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Assessing the trend of iodine deficiency among antenatal patients of the university of Port Harcourt teaching hospital

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Abstract

Background: Iodine deficiency is a global health problem of public health significance; it is the leading cause of preventable neurodevelopmental impairment in children globally. This deficiency can occur in pregnancy leading to various degree of morbidity.

Aims and objective: This study was aimed at determining the pattern and severity of iodine deficiency amongst pregnant women in the University of Port Harcourt Teaching Hospital.

Methodology: This study was a hospital-based cross-sectional comparative study that measured the urinary iodine concentration in two subgroups of the population; pregnant women and non- pregnant women of reproductive age. Structured questionnaires were administered to and urine samples were obtained from the participants. The urinary iodine concentration was measured using the Sandell-Kolthoff reaction. The data from the structured questionnaire was entered into a spreadsheet and analyzed using the statistical package for social sciences 25.0 software package (IBM, Armonk, NY, USA).

Results: The mean age for the pregnant study group was 32.15±5.2, the median and modal age was 31 years, with a range of 23 to 43 years.

Mild iodine deficiency was seen in 57.1% of the non-pregnant respondents and 34.4% of the pregnant respondents. Moderate iodine deficiency was seen in 42.9% of non-pregnant respondents and 56.2% of pregnant respondents. Severe Iodine deficiency was observed only among the pregnant respondents (9.4%)

The median urinary iodine concentration (Median UIC) among pregnant women was 42.87ug/l, while the median UIC among non-pregnant women was 52.33ug/l. A Mann-Whitney U test indicated that this difference was statistically significant, U (NPregnant=66, Nnon-pregnant =63) =1234.5, z= -3.98, p≤ 0.001).

Conclusion: This study found that iodine deficiency was prevalent among women in the study population (pregnant and non-pregnant women), however, it was more severe in pregnant women. Based on the results of our study there is an urgent need for iodine supplementation in our pregnant women.

Keywords: Iodine; Deficiency; Pregnancy; Port Harcourt

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1. Introduction

Iodine was the first micronutrient found to be essential to man and it is relevant to health at all stages of life [1,2], however, one-third of the world's population (approximately 2 billion people globally), still suffer from iodine deficiency [3,4]. Pregnant women and lactating mothers are most susceptible to the effects of iodine deficiency and this may be passed on to the babies with dire consequences [4]. Globally, 18-20 million babies are born mentally or intellectually impaired as a result of iodine deficiency [5]. An estimated 38 million babies born in developing countries annually are at risk of brain damage from iodine deficiency in the mother [6]. Iodine deficiency is of public health significance, it is the leading cause of preventable neurodevelopmental impairment in children globally [7–9].

The daily physiological requirement of iodine in an average adult is 150ug [10], this increases by more than 50% in pregnancy (250ug) [11]. During the first half of pregnancy, the fetus is dependent on the mother for thyroxine essential for brain development. Maternal thyroxine crosses the placenta into the fetal circulation before the development of a functional fetal thyroid gland and in the second half of pregnancy, there is an increased uptake of iodine by the placenta into the fetal circulation for fetal production of thyroxine [11].

Neurodevelopmental disorders are often missed or diagnosed late with resultant late intervention in Sub-Saharan Africa [12]. Before 2016, data on the prevalence and pattern of neurodevelopmental disorders in Nigeria was not easy to come by. However, with declining under-five mortalities, these disorders are being increasingly diagnosed in childhood. The prevalence of such disorders in the paediatric unit of the University of Port Harcourt Teaching Hospital (UPTH) is 6.7% with the highest incidence amongst children under five years of age [13].

The populations most susceptible to iodine deficiency disorders are the pregnant and lactating mothers, women of reproductive age, as well as children under 2 years [4,8,14]. In pregnancy, most manifestations of iodine deficiency depend on the gestational age and severity of resulting hypothyroidism [8,15,16]. The mothers may present with goiter and other features of clinical or subclinical hypothyroidism. The fetuses are at risk of miscarriages, prematurity, stillbirths, low birth weight, and congenital abnormalities; most commonly microcephaly [8,17,18]. Newborn babies of mothers with iodine deficiency have increased perinatal and infant mortalities [16]. The effects of iodine deficiency in pregnancy continue into childhood resulting in low IQ, stunted growth, impaired learning, delayed motor development, muscular disorders, paralysis, and apathy [8,15,16,18,19]. It has been implicated in autism and related to preeclampsia in pregnancy [18–20].

In 1993, World Health Organization (WHO) and United Nations Children's Fund (UNICEF) through a joint committee on health policy recommended Universal Salt Iodization (USI) as the key strategy in combating iodine deficiency [7,9,10]. This will help curtail the associated complications of iodine deficiency.

Understanding the pattern and burden of iodine deficiency in pregnancy will help appreciate the required intervention in terms of iodine supplementation. In Rivers state Nigeria oil exploration has increased the interaction of hydrocarbons with a lot of nutritional health indices including availability of iodine in the diet. This has dire health implications.

It is therefore imperative to assess the severity of iodine deficiency amongst pregnant women in this region and to evaluate the need for supplemental iodine in pregnant women attending antenatal clinics at the University of Port Harcourt Teaching Hospital.

2. Material and methods

This study was a hospital based cross-sectional comparative study which measured the urinary iodine concentration in two subgroups of the population; pregnant women and non-pregnant women of reproductive age at the University of Port Harcourt Teaching Hospital, Rivers State. It assessed the median urinary iodine concentration (as a measure of the severity of iodine deficiency).

The first study population was made up of consenting pregnant women in all trimesters of pregnancy, recruited consecutively, over one month, as they present for their routine antenatal visits. The second study population was also recruited consecutively from non-pregnant consenting women of reproductive age attending the gynaecology and family planning clinics for reasons unrelated to iodine deficiency or thyroid dysfunction over one month.

This study included all pregnant women at all trimesters of pregnancy and all non-pregnant women of reproductive age residing in communities within the state for a continuous period of more than one year, who give consent for the study.

The following were excluded

1. Pregnant or non-pregnant women with previously diagnosed thyroid disease or visibly enlarged thyroid glands or on iodine-containing medication or anti-thyroid medications.
2. Pregnant or non-pregnant women residing outside Rivers state for a continuous period of more than a year.
3. Pregnant or non-pregnant women with obstetric, gynaecological, renal, hepatic or metabolic medical illnesses that may affect iodine status or thyroid function.
4. A patient who refuses to give consent.

The minimum sample size for this study was calculated using the formula for measuring significant differences in proportions between two groups [21],

$$n = \frac{(u+v)^2 \ (p1(100-p1)+p2(100-p2))}{(p1-p2)^2}$$

where;

n = Sample size for each group.
p_1 = Proportion in first study group
p_2 = Proportion in second study group
v = percentage point on the normal distribution corresponding two-sided significance level. (It is 5%, therefore, v = 1.96).

u = the one-sided percentage point on the normal distribution curve corresponding to 100% - the power of the study. (The power of the study is 90%, therefore u = 1.28).

The prevalence of iodine deficiency among pregnant women in a similar hospital-based study in Imo State, South-East, Nigeria by Ujowundu et al[51] was 14% (using UIC of less than 100ug/l as iodine deficiency). Therefore, p_1 is 14%.

The prevalence of iodine deficiency in the general Nigerian population estimated from a study in 2012, was 40.4%[26] (using UIC less than 100ug/l as iodine deficiency) Therefore, p_2 is 40.4%.

Therefore, a total sample size of 134 with 67 persons in each arm of the study was used and the samples collected over two months for analysis.

The probability sampling method was used to select the study participants for both arms of the study. While a simple random sampling technique was used to pick non-pregnant women of reproductive age for one arm of the study, a stratified sampling technique was used to pick pregnant women for the other arm of the study.

The study questionnaire was administered to consenting participants and a casual urine sample of not less than 10mls was collected in a marked sterile universal specimen bottle and stored at temperatures below 20^{o}C, and transported to chemical pathology research laboratory of the University of Port Harcourt Teaching Hospital where the urinary iodine concentration was measured using Sandell-kolthoff test and validated with an ELISA kit, read on a spectrophotometer [10].

The data was entered into a spreadsheet and analyzed using the statistical package for social sciences 25.0 software package (IBM, Armonk, NY, USA). The mean, median, mode, and standard deviation were calculated. These results were presented in statements and frequency tables.

For tests of significance, the Mann-Whitney U test was used for comparisons between medians, the Chi-square test was used to compare categorical variables while Student 't' test was used to compare continuous variables between the pregnant and non-pregnant subgroup of women and p-value <0.05 was considered significant at a 95% confidence level.

3. Results

The demographic data of the patients in the two arms of the study (pregnant and non-pregnant women of reproductive age) are presented in Table 1. The mean age for the non-pregnant study group was 32.14±7.5, the median age was 33 years and the modal age was 38years with a range of 20 to 52 years. They were mostly nulliparous (76.2%). Most of the patients in both arms of the study had a tertiary level of education; 85.5% of pregnant respondents and 83.6% of non-pregnant respondents.

Table 1 Demographic data

	Groups				P-Value
	Pregnant (N=66)		Non- Pregnant(N=63)		
	N	%	N	%	
Age Group					0.001
20-24	0	0.0%	16	25.4%	
25-29	16	24.2%	13	20.6%	
30-34	31	47.0%	9	14.3%	
35-39	13	19.7%	19	30.2%	
>40	6	9.1%	6	9.5%	
PARITY					
Nullipara	34	51.5%	48	76.2%	0.013
Primipara	15	22.7%	6	9.5%	
Multipara	17	25.8%	9	14.3%	
Marital Status					
Single	0	0.0%	25	39.7%	0.001
Married	66	100.0%	38	60.3%	
Patient's Occupation					
Employed	20	35.7%	23	46.0%	0.259
Self Employed	29	51.8%	18	36.0%	
Unemployed	7	12.5%	9	18.0%	
Husband's Occupation					
Employed	36	60.0%	15	46.9%	0.099
Self Employed	24	40.0%	15	46.9%	
Unemployed	0	0.0%	2	6.3%	
Educational Status					
No Formal Education	1	1.6%	0	0.0%	
Primary	0	0.0%	2	3.3%	
Secondary	8	12.9%	8	13.1%	0.387
Tertiary	53	85.5%	51	83.6%	

The median urinary iodine concentration (Median UIC) among pregnant women was 42.87ug/l, while the median UIC among non-pregnant women was 52.33ug/l. A Mann-Whitney U test indicated that this difference was statistically significant, U ($N_{Pregnant}$=66, $N_{non\text{-}pregnant}$ =63) =1234.5, z= -3.98, p≤ 0.001. The mean UIC among pregnant women was 42.14±1.23ug/l, with a range of 14.05ug/l-62.44ug/l, while the mean UIC among non-pregnant respondents was 49.82±7.6ug/l with a range of 31.5ug/l-60.56ug/l.

Table 2 Median UIC between pregnant and non-pregnant women

	Groups						
	Pregnant(N=66)		Non-Pregnant(N=63)				
	Mean Rank	Median	Mean Rank	Median	U Statistics	Z score	p-value
UIC (µg/L)	52.20	42.87	78.40	52.33	1234.50	-3.98	0.001

All participants in the study had iodine deficiency of some degree. Mild iodine deficiency was seen in 57.1% of the non-pregnant respondents and 34.4% of the pregnant respondents. Moderate iodine deficiency was seen in 42.9% of non-pregnant respondents and 56.2% of pregnant respondents. Severe Iodine deficiency was observed only among the pregnant respondents (9.4%), as presented in Figure 1. Table 3, shows the WHO Classification of Iodine deficiency published in 2007.

Table 3 Criteria for assessing iodine nutrition

Life Stage	Median urinary iodine (µg/l)	Category of iodine status
Sch-aged children, non-pregnant and non-lactating adults	<20	
	20-49	Severely deficient
	50-99	Moderately deficient
	100-199	Adequate
	200-299	More than Adequate
	≥300	Excessive
Pregnant women	<150	Insufficient
	150-249	Adequate
	250-499	More than adequate
	≥500	No added health benefit expected

Culled from WHO, UNICEF & ICCIDD (2007) Assessment of Iodine Deficiency Disorders and Monitoring Their Elimination, 3rd. Geneva: World Health Organisation.

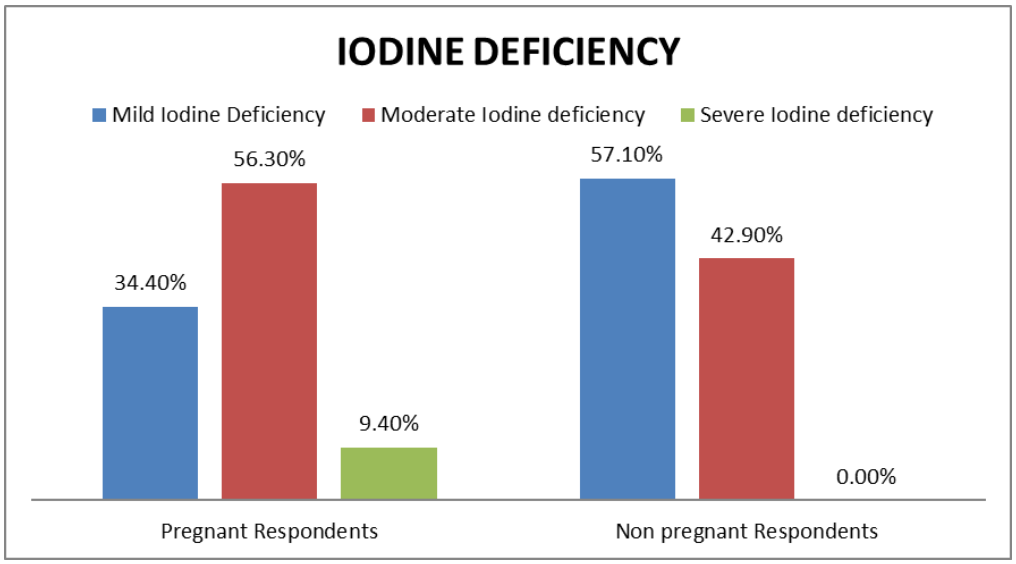

Figure 1 Severity of iodine deficiency among respondents

4. Discussion

This study confirmed iodine deficiency in both pregnant (at-risk population) and non-pregnant (general population) women in this environment. Despite statistically significant differences in the age and marital status of the women in both arms of the study, the respondent all fell within the coverage of reproductive age group (15-49 years) [22–24].

The median UIC of 42.87ug/l reported in this study among the pregnant respondents is similar to the values reported from a multicenter study in Abia state by Igwe et al in 2011, where a median UIC of 58.67ug/l was reported, with all the pregnant women from all 3 communities studied being iodine deficient [25]. This was attributed to the high consumption of cassava in this region despite high household coverage of the USI program.

The severity of iodine deficiency observed in this study, however, was surprising, with severe iodine deficiency seen in 9.4% of the pregnant respondents, moderate iodine deficiency seen in 56.2% of respondents and mild iodine deficiency seen in 34.4% of respondents. This is almost a reversal of the picture seen in Abia state where only mild and moderate iodine deficiencies were observed; 64% and 36% respectively. A similar study in Zaria by Jibril et al had a median UIC among pregnant women of 193ug/l and prevalence of mild iodine deficiency (UIC<150ug/l) of 46% [26].

Although iodine deficiency was also observed in the non-pregnant respondents representing the iodine status of the general population, with a median UIC of 52.33ug/l, the severity of the problem was worse in pregnancy (Table 2). Pregnancy is a known independent contributor to iodine deficiency due to the high demands made on maternal iodine stores by the fetus [17].

5. Conclusion

In conclusion, this study found that iodine deficiency was prevalent among women in the study population (pregnant and non-pregnant women), however, it was more severe in pregnant women.

WHO recommends iodine supplementation in pregnancy in regions were USI coverage is less than 90% in over 2 years as well as scaling up of the USI program. On the basis of this recommendation alone, the results of our study suggests there is an urgent need as well as scientific justification for iodine supplementation in our pregnant women.

Compliance with ethical standards

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Disclosure of conflict of interest

We have no conflict of interest to declare.

Statement of informed consent

All information and statements obtained from respondents (informants) are for research purposes and will be maintained.

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