Austin Journal of Pregnancy & Child Birth

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Research Article

Urinary Iodine Status at Delivery in Rural Pregnant Mothers from KONKAN Region of India (BKLWHANC-2)

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Received: July 22, 2021; **Accepted:** August 20, 2021; **Published:** August 27, 2021

Abstract

Adequate iodine is necessary in pregnancy for normal maternal as well as fetal thyroid function. Fetus cannot produce thyroid hormone so it is exclusively dependent on mother. During pregnancy, iodine demand is increased by 50%. An adequate intake of dietary iodine in pregnancy is essential for the normal neurodevelopment of the offspring.

We measured urinary iodine concentrations in 220 pregnant women who reported for delivery at a rural hospital in the KONKAN region of the State of Maharashtra, India. The mean age and gestation at delivery were 26.9 years and 38.2 weeks respectively. The observed median UIC was 84.6μg/l. Urinary iodine of mother was not associated with neonatal anthropometric measurements (weight, length and head circumference). We have found low median UIC levels at delivery among pregnant women. The increased demand in pregnancy could be met by iodine supplementation or increasing iodine content in the salt. The burden of poor iodine status in pregnant women will further adversely affect the fetal neurodevelopment. There should be universal screening of every pregnant woman for the identification of iodine status. A simple strategy of improving iodine content in the salt beyond the current recommendation for pregnant women might be beneficial for mother as well as fetus but continuous monitoring for adequate iodine is warranted.

Keywords: Urinary iodine concentration; India; Pregnancy; KONKAN; Neurodevelopment

Abbreviations

UIC: Urinary Iodine Concentration; LBW: Low Birth Weight; IQ: Intelligence Quotient; TSH: Thyroid Stimulating Hormone

Introduction

Iodine is an essential micronutrient for normal thyroid function that is necessary in the growth and metabolism throughout the course of the life span [1]. Iodine deficiency in pregnancy affects maternal as well as fetal thyroid function. Normal functioning of thyroid hormone is required for normal neurodevelopment [2]. During pregnancy, there is a necessity to increase dietary iodine intake by 50% to fulfil the increased demand of the mother and the fetus [3]. Fetus cannot produce thyroid hormone so it is exclusively dependent on mother for the same. Moderate or severe iodine deficiency in euthyroid mothers has a damaging effect on fetal brain development due to low circulating thyroid hormone levels in the first half of pregnancy [4,5]. An adequate intake of dietary iodine in pregnancy is essential for the normal neurodevelopment of her offspring.

The KONKAN region of the western Indian state of Maharashtra has witnessed under nutrition for many years across all stages of life. This is based on the reported evidence of anthropometric indicators of under nutrition (stunting, wasting and underweight) [6]. The prevalence of Low Birth Weight (LBW), a crude marker of maternal under nutrition, is very high [7]. Furthermore, there is hardly any reported data on macro as well as micronutrient deficiency among pregnant women in the region. The associations between maternal nutrient deficiencies and offspring health are very well established [8,9].

BKL Walawalkar hospital established in 1996 is a tertiary care referral center in Ratnagiri district. A small study conducted on 3 to 7 years old rural children in the same geographical region at our hospital, found high proportion of poor Intelligent Quotient (IQ) [10]. Considering the important role of iodine in neurodevelopmental outcomes in children, we decided to do a pilot study to measure urinary iodine concentration in pregnant women who were admitted in our hospital for delivery.

Materials and Methods

Height and weight of the women were measured. BMI was calculated. Obstetric history was extracted from antenatal records. Gestation at delivery was calculated using last menstrual period. Neonatal measurements (weight, length, head circumference, chest circumference and mid upper arm circumference) were carried out using standardized protocol. Placental weight was measured using protocol reported earlier [7]. History of hypothyroidism was extracted from antenatal records.

Urine sample collection was done on hospitalization for delivery. A 10ml of urine was collected and stored at -80°C till analysis.

Laboratory: We measured urinary iodine based on Sandell-Kolthoff reaction and using 96 well plates. The absorbance was measured using ELISA Bio-Rad PR-4100analyzer.

Citation: Patil SN, Bhat P, Chavan S, Jadhav D, Dervankar O, Joglekar C, et al. Urinary Iodine Status at Delivery in Rural Pregnant Mothers from KONKAN Region of India (BKLWHANC-2). Austin J Pregnancy Child Birth. 2021; 2(1): 1006.

Intra and inter batch coefficient of variation were 5.0% and 3.3% respectively.

Classifications: Low Birth Weight (LBW), stunting and small head were defined using WHO charts [11]. Pre term refers to women who delivered before 37 weeks of gestation. Different threshold values set by WHO task force on iodine deficiency were used to classify UIC distribution of our data [12].

Statistical methods

Data has been shown as mean (standard deviation) for continuous variables and percentage for categorical variables. The associations between continuous maternal exposures and UIC were analyzed by Pearson's correlation. Pearson's correlation was also used to analyze the association between UIC as exposure and neonatal anthropometric outcomes. The comparison of UIC between maternal categorical exposures was by non-parametric median test. The data were analyzed using Statistical Package for Social Sciences (SPSS) V25.0.

Ethics

Informed and written consent was obtained from all the pregnant women to use the data. The study was approved by the Institute Ethics Committee of BKL Walawalkar Rural Medical College and Hospital. Our institute ethics committee is registered with the Government of India. Registration code is EC/755/INST/MH/2015/RR-18.

Results

From 28th October 2020, 347 pregnant women delivered in our hospital. 109 women were already in active labor on arrival at the hospital. We could not collect urine sample from them. Out of the remaining 238, there were 2 still births and no urine samples were collected from additional 11 women. Thus, we collected urine samples from 225 pregnant women. After further exclusion of 5 known cases of hypothyroidism, we arrived at the final sample size of 220.

The observed median UIC was 84.6μg/l (Figure 1).

Table 1 shows the characteristics of the women and the newborns. The mean age, height, weight at delivery and BMI at delivery were 26.9 years, 152.0cm, 54.7kg and 23.6kg/m^2 respectively. 46.8 % of women were Primigravida and the mean gestation at delivery was 38.2 weeks. Total 35 (15.9%) delivered preterm. Total 16 (7.2%) had preeclampsia.

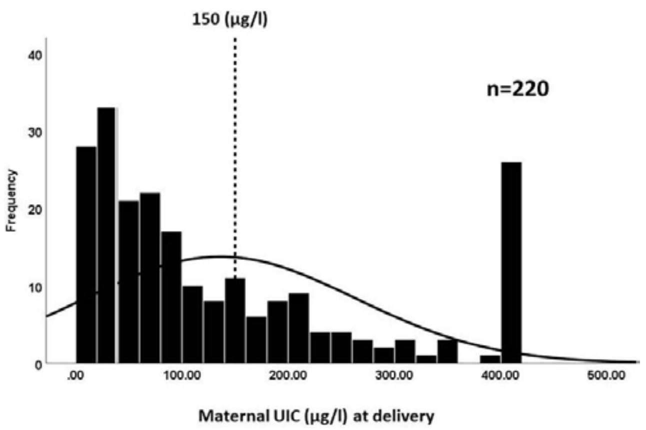

Figure 1: Maternal UIC distribution.

Table 1: Characteristics of maternal and neonates at delivery (n=220).

	Mean or n	SD or %
Maternal		
Age (years)	26.9	4.3
Primigravida	103	46.80%
Gestation at delivery	38.2	2.1
Preterm (<37 weeks)	35	15.90%
Height (cm)	152	4.8
Weight at delivery (kg)	54.7	10.3
BMI at delivery (kg/m^2)	23.6	4.3
High Risk Complications		
Preeclampsia	16	7.20%
Neonatal		
Birth weight (kg)	2.6	0.45
LBW (<2.5kg)	90	40.90%
Length (cm)	46.9	3.1
Stunted	65	29.50%
Head circumference (cm)	32.9	1.7
Small head (< -2 SD of WHO)	33	15.00%
Placental weight (kg)	480.2	84.6

Data is represented as mean (Standard Deviation) for continuous variables and n (%) for categorical variables; SD: Standard Deviation; BMI: Body Mass Index; LBW: Low Birth Weight; NA: Not Applicable.

Among neonatal measurements birth weight, length, and head circumference were 2.6kg, 46.9cm and 32.9cm respectively. Total 40.9% were LBW, 29.7% were stunted and 15.0% had small head.

Maternal UIC was positively associated with maternal weight and BMI at delivery. There was no association with any of the neonatal anthropometric outcomes (Table 2).

Discussion

This is the first report about UIC in pregnant women at the time of delivery from KONKAN region. We were unable to find any published data from the region for comparison. But there is a report on UIC in pregnancy from the city of Pune. The median UIC was 203μg/l and 211μg/l at 17 and 34 weeks of gestation respectively [13]. Another report from the same state, but among tribal population, reports median UIC of 106μg/l and 71μg/l at 17.5 and 34.5 weeks of gestation respectively [14]. A report on pregnant women from the city of Kolkata from eastern Indian State of West Bengal measured UIC in each of the three trimesters and found increasing deficiency [15] as the pregnancy progressed. A study of pregnant women in north Indian state of Rajasthan found median UIC 127μg/l [16]. Unlike these reports, we measured UIC at delivery. In our study sample, the median UIC at delivery was 84.6μg/l. This is much lower than those reported from other parts of India. Iodine deficiency has been associated with low birth weight, preterm birth but the results are varied [17-20]. In our study, there was no association (Table 2).

The government of India in 1962 launched a salt iodization programme as National Goiter Control Program to replace ordinary

Table 2: Associations of maternal urinary iodine concentrations at delivery with maternal exposures and neonatal outcomes.

Maternal	Pearson Correlation
Age (years)	0.085 (p=0.208)
Gestation at delivery	-0.053 (p=0.437)
Height (cm)	-0.029 (p=0.676)
Weight at delivery (kg)	0.218 (p=0.001*)
BMI at delivery (kg/m²)	0.239 (p=0.000*)
Neonatal	
Birth weight (kg)	0.001 (p=0.984)
Length (cm)	0.084 (p=0.248)
Head circumference (cm)	-0.031 (p=0.674)
Placental weight (kg)	-0.020 (p=0.784)

salt with iodized salt, particularly in the goiter endemic regions. In 2005, universal salt iodization was made mandatory in the country. According to the recent National Family Health Survey-5 (NFHS-5), 94.2% of rural household in the state of Maharashtra [21] and 91.1% households from Ratnagiri district [22] are using iodized salt.

Our unpublished results from a cohort study [23] of 16-18 year old adolescent girls from the same region (who are future mothers) have shown median UIC of 171.0μg/l. However substantially lower median of 84.6μg/l has been observed in our present study. This difference in UIC of adolescent girls and pregnant mothers could be due to increased iodine demand during pregnancy. The WHO recommends daily iodine intake of 150μg/day for non-pregnant women and 250μg/day for pregnant women [12]. Iodine content of >15 ppm in salt is considered as adequate in Indians. A study from northern Indian state of Rajasthan found it to be adequate only for children and not for pregnant women in the same family [16]. The same report also found optimal iodine status among pregnant women consuming salt with iodine content >30 ppm. Thus increasing iodine content in the salt beyond current recommendation could be beneficial in pregnancy. A study from Switzerland has reported beneficial effect of increasing iodine content in the salt for pregnant women [24]. There are additional factors contributing to poor iodine status. Loss of iodine during cooking has also been cited as another reason as most Indians eat cooked foods. Salt restricted diet is advised in some cases (preeclampsia, ankles and feet swelling) during pregnancy [14] and this may be one of the factors. This can be overcome by using salt with low sodium and high iodine content. Implications of poor iodine status on child IQ are well documented [25,26]. A recent review has estimated that iodine deficiency in utero and in early childhood reduces IQ in children [27]. A small study done at our institute found poor IQ in young rural children [10] but we do not have any UIC measurements in their fetal life. The subtle impairment in cognition has also been reported in children of mothers with mild or asymptomatic hyperthyroidism [28,29].

We have used median UIC cut offs as per WHO recommendation for assessing population deficiency [12]. There are some shortcomings in our study. Our urine samples are spot samples hence we cannot comment on individual iodine deficiency. We do not have complete TSH and cord thyroglobulin data on neonates. We also do not have data on TSH levels of mothers and any postnatal neurodevelopmental data. We used head circumference as a surrogate for brain development, but it did not show any associations with maternal UIC.

Loss of electrolyte including iodine due to excessive sweating could be another reason as this area being coastal has high humidity [30]. Though >90% women are consuming iodized salt we do not have data on individual salt consumption.

Conclusion

To summarize we have found low median UIC at delivery among pregnant women in our region. This is despite worldwide efforts to reduce it by universal salt iodization. The increased demand in pregnancy could be met by increasing iodine content in the salt. Burden of iodine deficiency in pregnant mothers may adversely affect the fetal neurodevelopment. This is potentially preventable by screening every pregnant woman for iodine deficiency. Screening alone will not prevent deficiency but will provide an opportunity for corrective measures.

Acknowledgements

We thank all pregnant mothers in the study for giving their valuable urine sample. We would like to extend our thanks to Sanjiv Patankar educator and advisor, the Department of Surgery, BKL Walawalkar Hospital for the final editing of the manuscript.

Financial support: This study was funded by our institute.

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