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URINARY IODINE CONCENTRATION (UIC) µG/L DETERMINATION AT EARLY GESTATION IN PREGNANT WOMEN

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ABSTRACT

Background: Daily requirement of iodine increases during pregnancy making pregnant women a high-risk group for iodine deficiency disorders. The limited available literature shows that even in iodine sufficient population, pregnant women are iodine deficient. **Objective:** The objective of this study is to assess the current iodine nutrition status among pregnant women in Visakhapatnam district, Andhra Pradesh. **Materials and Methods:** Pregnant women were recruited from Victoria hospital, Visakhapatnam, Andhra Pradesh. Consecutive sampling strategy was followed to recruit 153 pregnant women at early gestation. Urinary iodine estimation was done using UV-spectroscopic methodto assess the iodine status. The study was approved by Institute Ethics Committee, King George Hospital, Visakhapatnam, Andhra Pradesh. **Results:** Out of the total 153 pregnant women, 65.6% were using adequately iodized salt. Median urinary iodine concentration (UIC) for the pregnant women was 246(50, 498) µg/L. 20.6% of pregnant women had insufficient iodine status (UIC <150 µg/L). **Conclusion:** Iodine nutrition status of the pregnant women attending Victoria hospital wasadequate with attainment of universal salt iodization goal of >80 % adequately iodized salt coverage and excess urinary iodine levels may cause thyroid dysfunction in study population.

KEYWORDS: Urinary iodine concentration, Iodine status, iodine deficiency.

INTRODUCTION

Iodine is an essential micronutrient obtained from diet and plays a vital role in the production of thyroid hormones from thyroid gland (Zimmermann and Andersson, 2012). The thyroid gland produces the thyroid hormones such as thyroxine (T4) and triiodothyronine (T3), which contains four iodine and three iodine molecules respectively. These hormones are primarily responsible various functions such as the regulation of metabolism, normal growth and optimal brain development in the case of neonates (Zimmermann and Andersson, 2011).

Normal changes in thyroid function in Pregnancy

The changes that occur to thyroid function in pregnancy are elaborate and not entirely well understood, with some only seen transiently while others persist for the continuance of pregnancy (Kennedy et al., 2010). The feedback mechanisms of the hypothalamic-pituitary-thyroid axis function normally in pregnancy, to adjust thyroid hormone production and to maintain homeostasis (Glinoer, 2001). During the first trimester thyroid hormone concentrations increase (Kennedy et al., 2010). This is likely due to the influence of human chorionic gonadotropin hormone (hCG) which is an analogue of Thyroid stimulating hormone (TSH), which results in rise of thyroid hormone levels via the feedback of the pituitary-thyroid axis as well as the rise in Thyroxine-binding globulin (TBG) concentrations due to the elevation of oestrogen levels, trans placental transfer of thyroid hormones and increased renal clearance (Glinoer, 1997).

As hCG reaches a peak level near the end of the first trimester, a decrease of free Tri-Iodo thyronine (fT3) and free thyroxine (fT4) and an increase in thyroid stimulating hormone(TSH) was often observed due to progression of pregnancy. However, the changes in thyroid metabolism that occur in pregnancy are complex and dependent on a number of factors including the wide variation in thyroid function between women prior to pregnancy, the prevalence of thyroid abnormalities and the variations in the iodine intake status between populations (Kennedy et al., 2010). The changes occur in the earlier stages of pregnancy lead to a new equilibrium which accounts for the increased hormonal demands throughout pregnancy, likely due to the higher T4 turnover and possible increase in renal excretion which are sustained until birth. In areas of iodine sufficiency, the maternal thyroid gland should be able to adapt to these changes, however this may not be the case in areas of iodine deficiency (Glinoer, 2001).

Thyroid homeostasis during pregnancy

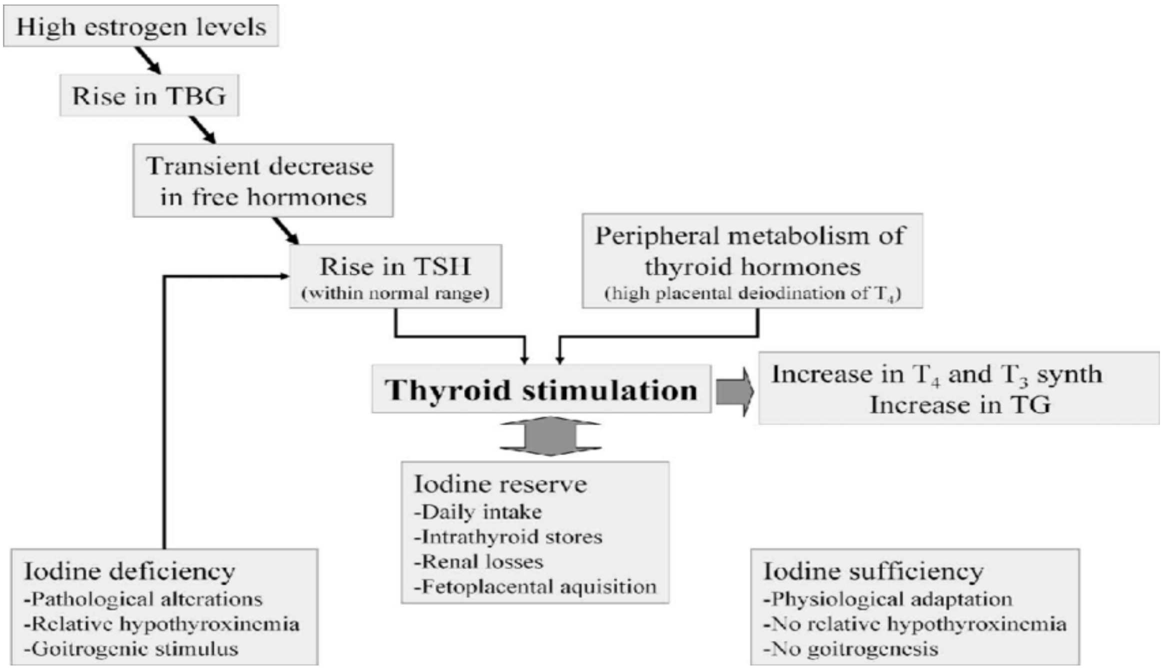

Fig 2: Thyroid homeostasis in pregnancy.

Reference: Perez-Lopez, Faustino. (2007), Iodine and thyroid hormones during pregnancy and postpartum. Gynaecological endocrinology: The official journal of the International Society of Gynaecological Endocrinology. 23. 414-28.

Tran's placental transfer of thyroid hormone

During the first trimester, the foetus dependents on the maternal supply for thyroid hormone, as the foetal thyroid does not develop until 10-12 weeks' gestation and is completed at birth (Patel et al., 2011). This dependency decreases during the second half of gestation when the maturation of the foetal hypothalamus-pituitary-thyroid axis results in an increased foetal T4 production. Maternal T4 is thought to be the primary thyroid hormone that is transported across the placenta. In the first trimester, the concentrations of fT4 in the amniotic fluids are less than maternal fT4 concentrations. As pregnancy progresses, cord serum concentration of thyroid hormones increases and by early in the third trimester the levels of TSH and fT4 in cord serum reach a peak that is higher than maternal levels at the same time, however cord serum levels of fT3 are thought to remain lower (Chan et al., 2009). Because of this complex mechanisms and influences involved in the trans placental transfer of thyroid hormone, a deeper understanding of these processes is required to assist with ensuring normal foetal development in thyroid diseased situations (Chan et al., 2009).

Maternal iodine nutrition during pregnancy

Iodine requirements in Pregnancy

The ingested inorganic iodine and iodate (extensively used in salt iodization) are nearly completely absorbed from the gastrointestinal tract (Zimmermann 2010, Li and Eastman 2018). It has been estimated that more than 90% of ingested iodine is ultimately excreted in the urine, being the kidney the main route of excretion; about 20% are excreted in the faeces, 5% appear in the sweat, saliva and the bile. In pregnancy, iodine intake should be increased ≥ 50% (Zimmermann 2012)due to Tran's placental transfer of thyroid hormones there was a need for increase in the synthesis of thyroid hormones which results in increased requirement for micronutrient iodine, which is essential for thyroid hormone synthesis. Soensuring an adequate level of thyroid hormone in early pregnancy is essential to ensure ample supply of thyroid hormone to the foetus at this crucial time of early gestation. Table: 1

Recommended dietary allowance (RDA) for Iodine

Micronutrient	RDA non pregnant women	RDA pregnant women	Increase in requirement
Iodine	100µg/d	160µg /day	60µg/day

Source: NIN, 2020; RDA: Recommended dietary allowance.

Sources of iodine

The natural sources of iodine are found in the sea as well as soil and minerals, with the main dietary sources being seafood and marine products. Other rich sources include milk and dairy products (Delange F et al, 1993) .The lack of iodine in many common foods, as well as the inconsistent iodine content in food sources may pose challenges to meeting adequate dietary iodine intake (Flachowsky G; 2014).

Iodine and its deficiency

A lack of iodine in the diet can affect thyroid hormone production, resulting in an inadequate secretion of thyroid hormone which can lead to hypothyroidism and a spectrum of disorders known as Iodine Deficiency Disorders (IDD) affect all stages of human life and are characterized by a variety of conditions(Zimmermann and Andersson, 2011). In the developing fetus or during infancy the effects of IDD can be serious, leading to impaired growth and development in children (Eastman and Zimmermann, 2018). In severe cases, iodine deficiency in pregnancy can result in cretinism, increased perinatal death, and infant mortality(Eastman and Zimmermann, 2018). Thus, adequate iodine intake is particularly important in pregnancy to ensure optimal growth and cognitive development of the offspring's.

Iodine deficiency disorders (IDD) in pregnancy

Iodine deficiency (ID) leads to severe clinical effects on the development and growth of animal and humans (Zimmermann 2010, Andersson, Karumbunathan et al. 2012, and Zimmermann 2012). These clinical effects are considered as iodine deficiency disorders (IDD) (WHO 2007) due to the inadequate Thyroid hormone production. The main impact of iodine deficiency is on pregnancy, lactating women and during the first two years of life (Andersson, de Benoist et al. 2005).

MATERIAL AND METHODS

- Prior to the start of the study, ethical committee approval was obtained from the institutional Ethical committee of King George hospital, Vishakhapatnam, Andhra Pradesh, India.
- Pregnant woman attending Victoria government hospital Vishakhapatnam were recruited after obtaining informed consent form.

Source of Data

- Data was collected with use of pretested questionnaire by a face-to-face interviewing technique from the pregnant women at hospital. Along with the above demographic data information regarding education, marital status, social economic status, use of medication, alcohol consumption, smoking habits, anthropometric measurements, religion, awareness regarding iodine deficiency disorders and intake of iodine rich foods during pregnancy obtained through a Questionnaire.

Study Design

- This longitudinal study recruited 168 pregnant women by purposeful convenience sampling among the pregnant women attending the tertiary health care centre for their routine visits.

Duration of study

- The study was conducted for a period of September 2017 – August 2019.

Inclusion criteria

- Married pregnant women age 18-45.
- Pregnant Woman with less than 12 weeks pregnancy.
- Pregnant Woman able to give informed consent form.
- Pregnant Woman with Singleton pregnancy.
- Pregnant Woman planning to deliver in the same hospital.

Exclusion criteria

- A history of thyroid disease.
- Known history of alcohol abuse or smoking.
- Woman not willing to deliver in the study hospital.
- Woman with the known foetal abnormality.
- Woman who are using iodine containing products.
- Women with Twin pregnancy.
- All lactating women.

Method of Urine Collection

- The participants were asked to void their urine into the container. After desired amount of urine samples collected, the transparent box was closed air-tightly and carried safely to the site of storage without any spillage.

Estimation of Urine Iodine

- It was done by wet digestion method using perchloric acid known as the Sandal Kolthoff reaction recommended by WHO/UNICEF/ICCIDD. (WHO, 2007).For assessing the women's iodine intake during pregnancy on a population basis, we used the criteria developed by WHO, where a median UIC< 150 mg/L was considered to reflect insufficient intake, 150–249mg/L— adequate intake, 250–499 mg/L—more than adequate.

Statistical analysis

Minitab -19 was used for performing statistical analysis.

RESULTS

TYPE OF FAMILY	Number of subjects	percentage
Nuclear	45	29.4%
Joint family	107	69.9%
Single	1	0.7%
Total	153	100.0%
OCCUPATION	**Number of subjects**	**percentage**
Home maker	138	90.8%
Working women	11	7.6 %
Students	4	2.6%
Total	153	100.0%
EDUCATION STATUS	**Number of subjects**	**Percentage**
Primary school	38	24.8%
Secondary school	51	33.3%
Higher secondary	31	20.3%
Graduation	26	17.0%
illiterate	7	3.9%
Total	153	100.0%
UTILIZATION OF IODINATED SALT	**Number of subjects**	**percentage**
Yes	100	65.36%
No	47	30.72%
Not known	6	3.92%
Total	153	100.0%

Food frequency distribution of iodine containing food among pregnant women (n=153)

Intake of Sea food	Number of subjects	percentage
Two times/ week Yes	**83**	**54.2%**
Two times /week No	**70**	**45.8%**
Total	**153**	**100.0%**

Milk intake	Number of subjects	percentage
No intake	38	24.8%
1glass/day	97	63.4%
2glasses/day	18	11.7%
Total	153	100.0%

Eggs intake /day	Number of subjects	percentage
0= no intake	39	25.4%
1 egg/ day	84	54.9%
2 eggs/ day	30	19.6%
Total	153	100.0%

The mean age of the study participants was 22.96±6.75 years and majority of the study subjects were 88 (57.5%) in the age range between 18-22 years, Among the study subjects 107(69.9%) subjects live in a joint family, there the average family numbers are around 4-6, 43(29.4%) subjects live in nuclear family there the average family numbers 2-3 respectively.

Out of total 153 pregnant women in the study 88 (57.6%) were residing in urban area, 65(42.4%) were residing at rural area. In the present study 90% study subjects were home makers, only 10% are students and employees. Majority of pregnant women in the present study has finished their only secondary school education. Economic status was classified based on modified Prasad scale according to the scale 43% of pregnant women belongs to lower class, 51% were middle class and 6% were middle class. Among the 153 pregnant women 83(54.2%) were consuming the sea food which mainly include shrimp, sea fish twice weekly, majority of women 97 (63.4%) consume at least one glass of milk per day, 38(24.8%) pregnant women did not consumed milk per day, 30(19.6%) consumed 2 eggs/day and 39(25.4%) not consumed eggs in their diet. In the current study the median urinary iodine excretion (MUIE) was 246.00 (μ g /L). The pregnant women in this study fall into the category of adequate iodine status. In the current study UIC of all the subjects was between 50mcg/L to 499 mcg/L respectively, hence all the pregnant women classified in to three groups ie Urinary iodine excretion <150 mcg/L which indicate iodine deficiency, UIE 150-249 mcg/L which indicate adequate level of iodine nutrition, UIE 250-499mcg/L which indicate more than adequate level of iodine nutrition. All these women were receiving iodized salt in their diet. **Forty one (26.80%) pregnant women had urinary iodine excretion <150 mcg/L which indicate iodine deficiency,** Forty seven (30.72%) pregnant women had UIE 150-249 mcg/L which indicates adequate level of UIC, sixty five (42.48%).

Pregnant women had more than UIE 250-499mcg/L.

Table 3: Median Urinary iodine concentration (mUIC) in pregnant women.

Urinary iodine (mcg/L)	Number of subjects	Percentage	Mean ±SD
< 150 mcg/L	41	26.80%	80.76±34.51
150-249 mcg/L	47	30.72%	218.51±32.41
250-499 mcg/L	**65**	**42.48%**	**338.69±60.03**
Total	153	100.0%	

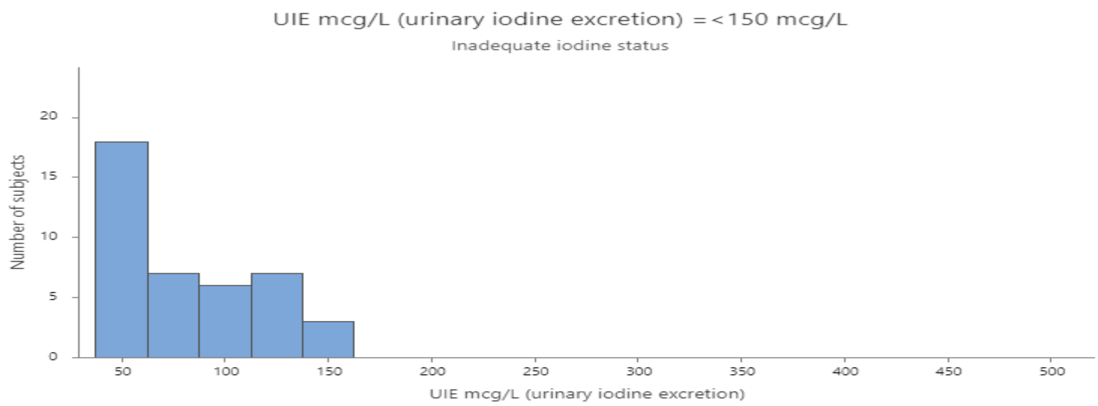

Fig 3: Frequency distribution of <150 mcg/L UIE among pregnant women.

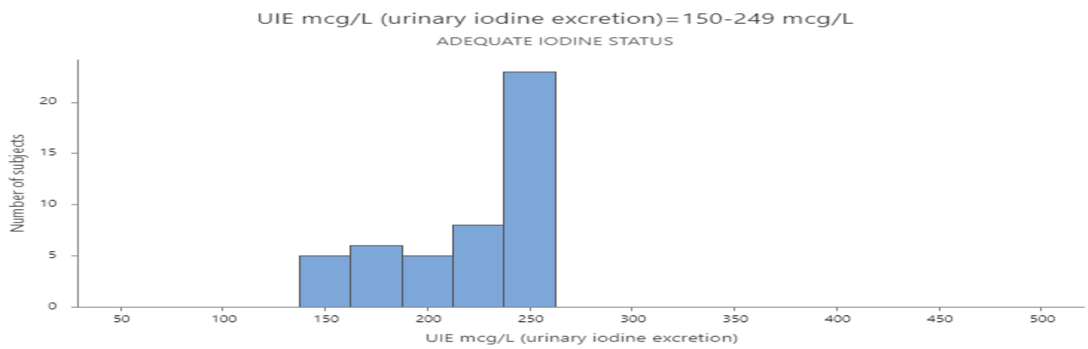

Fig 4: Frequency distribution of 150 -249 mcg/L UIE among pregnant women.

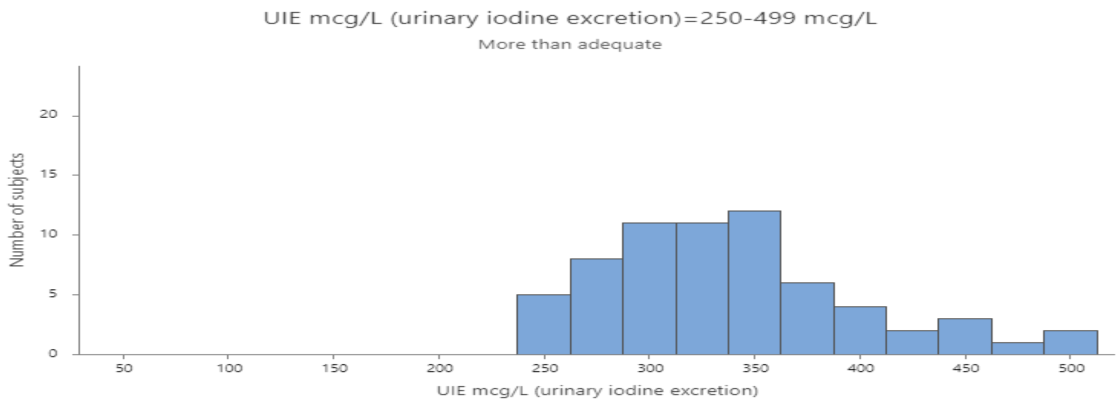

Fig 5: frequency distribution of 250-499 mcg/Lurinary iodine excretion among pregnant women (n=153).

DISCUSSION

During pregnancy lot of physiological and hormonal change takes place such as the rise in oestrogen level leads to rise in thyroxine - binding globulin and stimulation of Thyrotropin receptors (TSH) by human chorionic gonadotropin (HCG), these changes influences synthesis of maternal thyroid hormone (Glinoer D et al; 1997). In this context during pregnancy the iodine requirement increases, thus adequate amount of iodine intake during pregnancy was important to ensure proper maternal and foetal thyroid function, growth and cognitive development of the offspring. Hence there was an urgent need to study about the knowledge, attitude and practices followed by the pregnant women in use of iodized salt, which was the primary source for iodine in our diet and also about the frequency of consumption of iodine rich food in their diet. Iodine taken through the diet was well absorbed and 90% was excreted by the kidney through urine, hence the estimation of urinary iodine in pregnant women can reflect their iodine status. There was a sparse data on iodine status of the pregnant women at Vishakhapatnam district, Andhra Pradesh. There were no studies on association between iodine status and thyroid function tests, as well as on the association between Iodine status and pregnancy outcomes. This is concerning because the iodine deficiency and iodine excess are contributing to thyroid dysfunction during pregnancy and thyroid dysfunction can impact delivery outcomes and neonatal outcomes, thus the present study was conducted in pregnant women.

The present study was conducted on randomly selected 153 pregnant women, attending the outpatient department of victoria hospital with gestational age from <12 weeks. The pregnant women were included in the study in accordance to inclusion criteria. The mean age of pregnant women was 22.96±6.75 years. The median urinary iodine concentration (UIC) µg/L of pregnant women was taken as golden standard for the assessment of iodine nutritional status. In the current study the median urinary iodine concentration (mUIC) was 246.00 (µ g /L). The pregnant women in this study fall into the category of adequate iodine status. In the current study UIC of all the subjects was between 50mcg/L to 499 mcg/L respectively, hence all the pregnant women classified in to three groups ie Urinary iodine concentration <150 mcg/L which indicate iodine deficiency, UIC 150-249 mcg/L which indicate adequate level of iodine nutrition, UIC 250-499mcg/L which indicate more than adequate level of iodine nutrition. All these women were receiving iodized salt in their diet.The prevalence iodine deficiency was 26.8% at early gestation. Our study results were in accordance with the result of study conducted by Torres, M.T., Francés, L., Vila, L.et al; 2019 in first trimester. Our study results are similar to study conductedby Alvarez-Pedrerol M; 2010 in Sabadell, which reported mUICwere indicative of adequate iodine nutritionand stated that the pregnant women fall into adequate iodine status.

CONCLUSION

In conclusion, the overall median UIC of women in their first trimester of pregnancy found in our study is indicative of adequate iodine nutritional status according to the criteria established by the WHO and ICCIDD, although 20.6% were found to have iodine deficiency. Simultaneous consumption of iodized salt and milk this might be reason for adequate iodine status in our study.

REFERENCES

1. Alvarez-Pedrerol M, Ribas-Fito N, Garcia-Esteban R, Rodriguez A, Soriano D, Guxens M, Mendez M, Sunyer J. Iodine sources and iodine levels in pregnant women from an area without known iodine deficiency. ClinEndocrinol, 2010; 72: 81–6.
2. Torres, M.T.,Francés, L., Vila, L. *et al*. Iodine nutritional status of women in their first trimester of pregnancy in Catalonia. *BMC Pregnancy Childbirth*, 2017; 17: 249.
3. Zimmermann MB, Andersson M. Update on iodine status worldwide. CurrOpinEndocrinol Diabetes Obes, 2012; 19: 382-387.
4. Zimmermann MB, Andersson M. Prevalence of iodine deficiency in Europe in 2010. Ann Endocrinol (Paris), 2011; 72: 164-166.
5. Eastman CJ, Zimmermann MB. The iodine deficiency disorders. Endotext [Internet]. 2018 Feb 6.
6. WHO, UNICEF & ICCIDD. Assessment of Iodine Deficiency Disorders and Monitoring their Elimination: A Guide for Programme Managers. Geneva: World Health Organization, 2007.
7. Zimmermann MB &Boelaert K. Iodine deficiency and thyroid disorders. Lancet: Diabetes and Endocrinology, 2015; 3: 286–295.
8. Andersson M, Takkouche B, Egli I, Allen HE & de Benoist B. Current global iodine status and progress over the last decade towards the elimination of iodine deficiency. Bulletin of the World Health Organization, 2005; 83: 518–525.
9. Andersson M, Karumbunathan V & Zimmermann MB. Global iodine status in 2011 and trends over the past decade. Journal of Nutrition, 2012; 142: 744–750.
10. Kennedy R.L., Malabu U.H., Jarrod G., et al. (2010) Thyroid function and pregnancy: Before, during and beyond. Journal of Obstetrics &Gynaecology, 30(8): 774-783.
11. Glinoer D. (2001) Pregnancy and Iodine. Thyroid, 11(5): 471-481.

12. Glinoer D. (1997) The Regulation of Thyroid Function in Pregnancy: Pathways of Endocrine Adaptation from Physiology to Pathology. Endocrine Reviews, 18(3): 404- 433.
13. Patel J., Landers K., Li H., et al. (2011) Delivery of maternal thyroid hormones to the foetus. Trends in Endocrinology & Metabolism, 22(5): 164-170.
14. Chan S.Y., Vasilopoulou E., Kilby M.D. (2009) The role of the placenta in thyroid hormone delivery to the foetus. Nature Clinical Practice Endocrinology and Metabolism, 5(1): 45-54.
15. Pérez-lópez F.R. (2007) Iodine and thyroid hormones during pregnancy and postpartum. Gynaecological Endocrinology, 23(7): 414-428.
16. Delange F. (2007) Iodine requirements during pregnancy, lactation and the neonatal period and indicators of optimal iodine nutrition. Public Health Nutrition, 10(12A): 1571-1580.
17. Flachowsky G., Franke K., Meyer U., *et al.* (2014) Influencing factors on iodine content of cow milk. *European Journal of Nutrition*, 53(2): 351.
18. Pelala NB, Radhakrishna V, Kolekar V, Shenoy RD. Maternal and neonatal iodine status in Dakshina Kannada district of Karnataka, India.
19. Delange F. Requirements of Iodine in Humans. In: Delange F, Dunn JT, GlinoerD, editors. Iodine Deficiency in Europe: Springer US, 1993; p.5-15.