาที่เลี้ยงลูกด้วยนมได้ด้วย

คำสำคัญ : ไอโอดีนในปัสสาวะ, นมแม่, ภาวะขาดสารไอโอดีน, ภาคตะวันออกเฉียงเหนือของประเทศไทย

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