ORIGINAL ARTICLE

Maternal and neonatal iodine status in Dakshina Kannada district of Karnataka, India

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ABSTRACT

This study was designed to assess iodine status of mother-fetus dyad by estimation of spot urine iodine concentration (UIC) in the study district. It is a cross-sectional study of 250 pregnant women with euthyroid status and their term neonates residing in Dakshina Kannada district. Neonates with foetal growth restriction or requiring intensive care were excluded. Median UIC was quantified using modified Sandell-Kolthoff reaction by microplate method. World Health Organization (WHO) classification was used to categorise the iodine status of pregnant women. Among 250 pregnant women, the majority were primigravida (38%). Median maternal thyroid stimulating hormone (TSH) was 1.54 mIU/l, and median UIC was 352 mcg/l. Urine iodine levels were insufficient (<150 mcg/l) in 1.2% ($n = 3$), adequate (150–249 mcg/l) in 9.2% ($n = 23$) and above requirement (250–499 mcg/l) in 89.6% ($n = 224$); none had excess (> 500 mcg/l). Median birth weight was 3,000 g and head circumference was 34 cm. Median cord blood

TSH was 8.1 mIU/l, and median UIC 344.5 mcg/l. All the newborns had adequate (> 100 mcg/l) iodine status, including those born to mothers with insufficient values. Maternal and newborn median UIC showed positive correlation ($r = 0.139$; $p = 0.028$). Iodine statuses were above requirement or adequate in pregnant women from the study district and their neonates, respectively, indicating successful salt iodisation.

KEYWORDS

Euthyroid; Salt iodisation; Sandell-Kolthoff; Thyroid stimulating hormone.

INTRODUCTION

Iodine is an essential micronutrient and a key component of the thyroid hormones. When iodine intake falls below recommended levels, it results in a low serum level of these hormones leading to iodine deficiency disorders (IDD). About 1.9 million people worldwide are affected by IDD; pregnant women and infants are, especially, at risk due to their increased requirements [1]. During

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pregnancy, iodine requirement increases to 250 mcg/day in comparison to 150 mcg/day required by a normal adult [2]. The spectrum of IDD in foetus includes abortions, still birth, congenital anomalies, increased perinatal, infant mortality and endemic cretinism [3]. Even in maternal subclinical states, iodine deficiency has a negative impact on foetal brain development leading to reduced intelligent quotient [4]. Population median urine iodine concentration (UIC) estimation is the standard method of assessing iodine status [5]. With the introduction of iodisation of salt, India as a whole has a median UIC of 100 mcg/l and is categorised under adequate consumption of the iodine [6]. In the study by Kapil et al. [7], 88% of 150 randomly sampled population from Dakshina Kannada district were found to be consuming salt with iodine <15 parts per million. The median UIC was 70 mcg/l, which is considered as deficient [7]. There are no recent studies from DK district or Karnataka on the iodine status after strict implementation of iodised salt. Serum thyroid function tests do not reflect the true iodine status, especially during pregnancy. Thus, this study was designed to assess iodine status of mother-foetus dyad, a particularly vulnerable group, in the study district using spot urine iodine concentration estimation.

METHODS

This cross-sectional study was carried out in a medical college hospital in Dakshina Kannada district between January 2017 and June 2018. Study group consisted of 250 pregnant women and their neonates. Pregnant women residing in the study district with term gestation and euthyroid status were included. High risk pregnancy leading to foetal growth restriction and neonates requiring intensive care at birth were excluded. Spot urine sample of 3 ml was collected from mothers prior to delivery and from the newborn within 48 hours of birth. The collected urine samples were labelled and stored at -80°C until the time of analysis. Maternal and cord blood thyroid stimulating hormone (TSH) levels were recorded.

Median UIC was quantified using modified Sandell-Kolthoff reaction based on the principle of digestion with ammonium persulfate. Iodide acts

as a catalyst in the reduction of ceric ammonium sulphate (yellow in colour) to cerous form (colourless), and is detected by the rate of colour disappearance. Modified microplate method was used to process multiple samples simultaneously and absorbance was read at 405 nm optic density [5]. Values were expressed in microgram per litre (mcg/l). World Health Organization (WHO) classification was used to categorise iodine status of pregnant women as follows: < 150 mcg/l—*insufficient*, 150–249 mcg/l—*adequate*, 250–499 mcg/l—*above requirement*, and >500 mcg/l—*excessive*. In new-borns median, UIC of ≥ 100 mcg/l was interpreted as *adequate* and < 100 mcg/l as *insufficient* [8].

Statistical analysis

Statistical analysis was performed using SPSS 15.0. Frequency with percentage and median with inter quartile range (IQR) for quantitative data. Spearman test was used for correlation statistics. A *p* value of < 0.05 was considered as significant.

RESULTS

Demographics of participants

Among 250 pregnant women, The median maternal age was 28 years (IQR: 7years) (Table 1), majority belongs to upper middle class as per Revised Kuppuswamy's Socioeconomic Status scale. All mothers used iodised salt and majority (90%) were fish eaters. Median birth weight was 3,000 g (IQR: 565 g). Median birth length was 49.5 cm (IQR: 2.8 cm) and head circumference was 34 cm (IQR: 2 cm). None of the neonates had goitre.

Iodine status and thyroid function

Median maternal TSH value was 1.54 mIU/l (Table 2). Sub-clinical hypothyroidism with TSH ranging from 3 to 10 mIU/l was noted in 10% of mothers. Median maternal UIC was 352 mcg/l. UIC values were shown in Figure 1. Three mothers with *insufficient* iodine status did not show any significant demographic characteristics. Median cord TSH was 8.1 mIU/l; 6.4 % ($n = 16$) had cord TSH > 20 mIU/l requiring re-evaluation. All babies were found to

Table 1. Demography of the study population.

Parameter	n (%)
Gravidity	
Primi gravida	95 (38.0%)
Second gravida	73 (29.2%)
Multi gravida	82 (32.8%)
Socio economic class ^a	
Upper middle class	164 (65.6%)
Lower middle class	86 (34.4%)
Gender	
Males	148 (59.2%)
Females	102 (40.8%)
Classification	
Appropriate for gestational age	232 (92.8%)
Small for gestational age	14 (5.6%)
Large for gestational age	4 (1.6%)

^aKuppuswamy Socioeconomic Status [Sharma R. Indian Pediatr 2017;54:867–870]

Table 2. Maternal and newborn median thyroid stimulating hormone and urine iodine concentration.

Variable	Median	IQR
Maternal TSH (mIU/l)	1.54	1.14
Maternal UIC (mcg/l)	352	96
Cord blood TSH (mIU/l)	8.1	5.55
Newborn UIC (mcg/l)	344.5	97

IQR = Inter quartile range, TSH = Thyroid stimulating hormone, UIC = urine iodine concentration.

have normal thyroid function tests subsequently. Median newborn UIC was 344.5 mcg/l; all newborn had *adequate* status with UIC $\geq$ 100 mcg/l.

Associations between maternal and newborn thyroid and iodine status were explored (Table 3). A statistically significant ($p = 0.028$), but weak positive correlation ($r = 0.139$) was noted between maternal and newborn median UIC (Figure 2). No significant correlation was found between TSH and median UIC in both mother and newborn. Positive correlation was also observed between maternal UIC and newborn head circumference ($r = 0.129$; $p = 0.041$).

DISCUSSION

This cross-sectional study was done to assess the iodine status of pregnant women and their live

births by estimating the median UIC. The majority of population in this study district consume fish, but live in hilly terrains. The region receives heavy rainfall during monsoons, which could wash away the iodine in the soil. Earlier studies done in the district in early 2000s on adults and school children have shown that consumption of iodised salt was less than recommended and one third of the population to be iodine deficient [7,9]. Our study showed that $< 2\%$ of mothers to be iodine *insufficient*.

Among Indian studies on iodine status in pregnant women, Majumder et al. [10] found 40% of his study group to be deficient. Chakraborty et al. [11] using 100 mcg/l UIC median cut off found 21.7% of the maternal population to be iodine deficient. The newborn status was not assessed in these previous studies. The median maternal UIC noted in various studies ranged between 100 and 220 mcg/l [11–14]. In contrast, the median maternal UIC in our study was 352 mcg/l. None of the studies found any correlation between maternal iodine status and thyroid function. Similar to our results, other studies also showed a newborn UIC of ≥ 100 mcg/l [13–15]. Our results also showed that foetal iodine concentration was higher irrespective of the maternal status. Although the newborn median UIC was more than 300 mcg/L, none of the babies had goitre in our study. All the children with cord TSH > 20 mIU/l did not require thyroid replacement therapy in the follow up.

Figure 1. Maternal iodine status by WHO classification.

Table 3. Maternal iodine status and median maternal and newborn urine iodine concentration.

Maternal iodine status	Median maternal UIC (mcg/l)	Median Neonatal UIC (mcg/l)
Insufficient	132	301
Adequate	212	329
Above requirement	363	345.5

UIC = Urine iodine concentration.

Figure 2. Scatter plot showing the correlation between maternal and newborn median urine iodine concentration levels.

Few of the limitations of the study include a small sample size being conducted in hospital settings. Also, Iodine concentration of the salt

was not assessed. Urine samples could not be collected simultaneously from the mother-newborn pair.

CONCLUSION

Pregnant women enrolled from the study district and their neonates had iodine statuses identified as above requirement and adequate, respectively, indicating successful salt iodisation in the area.

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CONFLICTS OF INTEREST

None.

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None.

ETHICAL APPROVAL

Ethical clearance and approval of the study were granted by the Institutional Ethics Committee. Signed informed consent for participation and publication of medical details were obtained from the mothers enrolled in the study. Confidentiality was ensured at all stages.

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