Thai Journal of Obstetrics and Gynaecology
September 2017, Vol. 25, pp.175-181

OBSTETRICS

Evaluation Iodine Status and Factors Associated with Low Urinary Iodine Level among Pregnant Women Who Received Iodine Supplementation during Pregnancy

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ABSTRACT

Objectives: To assess iodine status and factors associated with low urinary iodine level in women who received iodine supplementation during pregnancy.

Materials and Methods: A prospective cross sectional study in term pregnant women admitted to labor room, Srinagarind Hospital, Khon Kaen University was implemented during May 2014 to December 2015. All 245 recruited women after completing the questionnaire for evaluating their knowledge, attitude and practice (KAP) of iodine consumption were asked to collect urine 5 - 10 ml. to assess urine iodine level. The information from their medical records was used to assess their obstetric history and medications during pregnancy. The good KAP was defined as six or higher from the full ten score. The urine iodine (UI) level <150 µg/L was categorized as low level. The microplate method was used to assess urine iodine levels by certified laboratory at Regional Health Promotion Center 7 Khon Kaen, Department of Health, Ministry of Public Health.

Results: Almost all of women received daily iodine supplementation tablets, only 6 received iodized oil. Their median UI level was 182 µg/L and 35.5% had low UI level. Their mean KAP score was 4.9 (SD=1.9). There were 39.6% women with good KAP. The daily tablet of iodine supplementation side-effect was the only significant factor associated with low UI levels.

Conclusion: Though the findings demonstrated the adequate median urine iodine level in pregnant women with the iodine supplementation, a substantial proportion of them still had low urine iodine level and need additional intervention.

Keywords: Iodine deficiency, iodine supplementation during pregnancy

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การประเมินระดับไอโอดีนและปัจจัยที่เกี่ยวข้องกับการมีไอโอดีนในปัสสาวะต่ำของสตรีตั้งครรภ์ที่ได้รับการเสริมไอโอดีน

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บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาระดับไอโอดีนในปัสสาวะ และปัจจัยที่เกี่ยวข้องกับการมีระดับไอโอดีนต่ำในปัสสาวะของสตรีตั้งครรภ์ที่ได้รับการเสริมไอโอดีน*

วัสดุและวิธีการ: *ศึกษาโดยการเก็บข้อมูลระหว่าง พฤษภาคม 2557 ถึง ธันวาคม 2558 ในสตรีตั้งครรภ์ครบกำหนดที่มาคลอดที่โรงพยาบาลศรีนครินทร์ จำนวน 245 คน ที่ตอบแบบสอบถามเกี่ยวกับความรู้ ทัศนคติ พฤติกรรม เกี่ยวกับการบริโภคไอโอดีน และเก็บปัสสาวะ 5-10 มิลลิลิตร เพื่อตรวจวัดระดับไอโอดีน จากนั้นเก็บข้อมูลจากเวชระเบียนเพื่อประเมินการตั้งครรภ์และการเสริมไอโอดีนที่ได้รับระหว่างตั้งครรภ์ หากคะแนนที่ได้จากการตอบแบบสอบถาม ≥ 6/10 จะถือว่ามีความรู้ ทัศนคติ พฤติกรรมเกี่ยวกับการบริโภคไอโอดีนอยู่ในเกณฑ์ดี และหากระดับไอโอดีนในปัสสาวะ น้อยกว่า 150 ไมโครกรัมต่อลิตร จะประเมินว่ามีการขาดไอโอดีน โดยใช้การตรวจวัดระดับไอโอดีนด้วยวิธีไมโครเพลท ที่ห้องปฏิบัติการของศูนย์ส่งเสริมสุขภาพเขต 7 กรมการอนามัย กระทรวงสาธารณสุข*

ผลการศึกษา: *สตรีตั้งครรภ์ส่วนใหญ่ได้รับการเสริมไอโอดีนด้วยเม็ดยารับประทานวันละครั้ง มีเพียง 6 คน ที่ได้รับเม็ดยาน้ำมันไอโอดีน ซึ่งมีค่ามัธยฐานของไอโอดีนในปัสสาวะเท่ากับ 182 ไมโครกรัมต่อลิตร และมีสตรีตั้งครรภ์ ร้อยละ 35.5 ที่มีค่าปริมาณไอโอดีนอยู่ในระดับต่ำ ส่วนการประเมินความรู้ ทัศนคติ และพฤติกรรมการบริโภคที่เกี่ยวข้องกับการได้รับไอโอดีน มีค่าคะแนนเฉลี่ยอยู่ที่ 4.9 (ค่าเบี่ยงเบนมาตรฐาน = 1.9) ร้อยละ 39.6 มีคะแนนเฉลี่ยอยู่ในเกณฑ์ดี และพบว่าปัจจัยที่เกี่ยวข้องกับการขาดไอโอดีน ที่มีนัยสำคัญคือผลข้างเคียงของเม็ดยาเสริมไอโอดีน*

สรุป: *แม้ว่าจากผลการศึกษานี้ จะแสดงให้เห็นถึงค่ามัธยฐานของไอโอดีนในปัสสาวะของสตรีตั้งครรภ์อยู่ในระดับที่พอเพียง แต่ยังมีสตรีตั้งครรภ์อีกจำนวนไม่น้อยที่ยังมีไอโอดีนในปัสสาวะอยู่ในระดับต่ำ และยังต้องการมาตรการอื่นมาเสริม*

คำสำคัญ: *การขาดไอโอดีน, การเสริมไอ,โอดีนระหว่างการตั้งครรภ์*

Introduction

Iodine is an important micronutrient needed for the production of thyroid hormones that have many functions in the body, all of which are essential for optimal physical and mental development. Iodine deficiency (ID) causes a broad range of adverse effects on health when diet contains insufficient iodine and the thyroid glands cannot produce enough hormones to satisfy the body's needs. Consequences of iodine deficiency are most prominent in pregnant women and their fetuses, including goiter, cretinism, increasing risk of abortion, growth restriction, neonatal hypothyroidism and infant mortality[1, 2]. Since thyroid hormones are required for neuronal migration and myelination of the fetal brain, lack of iodine might cause irreversibly impaired brain[2]. A study showed that it is important to have adequate iodine intake during early gestation since the risk of iodine deficiency can pose to the developing infant, even in a country classified as mild iodine deficient[3]. It was estimated that iodine deficiency disorders (IDD) in a population lowered mean IQ score by 13.5 point[4]. Iodine deficiency is considered to be the single most important preventable cause of brain damage[5].

The insufficient iodine in Thai daily diet causing IDD, has been recognized as a serious public health problem in Thailand for decades. The long-term iodine deficiency, especially on the worrying decline in the intelligence quotient (IQ) levels of Thai children was considered to be associated with poor school performance, reduced intellectual ability, impaired work capacity and lower productivity in adults throughout life. Less than 50% of pregnant women in Thailand had adequate urine iodine level, according to a Ministry of Public Health survey in 2006-2009[6].

Since the establishment of the National IDD Control Board in 1994, a number of initiatives and projects have been carried out to eliminate IDD in the country and certain progress has been made. Three main measures are universal salt iodization (USI), iodized oil capsules and water iodization. An external review conducted by the International Council for Control of Iodine Deficiency Disorders (ICCIDD) in 2009, indicated the failure to achieve USI. Furthermore suboptimal iodine nutrition revealed in 60-70% of pregnant women in Thailand[7]. In 2010, Thailand by the Ministry of Public Health and UN Country Team Hosted a seminar in Bangkok that brought together representatives from Royal Thai Government, private sector, salt associations, United Nations agencies and other relevant experts. The consensus modalities for the sustainable elimination of IDD in the country arising from the seminar included the policy implementation to reduce iodine deficiency, operationalization of the IDD Elimination Program, regulations, and strengthening partnerships with relevant stakeholders. USI with enforceable legislation is highly recommended as a sustainable basis to eliminate IDD in Thailand. Along with USI, other measures such as multi-vitamin supplementation with iodine to vulnerable and high risk groups, including pregnant women and children in provinces with severe problems of IDD[8].

Iodine supplementation by iodized oil was recommended as an alternative method where universal salt iodization program will not reach women of reproductive age within 1-2 years[9]. The Government Pharmaceutical Organization (GPO), a state enterprise under the Ministry of Public Health was assigned to produce and distribute iodine supplementation tablets in two preparations, a fixed-dose combination of the three nutrients (folic acid, iodine and iron: Triferdine®) for the target population and potassium iodide in a single tablet for thalassemic pregnant women. Maternal iodine supplementation program was inaugurated nationwide since October 2010[10], while salt iodization is still not sustained in Thailand from the last survey in 2013[11]. So we planned to assess the low urine iodine status as the primary objective and the secondary objective was to assess the factors associated with low iodine levels among term pregnant women at Srinagarind Hospital following the iodine supplementation policy implemented.

Materials and Methods

Pregnant women who were admitted to the labor room after 37 weeks of gestational age at Srinagarind

Hospital, a tertiary care center in the northeast of Thailand, were approached to participate in the study. After having been informed and written consent obtained, the information were retrieved from their medical records regarding the current pregnancy status and types of iodine supplementation as well as its adverse effects during antenatal care. They were also asked to complete the questionnaire related to knowledge, attitude and practice (KAP) of iodine consumption such as if they know the effects of iodine deficiency, how to find the source of iodized salt, how they cook and how they like the taste of cooked meal with iodized salt. We assessed their KAP from questionnaire composed of 10 questions regarding to the effects of iodine deficiency, how to access iodized salt and the behavior that ensure adequate iodine consumption. The good KAP was defined as score of six or higher from a full ten score, otherwise was poor. They were also asked for 5-10 ml. of urine collection in plastic bottle to assess urine iodine level. The urine iodine (UI) levels (microgram per liter: µg/L) was used to categorize the iodine intake of pregnant women as the followings: inadequate (< 150 µg/L), adequate (150-249 µg/L), more than adequate (250-499 µg/L), and no added health benefit expected (≥ 500 µg/L). These are based on the Technical Consultation proposed to increase the current FAO/WHO recommended nutrient intake for iodine during pregnancy[12].

The collected urine in tightly sealed with screw top bottles keeping in 4 degree Celcius refrigerator were transferred to the laboratory of Regional Health Promotion Center 7 Khon Kaen, Department of Health, Ministry of Public Health. We used microplate methods to verify urine iodine levels. The urine was digested with ammonium persulfate. Iodide was the catalyst in the reduction of ceric ammonium sulfate (yellow) to the cerous form (colorless), and was detected by the rate of color disappearance (Sandell-Kolthoff reaction). Quality control (QC) of laboratory test was regular examined with internal QC and external QC from Laboratory Center of Bureau of Nutrition which joint in Ensuring the Quality of Urine Iodine Procedure (EQUIP) of Center of Disease Control and Prevention (CDC), USA since 2001.

Sample size estimation was 245, based on the proportion of the iodine deficiency 20% after iodine supplementation during pregnancy, 5% allowance error and 95% confidence level. Statistical methods were used according to type of data including mean, standard deviation, frequency, percentages. Specifically to urine iodine level, the median rather than the mean should be used as the measure of central tendency. Since urinary iodine values from population are usually not normal distributed[5]. Univariate and multivariate logistic regression were used to evaluate factors associated with iodine deficiency and presented as odds ratio and 95% confidence intervals, with $p<0.05$ considered statistically significant.

Results

Between May 2014 and December 2015, 245 term pregnant women who were admitted to the labor room of Srinagarind Hospital, Khon Kaen University were recruited after obtaining informed consent. General characteristics of the recruited women are shown in Table 1. Eighty percent of them live in Khon Kaen Province. Their KAP mean score was 4.99 (SD = 1.95). There were 97 (39.6%) women with good KAP (score at least 6/10). Almost all women received daily iodine supplementation one tablet of Triferdine® (iodine 150 µg/tablet) (119 women) or obiminAZ® (iodine 200 µg/tablet) (120 women), only six women received 2 iodized oil capsules (iodine 200 mg/capsule). None of them received iodized salt prescription during pregnancy. There were 40 of 245 studied women reported of adverse effects including palpitation (2 cases), constipation (1 case), and dizziness (8 cases). Most of the adverse effects were nausea and/or vomiting (29 cases) in women taking daily tablets but not in women who received iodized oil. Mean urine iodine level was 229.8 µg/L (SD = 175.2). Their median UI concentration was 182 µg/L (95%CI: 171, 195) and 35.5% (95%CI: 29.5, 41.5) had inadequate UI level (< 150 µg/L). They were categorized into 4 groups according to their UI levels as shown in Table 2. By univariate analysis, daily tablet of iodine

supplementation side-effect was the only significant factor associated with low UI level. Multivariate analysis to control confounders the result still be the same, as demonstrated in Table 3.

Table 1. Characteristics of women.

General characteristics	Mean (range)	SD
Age (year)	29.2 (13-43)	5.7
Body weight on admission (kg)	68.4 (40-110)	11.1
Parity	1.8 (1-5)	0.9
GA at first ANC visit (weeks)	10.4 (4-30)	4.8
Number of ANC visit	10.9 (5-18)	2.5

Table 2. Distribution of maternal urine iodine concentration.

Categorized group	N (%)	95%CI
Inadequate (UI < 150 µg/L)	87 (35.5)	29.5, 41.5
Adequate (UI 150-249 µg/L)	83 (33.9)	27.9, 39.8
More than adequate (UI 250-499 µg/L)	63 (25.7)	20.2, 31.2
No additional benefit expected (UI ≥ 500 µg/L)	12 (4.9)	2.2, 7.6

Table 3. Factors associated with low urine iodine level by univariate and multivariate analyses.

Factors	N	% low UI	Crude OR	95%CI	Adjusted OR	95%CI
Age at pregnancy						
< 20 yrs.	12	45.5	1.51	0.44, 5.14	1.42	0.40, 5.03
20 – 34 yrs.	183	35.5	1	-	1	-
≥ 35 yrs.	50	34.0	0.94	0.48, 1.81	0.79	0.40, 1.56
Parity						
Primiparity	112	35.7	1	-	1	-
Multiparity	133	35.3	0.98	0.58, 1.66	1.04	0.60, 1.79
First visit ANC						
< 20 wks.	229	34.1	0.40	0.14, 1.12	0.45	0.15, 1.29
≥ 20 wks.	16	56.3	1	-	1	-
Side effects of supplementation						
No	205	31.7	1	-	1	-
Yes	40	55.0	2.63	1.32, 5.24	2.59	1.28, 5.26*
KAP score						
< 6	148	36.5	1.11	0.65, 1.91	1.03	0.59, 1.79
≥ 6	97	34.0	1	-	1	-

* statistical significance (p<0.05)

Discussion

Most recruited women received iodine supplementation with daily tablets. Their median UI levels were 182 µg/L, which was satisfactory with WHO recommended nutrient intake for iodine during pregnancy. However, 35% of them had low urine iodine level (<150 µg/L). The only one significant factor associated with inadequate iodine consumption was the side effects of daily tablets supplementation.

Before iodine supplementation during pregnancy was implemented (2010), there were studies in Bangkok during the year 1990 – 1992 and 1999 – 2000, revealed that median UI level in pregnant women were 56 µg/L (n = 341) and 85 µg/L (n = 209), respectively[13]. Another similarly study conducted during the year 2000 – 2003 in 15 provinces of Thailand found that median urinary iodine level in pregnant women was 103 µg/L[14]. The Ministry of Public Health Survey's during 2006 – 2009, the median UI concentration less than 150 µg/L were 71.8%, 61.2%, 58.5% and 59% respectively[6]. A few years after the iodine supplementation during pregnancy policy was implemented, a study conducted between 2012 and 2013, in two tertiary care hospitals (Srinagarind and Khon Kaen Regional Hospital), among 184 pregnant women at the first antenatal care visit had median of dietary iodine intake 185.2 µg/day (assessed by using a semi-quantitative food frequency questionnaire), 58% had iodine intake less than 200 µg/day, their median UI level was 127.7 µg/L and 59% had UI level less than 150 µg/L[15]. This information indicated that iodine deficiency is still prevalent in Thailand. After having iodine supplementation tablets during pregnancy, as in this study that collected the data at term pregnancy, the median UI level was higher (182 µg/L) when compared to the median UI of the previous studies. The findings may indirectly reflect that supplementing iodine during pregnancy with the tablets containing iodine and other micronutrient including iron and folic acid increases urine iodine in pregnant women. However, the side effect of the tablets was the only factor significantly associated with low urine iodine level. We should consider additional management to raise iodine level for this group of pregnant women. Since the common side effects were nausea and vomiting which may relate to iron component of the tablets. Iodized oil or iodized salt may be a better alternative for the women who experience side effects of the combination tablets.

The strength of this study might be that we could be sure the coverage of the supplementation tablets according to all of them received either combination or iodized oil tablets documented in their medical records. However, a limitation is that we did not assess the medication compliance. Since only 16.3% complaint of the tablet side effects, so we cannot conclude that 35% of women who had low urine iodine level due to the side effect of the supplementation tablets alone or due to the medication compliance. Other than that we did not assess the iodine sources from their daily diet. In our study, KAP was not associated with low UI levels (OR = 1.11; 95%CI: 0.65, 1.91). Nonetheless, the KAP score of studied women on the average was low (mean 4.99, SD 1.95). The information from a study related to KAP of iodine intake concluded that a substantial proportion of reproductive age women lack of information about iodine deficiency, though this group of women had a significant role and influence on their children and families on the use of iodized salt[16]. So we should consider that the tablets will be supplement during pregnancy and may extend for a few months in postpartum period, after that their KAP might play role very much on their iodine intake from daily food for their whole lives and also their children.

In pregnant women, iodine supplementation would increase iodine intake in areas of mild iodine deficiency[17] due to there is about 50% increase in iodine requirement (100 µg/day for non-pregnant women to be 250 µg/day for pregnant women) to achieve a dietary intake of 250 µg/day[18]. A study found that iodine supplementation during pregnancy (iodized salt vs. iodine supplements) may not influence postnatal development. However, the intake of iodized salt before becoming pregnant was associated with a better maternal thyroid function[19]. Therefore further research to improve their iodine intake adequately before pregnancy would be necessary. Furthermore, the iodine deficiency surveillance among breast feeding women and their infant would be necessary after iodine

supplementation tablets is not prescribed to any further extent and iodized salt are not used adequately.

Conclusions

Though the findings demonstrated the adequate of median urine iodine level in pregnant women with the iodine supplementation, a substantial proportion of them still had low urine iodine level and need additional intervention.

Acknowledgment

Funding and support: This study was supported by the Invitation Research Grants, Faculty of Medicine, Khon Kaen University.

Ethical approval: This study was approved by the Khon Kaen University Ethics Committee for Human Research (HE 571448).

Potential conflicts of interest

The authors declare no conflict of interest.

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