Comparison of Iodine Status between Adult and Adolescent Pregnant Women at a Maternity Hospital in Dhaka City

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Abstract

Iodine deficiency is a major public health problem for populations throughout the world, particularly for pregnant women and young children. It is a menace to the social and economic development of a country. The most devastating effects of iodine deficiency are increased perinatal mortality and mental retardation. The aim of this study was to describe and compare the magnitude and severity of IDD among adolescent and adult pregnant mothers in Bangladesh. A cross-sectional study was conducted among adolescent and adult pregnant women (n =210) during the months of July 2006 to September 2006. Maternal urinary iodine excretion (UIE) was determined (n =210) together with estimation of salt iodine content (n =87) of the consumed salt sample collected. Data was analyzed using SPSS var.12. Considerable number of adolescent (21.8%) and adult (21.9%) pregnant mothers were suffering from iodine deficiency (UIE <100 μg/L), although there was no significant difference in iodine deficiency among these two groups (p =0.74) and between age and gestational age of the respondents. The overall median urinary iodine levels were 176.6 and 191.5 μg/L in adolescent and adult pregnant mothers respectively. About 30.0% of the respondents had UIE greater than 300 μg/L and 16.7% of the respondents had UIE within the range of 200-299.9 μg/L. Salt intake shows a large variation in iodine content (the minimum and maximum values were 15.2 and 64.3 mg/kg for adolescent group and 9.1 and 104.7 mg/kg for adult group) and significant correlation (Spearman's rho, P<0.05) was found between UIE (μg/L) and salt iodine intake (mg/kg). Therefore, findings of the present study suggest that biochemical iodine deficiency persist among the adult and adolescent pregnant mothers, though the median UIE level falls within the optimal iodine nutrition status. Significant association was found between salt iodine intake and urinary iodine excretion.

Key words: Iodine Deficiency Disorders, Adolescent and Adult pregnant mother, Urinary iodine excretion, Salt iodine level.

Introduction

Around the world, over 600 million people have goiter and 20 million have some degree of brain damage caused by the effects of iodine deficiency during pregnancy[1].

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Pregnancy influences thyroid function in multiple ways[2]. The thyroid economy undergoes a series of metabolic changes during pregnancy. One of the major factors involved in these changes is the increased requirement of iodine due to the transfer of thyroxin (T4) and of iodide from mother to fetus during pregnancy[3]. All degrees of iodine deficiency affect the thyroid function of the mother and neonate, and the mental development of the child[4]. The resulting mental deficiency has an immediate effect on child's learning capacity, woman's health, the quality of life of communities and economic production[5]. In areas with environmental iodine deficiency, pregnant adolescent girls are especially at risk of iodine deficiency, with serious consequences for the fetus[6]. Their requirement for iodine further increases to provide for the need of the fetus[7].

Although, the number of countries with iodine deficiency as a public health problem decreased from 110 to 54 between 1993 (using total goiter rate as an indicator) and 2003 (using urinary iodine excretion)[8], still in several studies conducted around the world, the pregnant women have been found to be particularly vulnerable to IDD[9-14]. Bangladesh is one of the countries most affected by iodine deficiency disorders (IDD) in the world and the findings of the most recent IDD survey[15] conducted in 2004-5 showed that IDD is still a public health problem in Bangladesh. National data is not available regarding urinary iodine level of adolescent and adult pregnant women. So, the present study was undertaken to investigate the UIE level in both adolescent and adult pregnant mothers and to evaluate if any significant difference exits between these two groups.

Materials and Methods

Study Design

A cross sectional study was conducted among the adult and adolescent pregnant mother of first and second trimester from low socio-economic group of Dhaka city.

Study Location and period

The study was conducted in the Institute of Nutrition and Food Science (INFS), University of Dhaka and the data, salt and urine samples were collected from Mother and Child Health Training Institute (MCHTI), Azimpur, Dhaka. The data and samples were collected during the months of July 2006 to September 2006.

Study Population

The study was conducted among 210 pregnant women of whom 55 were from the adolescent age group and 155 were from the adult age group, attending the antenatal clinic of Mother and Child Health and Training Institute (MCHTI), Azimpur. Urine samples were collected from every respondent whereas salt samples were collected from 87 respondents.

Pronouncement of Consent

The purpose of the study was explained to each respondent. After having permission, the data were collected from them.

Collection of Salt

During the interview, polythene bags and rubber bands (used to close the open ends of the polythene bags) with proper instructions were given to the respondents for collection of the salt. They were asked to collect a handful of the salt they used for cooking in the supplied polythene bag on the day of interview and bring it to the hospital during their next visit.

A total of 87 salt samples currently used by the respondents at their home were collected in polythene bags. Salt samples were packed and stored at room temperature till analysis.

Estimation of salt iodine

Iodine content of the collected salt samples was analyzed by iodometric titration method[26].

Collection of Urine

On the spot casual urine samples were collected from the respondents. The urine samples were collected in clean, dried, wide mouthed screw capped plastic bottles. Then the samples were carried in bags and brought to IDD Laboratory at the Institute of Nutrition and Food Science, Dhaka University. The samples were stored in a freezer at -20°C until analysis.

Estimation of urinary iodine

Urinary iodine was estimated by Ammonium Persulfate Digestion on Microplate (APDM) method[16].

Data Processing and Analysis

SPSS var.12 program was used for data analysis. Microsoft Excel 2007 was used to prepare graphs. Entry errors were checked and corrected accordingly. Chi square was done for categorical variables and T test was done for continuous variables.

Results

The percent distribution of respondents according to age group represents respondents of ≤19 years age termed as adolescent and >19 years age termed as adult. A total of 210 pregnant women were selected as study population, attending MCHTI, Azimpur, during the study period; among them 73,8% were adults and 26.2% were adolescents (***Table-1***).

Median and mean urinary iodine according to age group is presented in the ***Table 1***, which shows that median urinary iodine values were 176.6 μg/L for adolescents and 191.5 μg/L for adults. Minimum and maximum values showed a wide range of variation due to respondents different level of iodine intake through iodized salt. The minimum value of urinary iodine excretion was 38.1μg/L for adolescents and 18.0 μg/L for adults. The maximum value of urinary iodine excretion was 507.7 μg/L for adolescents and 610.4 μg/L for adults. More than three-fourth (78.2%) of the adolescent pregnant mothers had normal urinary iodine excretion (UIE ≥100 μg/L). Among the adolescents, 21.8% of the respondents were found to be biochemically iodine deficient (UIE ≥ 100 μg/L). Among the adult pregnant mothers, 78.1% had normal urinary iodine excretion (UIE 100 ≥ μg/L) and 21.9% were found to be biochemically iodine deficient (UIE <100 μg/L).

The distribution of urinary iodine excretion of the respondents is shown in ***Table 2*** and according to the obtained results, the adolescents had no severe iodine deficiency (UIE <20 μg/L) whereas 3.6% and 18.2% of them had moderate iodine deficiency (UIE 20-49.9 μg/L) and mild iodine deficiency (UIE 50-99.9 μg/L) respectively. Also 21.8% and 23.6% of the adolescent mothers had urinary iodine excretion in the range of 200-299.9 and ≥300 μg/L respectively.Nearly one-third (32.7%) of the adolescents had optimal urinary iodine excretion (UIE 100-199.9 μg/L).

Among the adults, 0.6%, 4.5% and 16.9% of the respondents had severe, moderate and mild iodine deficiency respectively, whereas 30.5% had optimal urinary iodine excretion (UIE 100-199.9 μg/L) and 14.9% and 32.5% of the respondents had urinary iodine excretion in the range of 200-299.9 and ≥300 μg/L respectively. Similar pattern of iodine deficiency prevails among both the adolescent and adult pregnant mothers except for severe iodine deficiency. Further analysis for association between UIE and age group of the respondents of the present study elucidated that no significant association exists (p= 0.74) (***Table 2***).

Among the respondents 95.4 % consuming salt contained adequate amount of iodine (≥15 mg/kg). Significant correlation (P<0.05) was found between salt iodine intake and urinary iodine excretion of the respondents (***Table 3***).

Discussion

A hospital based cross sectional study was conducted among 210 pregnant mothers, of whom 55 were adolescents and 155 were adults. Family members were greater than 5 persons for majority (54.8%) of the households. Most of the respondents' (77.4%) gestational age was between 19 to 26 weeks. Only 22.1% of the respondents' gestational age was between 13 to 18 weeks. Socio-economic data of the respondents showed that most of them (95.4%) were housewives and 53.0% of the respondents' husbands were engaged in small scale business for their earning (Data not shown).

The overall median urinary iodine levels were 176.6 μg/L and 191.5 μg/L in adolescent and adult pregnant mothers respectively. No national data is available regarding urinary iodine excretion in pregnant adolescent and adult women. A study

carried out among the pregnant women at "Mother and Child Health Training Institute (MCHTI)", Dhaka during July to December, 2002 reported that overall median urinary iodine excretion was 270 μg/L[17]. The study did not specify the differences in median urinary iodine excretion among adolescent and adult pregnant mothers. Data of present study indicated that overall median urinary iodine excretion of pregnant mothers, both adolescent and adult, was slightly lower as compared to the above mentioned study.

Furthermore, no significant difference was observed in iodine deficiency among adolescent and adult pregnant mothers ($p = 0.74$). The absence of this significant association might be explained by the unequal sample size i.e., the sample number of adolescent pregnant mothers was small (n=55) as compared to that of adult pregnant mothers (n=155).

More than one-fourth (31.1%) of the pregnant mothers, both adolescent and adult, had optimal iodine nutrition status (UIE 100 -199.9 μg/L). Only 21.8% of the adolescent pregnant mothers had urinary iodine excretion below the cut-off point (UIE <100μg/L), meaning that 3.6% had moderate (UIE 20 - 49.9 μg/L and 18.2% had mild iodine deficiency (UIE 50-99.9 μg/L). About one-fourth (21.9%) of the adult pregnant mothers had urinary iodine excretion below the cut-off point (UIE <100 μg/L) meaning that 4.5% had moderate (UIE 20 -49.9 μg/L) and 16.9% had mild iodine deficiency (UIE 50 -99.9 μg/L). This is an important findings because it is now believed that even mild maternal hypothyroidism (from mild iodine deficiency, thyroid autoimmunity, or thyroid under-replacement) may affect fetal brain development[18].

On the contrary, only one adult pregnant woman (0.6%) had severe iodine deficiency (UIE <20 μg/L); whereas the figure was 7.4% among adult females (15-44 years) during IDD survey in Bangladesh in 1999[19].

Further critical examination of the result showed that 16.7% of the total pregnant mothers had median UIE in the range of 200 - 299 μg/L and 30.1% had more than 300 μg/L. According to WHO criteria, it indicates more than adequate iodine or excess iodine intake[20]. Excess UIE increase the risk of iodine induced hyperthyroidism[21], especially when it is achieved suddenly in populations with previous long standing severe iodine deficiency[22,23] and when salt is iodized with excess iodine and is poorly monitored[24]. But iodine requirement is increased during pregnancy, the median urinary iodine during pregnancy indicating optimal iodine nutrition needs to be higher than 100 μg/L. If, as in non-pregnant adults, the recommended median urinary iodine (100 - 200 μg/L) corresponds to the recommended intake of iodine (150 μg/day), the median urinary iodine excretion during pregnancy and lactation should be in the range of 225-350 μg/L. If, on the contrary, the recommended median urinary iodine excretion was based on a recommended intake of iodine (225-350 μg/day) and a mean daily urinary volume of 1.5 L/day, it should be in the range of 150-230 μg/L, which is only slightly higher than the value recommended for non-pregnant adults[25].

Statistically significant correlation ($P<0.05$) was observed between salt iodine intake and UIE of pregnant women, both adolescent and adult. This association may explain the

high UIE among some pregnant mothers which was probably due to excessive iodization and poorly monitored iodized salt consumed.

Mean iodine content of the consumed salt was 36.4 mg/kg and 40.0 mg/kg, and median urinary iodine (MUI) excretion was 176.6 μg/L and 191.5 μg/L respectively for adolescent and adult pregnant mothers. This is strongly correlated with the study of pregnant women visiting "MCHTI" during November 2003 to April 2004, where mean iodine content of the salt consumed by pregnant women was 38.5 mg/kg[17] and MUI excretion was 218.6 μg/L. Adequately iodized salt at household level should contain 15 mg/kg iodine. Whereas in the present study, mean iodine content in salt was much higher than this value. The minimum and maximum values were 15.2 mg/kg and 64.3 mg/kg respectively for adolescent group and 9.1 mg/kg and 104.7 mg/kg respectively for adult group. These variations are consistent with the data provided in 2002 which states that the salt factories were not maintaining appropriate amount of iodine in salt as per law[24].

The absence of any significant association between urinary iodine excretion among adolescent and adult pregnant mothers is not conclusive as we know that during pregnancy metabolic adaptation occurs and it differs between individuals. The overall satisfactory rate of UIE may also be the result of this adaptation process. So, further research involving longitudinal follow up of adolescent and adult pregnant mothers is needed to elucidate the true picture.

Table-1: Median and Mean Urinary Iodine Values by Age

Age (years)	Total Samples Examined (%)	Median (μg/L)	Mean ±SD (μg/L)	Minimum (μg/L)	Maximum (μg/L)	Urinary Iodine Status	
						Normal ≥100 μg/L	Deficient <100 μg/L
≤19	55 (26.2)	176.6	219.5±135.5	38.1	507.7	78.2% (n=43)	21.8% (n=12)
>19	155 (73.8)	191.5	243.7±163.5	18.0	610.4	78.1% (n=121)	21.9% (n=34)
Total	210 (100.0)	185.5	234.17±153.5	18.0	610.4	78.1% (n=164)	21.9% (n=46)

Table-2: Distribution of Urinary Iodine Excretion of the Respondents by Age

Age (Years)	Urinary Iodine Excretion (μg/L)						P-value[a]
	<20	20-49.9	50-99.9	100-199.9	200-299.9	≥300	
≤19	0.0% (n= 0)	3.6% (n= 2)	18.2% (n=10)	32.7% (n= 18)	21.8% (n= 12)	23.6% (n= 13)	0.74
>19	0.6% (n= 1)	4.5% (n= 7)	16.9% (n= 26)	30.5% (n= 47)	14.9% (n= 23)	32.5% (n= 50)	
Total	0.5% (n= 1)	4.3% (n= 9)	17.2% (n= 36)	31.1% (n= 65)	16.7% (n= 35)	30.1% (n= 63)	

[a] *Differences tested with χ-square test*

Table-3: Relationship between Salt Iodine Intake and Urinary Iodine Excretion of the Respondents

Urinary Iodine Excretion (μg/L)	Salt Iodine Intake (mg/kg)				Total	P value[a]
	< 15	15-29.9	30-49.9	≥50		
<20	0 (0.0%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	1 (1.1%)	0.042
20-49.9	0 (0.0%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	1 (1.1%)	
50-99.9	1 (1.1%)	4 (4.6%)	13 (14.9%)	1 (1.1%)	19 (21.8%)	
100-199	3 (3.4%)	6 (6.9%)	14 (16.1%)	7 (8.0%)	30 (34.5%)	
200-299	0 (0.0%)	5 (5.7%)	7 (8.0%)	3 (3.4%)	15 (17.2%)	
≥300	0 (0.0%)	5 (5.7%)	13 (14.9%)	3 (3.4%)	21 (24.1%)	
Total	4 (4.6%)	21 (24.1%)	48 (55.2%)	14 (16.1%)	87 (100.0%)	

[a] *Spearman's rho correlation is significant at 0.05 level.*

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