Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 6 Issue 5 May 2022

Research Article

The Median Urinary Iodine Concentrations among Pregnant Women of Kashmir are Indicative of Insufficient Iodine Status

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DOI: 10.31080/ASNH.2022.06.1046

Received: March 22, 2022

Published: April 11, 2022

Abstract

Objectives: Inadequate iodine intake has a profound adverse impact on a child's developmental behaviour. The study's aim was to ascertain the median urinary iodine concentration (mUIC) and the prevalence of iodine deficiency, as well as to understand whether maternal characteristics have an effect on iodine status in Kashmiri pregnant women.

Study Design: Prospective study

Methods: A total of 112 pregnant women subjects were enrolled in this study from the Department of gynaecology and obstetrics, Sher-I-Kashmir Institute of Medical Sciences (SKIMS), Srinagar. UIC was calculated using a modified Sandell-Kolthoff reaction. The World Health Organization classification was established as a suggested cut off value of 150 µg/L to categorise the iodine status of pregnant women.

Results: All the 112 recruited subjects in their first trimester, were initially examined for goitre status. The mUIC was 80.91 (inter-quartile range (IQR): 49.2-116.47)µg/L. In our study 80 (71.4%) study subjects were from rural areas. 101 pregnant women (90%) had UIC < 150µg/L (insufficient), 8(7.14%) had UIC of 150-250µg/L(normal) and only 3(2.67%) study subjects had UIC of > 250µg/L(excess). Significantly higher UIC was present in the younger population having age ≤ 25 years (104 µg/L), as well as in urban subjects (117.38µg/ L) and in subjects without goitre (87.85µg/ L). The goitre prevalence was 37.5%. It was 7-fold more common in illiterate subjects as compared to literate (OR = 7.14, 95%CI:2.94-17.37). Similarly rural pregnant women were at 2-fold more risk than urban for goitre occurrence (OR = 2.39,95%CI:1.03-5.51). Likewise, income status of the study participants was significantly associated with UIC ($p < 0.027$). UIC also showed a weak negative correlation with age ($r = -.265$, $p = 0.005$)

Conclusion: This research concludes that there is a mild to moderate iodine deficiency in pregnant mothers and thus a broad and representative sample of Kashmiri pregnant women is needed to assess iodine status at the population level.

Keywords: Kashmir; Median Urinary Iodine Concentration; Pregnant Women; 1st Trimester

Introduction

Iodine is an indispensable micronutrient and a vital building block of thyroid hormones. Iodine deficiency disorders occur when iodine intake falls below recommended levels, leading to reduced serum levels of these hormones. Approximately 1.9 million people around the world are affected by Iodine deficiency disorders (IDDs) [1]. The IDDs are responsible for a wide range of health disorders like Neurological damage, Goitre, hypothyroidism, Miscarriage etc [2]. Factually, iodine scarceness associated to only goitre and cretinism [3,4]. For the last three decades, research has shown that iodine deficiency affects all age ranges, from infancy through adulthood, with serious consequences for the neuro developmental defects on children and other health and social issues [3,5-7].

Before the foetal thyroid gland develops, enough iodine supplement is especially crucial during the first half of pregnancy, as the foetus is entirely dependent on an adequate and consistent supply of iodine for proper hormonal functions like thyroid. Thyroid hormones play an important role in foetal development, particularly for cells in the central nervous system and the structural and functional development of the brain [8]. The urinary iodine concentra-

tion (UIC) measures overall intake and is considered a valid biomarker for estimating recent iodine intake at the population level [9]. In a population of pregnant women, a mUIC of 150-250µg/L implies acceptable iodine nutrition [10]. Studies have shown that even mild iodine deficiency during pregnancy has irreversible outcomes on foetal neurodevelopment and consequent cognition and learning capabilities of the young child [11-13]. The average intelligence quotient (IQ) of children born in iodine-deficient regions is 13.5 points lower than that of children born in iodine-sufficient regions [14]. IDD restricts the country's human resource growth (HRD) and progress by having a causal link with brain development, memory, and learning disabilities [15]. According to approximations, a one-point rise in a country's average IQ is correlated with a 0.11 percent annual increase in GDP; therefore, eliminating IDDs could lead to 1.5 percent GDP growth [16]. Iodine deficiency affects 1.8 billion people around the world due to poor dietary iodine intake [17]. IDDs are widespread in India because of iodine deficiency in the soil, which effects both animal and plant nutrition grown on iodine-deficient soil [16,18].

Keeping in view the importance of Iodine stores in pregnant women and the consequences of iodine deficiency on pregnant women and their foetus, this hospital-based study was designed to assess the iodine status in pregnant women of Kashmir valley.

Materials and Methods

In this study, a total of 112 subjects were recruited from the department of gynaecology and obstetrics, Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar during 2016-2017. A predesigned questionnaire was used to collect information regarding age, residence, goitre status, education, Socio economic status and trimester of the study participants. Besides, that a spot urine sample (≈2mL) was collected from each subject in the morning during first trimester and stored properly at -80ºC for further analysis. 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 [19].

Accordingly, the WHO/UNICEF/ICCIDD recommend comparing the mUIC of a population to established reference criteria to assess iodine status as follows: Among groups of pregnant women, mUIC < 150 µg/L is indicative of insufficient iodine intake, 150-249 µg/L of adequate intake, 250-499µg/L of intakes above requirements, and ≥ 500µg/L of excessive intake [10] (Table 1).

Median Urinary Iodine Concentration (µg/L)	Iodine intake	Iodine status
< 150	Insufficient	Insufficient
150-250	Sufficient	Adequate iodine nutrition
250-499	Above requirement	May pose a slight risk
≥ 500	Excessive	Risk of adverse health consequences

Table 1: Median urinary Iodine concentrations median (UIC) for pregnant women according to WHO.

Statistical analysis

The data analysis was done by SPSS v26 software. Normal distribution was determined by conducting Shapiro-wilk normality test and histogram analysis. UIC was very much skewed and not normally distributed. Data was expressed as medians, IQR and percentiles (25^{th} and 75^{th}). Non parametric Mann-Whitney U Test, Spearman's non-parametric correlation and logical regression analysis were performed for the analysis of skewed data. In a two Two-tailed test of significance, a p-value of less than 0.05 was considered significant.

Results

The median age of the participants was 27.50 (25^{th} and 75^{th} percentiles as 25-30) years. Out of 112 pregnant women 72(64.3%) were > 25years old and 40 (35.7%) were ≤ 25 years. All women were in the first trimester of their pregnancy. Physical examination revealed that 42 subjects (37.5%) had enlarged thyroid gland (goitre), indicating iodine deficiency disease, majority of which (74.6%) were rural inhabitants.

The overall mUIC among study population was 80.9µg/L. Those which belonged to age group ≤ 25 years and > 25 years had UIC of 104.1µg/L and 78.6 µg/L respectively. UIC of the rural pregnant women was 79.2µg/L, much lower than the UIC of the urban pregnant women which was 117.4µg/L. Subjects presented with goitre had a UIC of 80.4 µg/L which was very low when compared to subjects without goitre, which had a UIC of 87.8 µg/L.

Only 08 (7%) pregnant women had UIC between 150-250µg/L(normal) and 3 (2.7%) pregnant women had UIC > 250µg/L(excess). 101(90%) pregnant women in our study population had UIC < 150µg/L (insufficient iodine). Table 2 presents the UIC

(µg/L) with 25th and 75th percentiles according to maternal demographic, behavioural, characteristics. Further, income status was significantly associated with UIC in a non-parametric test (*p* value < 0.028).

	N	UIC(µg/L)	P- value
Maternal age, years			
≤ 25	40	104 (50-120)	
> 25	72	78.6 (49-104)	0.15
Residence			
Rural	80	79 (49-105)	0.11
Urban	32	117 (49-132)	
Goitre status			
Present	42	80.40 (46-118)	0.69
Absent	70	87.85 (50-114)	
Education			
Illiterate	35	79.63 (43-102)	0.78
Literate	77	89.94 (53-118)	
Monthly income			0.026
≤ 10000	34	74.02 (45-96)	
> 10000	78	91.04 (52-126)	

Table 2: Urinary iodine concentration (µg/L), according to maternal demographic and behavioural characteristics given as median with 25th and 75th percentiles in the study population.

Table 3 represents variables and their association with goitre and UIC. Illiterate women had a 7 -fold risk of developing goitre than literate study subjects (OR = 7.15, 95%CI:2.94-17.37). Furthermore, pregnant women from rural districts were having a 2-fold more risk for goitre occurrence than urban participants (OR = 2.39, 95%CI:1.03-5.51). In figure 1, we also observed that UIC showed a weak negative correlation with age (r = -.265, p = 0.005).

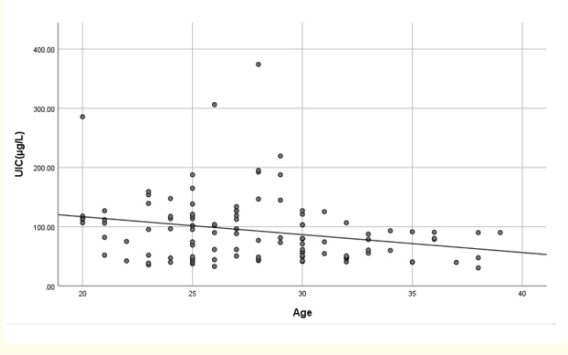

Figure 1: Scatter plot showing the correlation between maternal age and urine iodine concentration levels.

Variable	Goitre present	Goitre absent	OR (95% CI)
Age			
≤ 25yeas	16	24	18 (0.53-2.61)
> 25 years	26	46	
Maternal Education			
Illiterate	24	11	7.15 (2.94-17.37)
Literate	18	59	
Residence			
Rural	28	52	2.39(1.03-5.51)
Urban	18	14	
Monthly Income (INR)			
≤ 10,000	28	6	21.33 (7.43-69.43)
> 10,000	14	64	
UIC (µg/L)			
Variable	≤ 150	150-250	OR (95% CI)
Age			
≤ 25yeas	35	4	0.53 (0.12-2.25)
> 25 years	66	4	
Maternal Education			
Illiterate	33	0	Infinity
Literate	68	8	
Goitre status			
Present	39	1	4.4 (0.52-37.17)
Absent	62	7	
Residence			
Rural	74	4	2.74 (0.64-11.73)
Urban	27	4	
Monthly Income (INR)			
≤ 10,000	33	0	Infinity
> 10,000	68	8	

Table 3: Factors associated with goitre and UIC status among pregnant women in the study population.

Discussion

Iodine deficiency is one of the WHO's nutritional priorities [10] and is considered to cause a global loss in IQ of 13.5 points at the population level [14], constituting the world's greatest single cause of preventable brain damage and mental retardation [20]. Iodine deficiency and goitre representation are common in pregnancy as stated in reports of various researches conducted across worldwide [12, 21-25] as well as in India [26]. However, severe iodine deficiency in pregnancy especially in first trimester and in childhood is a risk factor and has a devastating effects on intellectual function in the offspring [27]. Globally, several studies have served as evidence that people living in regions of iodine deficiency areas are either intellectually very weak or have mild to moderate neurological disorders [28]. We could only find one study in our subjects of interest which proved that maternal hypothyroidism constitutes a risk factor for an abnormal neurobehavioral development of affected child [29]. But there are a lot of researches in children between age 6- 12 years old reported earlier in our population that have found a significant association between iodine insufficiency and its wrecking effects like goitre in different regions of Kashmir [30,31]. The main finding of this study was that mUIC of the participants was 80.9 µg/L, which is below the recommended cut off value of 150µg/L set by WHO [10]. We also observed that, illiterate and rural subjects were at higher risk than the literate and urban research subjects in developing goitre disease. This is evident from the fact that majority of illiterate and rural women in our study were found to have insufficient urinary iodine concentrations. These findings are in concordance with the reports published around the world [32-34]. In the same way we also found a weak inverse relationship between UIC and age which is also in harmony with the data published worldwide [35]. Another notable finding was the significant association of income status with UIC, which was evident by the majority of subjects with low-income having insufficient urinary iodine concentration. These findings are in agreement with the studies reported elsewhere in the world [36]. We also observed that iodine insufficiency was very high in age group greater than 25 years, rural pregnant women and in cases with goitre representation. In fact, 90% of the women in our study population had a UIC of < 150µg/L. The possible reason may be the geographical location of the current population which is surrounded by mountainous region covering a lot of forest cover, thereby receiving abundant amount of rainfall and frequent floods which washes off iodine micronutrient away from the soil, making soil and the vegetation iodine deficient. Unfortunately, there are no studies available in our population but there is a study available elsewhere in the country [37].

Additionally, inappropriate cooking methods and salt addition at initial stages of cooking, prolonged boiling, being common practice in our population especially in rural areas justifies iodine insufficiency in our rural population. However, again earlier reports are lacking in current population, but there are studies in India on cooking methods and iodine loss [38].

Conclusion

Despite salt iodization programme being introduced in Jammu and Kashmir more than two decades ago, the study revealed moderate iodine deficiency among pregnant women under study. More research is needed among a larger and more representative population of women in Kashmir to validate whether salt iodization programme was successful.

Author's Statement

The authors declare that there is no conflict of interest to declare. Furthermore, the study was executed in collaboration with the department of Obstetrics and Gynaecology, Sher-I-Kashmir Institute of Medical Sciences, Srinagar 190011. The sampling was part of routine test investigations and other lifestyle and dietary information was collected from only the admitted patients in the above department. Therefore, there was no requirement of separate institutional ethics committee clearance.

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