Original Research Article

Urinary iodine excretion in urine samples among children in Dang district, Gujarat

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ABSTRACT

Background: Iodine is an essential micronutrient required for normal human growth and development as it is needed for the synthesis of thyroid hormones produced by thyroid glands. The sicknesses occurred due to deficiencies of iodine in the nutrition are termed iodine deficiency disorders. Urinary iodine concentration is the prime indicator of a person's nutritional iodine status. So, the aim of this study was to assess the status of iodine deficiency based on median urinary iodine excretion.

Methods: Community based cross sectional study was carried out among purposively selected primary schools of the Dang district. All students between the age group of 6 to 12 years who were present on the day of visit were included in the study. A total 387 urine samples were collected during the period of August 2015 to September 2016.

Results: Based on median urinary iodine excretion, among total analysed samples, about 6.5% samples confirmed severe iodine deficiency, 22% samples showed moderate iodine deficiency and about 36% samples indicated mild iodine deficiency. About one third (31.3%) samples suggested optimum iodine intake. Only few samples (4.4%) revealed more than required iodine intake.

Conclusions: About one third (31.3%) of the surveyed population had adequate iodine intake while majority (64.4%) of them had inadequate iodine intake.

Keywords: Iodine intake, Iodine deficiency disorder, Median urinary iodine, School children

INTRODUCTION

Iodine is an essential micronutrient, required in minute amount of 100-150 µg daily for synthesis of the thyroid hormones, thyroxine (T₄) and triiodothyronine (T₃).^{1,2} It is an essential element which cannot be synthesized by our body.³ In areas where there is little iodine in the diet, typically remote inland areas where no marine foods are eaten, iodine deficiency is common. It is also common in mountainous regions of the world where food is grown in iodine poor soil.⁴ The sicknesses occurred due to deficiencies of iodine in the nutrition are termed iodine

deficiency disorders (IDDs).¹ Iodine deficiency create much wider range of disorders, not limited to goitre, started from intrauterine life and extending through childhood to adult life with serious mental and social implications. The spectrum of iodine deficiency disorders include - goitre, hypothyroidism, subnormal intelligence, delay motor milestones, mental deficiency, neuromuscular weakness, endemic cretinism and also intrauterine death.^{2,4} Various studies have documented that in areas with incidence of mild to moderate iodine deficiency disorder, IQ of school children are on average 13 points below, those of children living in areas where there is no iodine deficiency.⁵ The addition of iodine to

table salt has largely eliminated this problem in the wealthier nations. However, iodine deficiency still remained a serious public health problem in the developing world.

Recognising the importance of iodine and in greater concern of the public health to ensure the adequate supply of iodine, the central government issued notifications on 17th May 2006 and also passed amendment in preventions of Food Adulteration Rules 1955 that, no person shall vend non-iodised salt for direct human consumption.⁷

Iodine concentration in urine is the most important indicator of person's nutritional status of iodine, and also key variable to measure the implementation of iodine supplementation in a population. Optimal iodine nourishment is measured by median urinary iodine concentration as per recommendation given by World Health Organization (WHO) and United Nations Children's Fund (UNICEF).⁸ Concentration of urinary iodine of 100-199 µg/l in samples from school children and adults suggest adequate intake of iodine. The theory or postulation behind this recommendation was that, only 20% of population was found with <50 µg/l urinary iodine concentration, if threshold level of median urinary iodine concentration of 100 µg/l achieved.⁹

World's largest goitre belt found in India, that was extending from Kashmir to the Naga hills in the east and even we can say that no state in India entirely free from goitre. Almost 263 district were found endemic in sample survey, in which the prevalence of IDD is >10%. An estimated 71 million persons are suffering from goitre and other iodine deficiency disorders in the entire country.¹⁰

So, recognising importance of iodine intake for better nourishment and health, Community Medicine Department of Government Medical College, Surat carried out research activity to determine median urinary iodine excretion in urine samples among school going children of Dang district of Gujarat.

Aims and objective

1. To determine median urinary iodine excretion of urine samples.
2. To know status of iodine deficiency based on median urinary iodine excretion

METHODS

A state level IDD laboratory is running by Community Medicine Department of Government Medical College, Surat with the support of State Nutrition cell. Different activities carried out by IDD laboratory are: 1) to organise visits for collection of urine sample from different part of state Gujarat at regular interval, 2) to examine the school going children for iodine deficiency

disorders, 3) analysis of urine samples by Sandell-Kolthoff reaction, 4) to document median urinary iodine excretion and 5) reporting to state nutrition cell for further planning and necessary action.

As a part of activity of state IDD laboratory, community based cross sectional study was carried out among purposively selected primary schools of five villages of the Dang district. All students between the age group of 6 to 12 years who were present on the day of visit were included in the study. A total 387 urine samples were collected during the period of August 2015 to September 2016. Data were entered and analysed using Microsoft office excel 2013.

We used epidemiological criteria given by WHO, for evaluating iodine nutrition, based on median urinary iodine excretion in school going children. The frequency below the cut off value of 100, 50 and 20 µg/l correspond to mild, moderate and severe iodine deficiency, respectively. The frequency of population having laboratory result above 200 µg/l indicates having risk of iodine-induced hyperthyroidism.

Table 1: WHO criteria for evaluating iodine nutrition.

Median urinary iodine (µg/l)	Iodine intake	Iodine nourishment
<20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Optimal
200–299	More than adequate	Risk of iodine induced hyperthyroidism in susceptible groups
≥300	Excessive	Risk of adverse health consequences

Adopted from WHO¹¹

RESULTS

Out of total 387 samples, village Ahwa had median value of 100 µg/l, while all other villages had a median value below 100 µg/l. For total samples, median urinary iodine excretion was 70 µg/l (Table 2).

Urinary iodine excretion ≥100 µg/l, was highest (52.1%) in 12 years of age and lowest (14.3%) in 6 years of age. Gender wise distribution of urinary iodine excretion showed that the proportion of children with urinary iodine excretion <100 µg/l, was 63.4% among male students and 66% among female students (Table 3).

In a figure, it can be easily recognised that adequate intake of iodine (100-199 µg/l) was seen in more than half of study population of Ahwa village (51.6%); in Dhodhalpada, Chikar, Malegav and Sunaniya villages,

about 16.4%, 3.7%, 31.9% and 30.6% study population had adequate iodine nutrition, respectively. Nearly or more than 50% of samples from each villages had insufficient iodine intake revealed by their median

urinary iodine excretion of $<100 \mu\text{g/l}$. Few Urine samples from Malegav and Sunaniya showed more than adequate ($200\text{--}299 \mu\text{g/l}$) and excessive iodine intake ($\geq 300 \mu\text{g/l}$) (Figure 1).

Table 2: Village wise distribution of median and mean urinary iodine excretion.

Village	Urine sample collected (n)	Median urinary iodine excretion ($\mu\text{g/l}$)	Mean $\pm$ SD
Ahwa	126	100	92.3 ± 45.22
Dhodhalpada	73	60	60.68 ± 29.87
Chikar	54	50	49.72 ± 28.03
Malegav	72	77.5	93.86 ± 72.53
Sunaniya	62	85	102.34 ± 83.45
Total	387	70	83.87 ± 61.18

Table 3: Age and gender wise distribution of urinary iodine excretion.

	Total sample collected	<100 µg/l		≥100 µg/l	
		No	%	No	%
Age					
6	49	42	85.7	7	14.3
7	50	34	68	16	32
8	26	22	84.6	4	15.4
9	56	41	73.2	15	26.8
10	22	17	77.3	5	22.7
11	38	23	60.5	15	39.5
12	146	70	47.9	76	52.1
Total	387	249	64.3	138	35.7
Gender					
Male	246	156	63.4	90	36.6
Female	141	93	66	48	34
Total	387	249	64.3	138	35.7

Figure 1: Village wise assessment of iodine intake based on median urinary iodine excretion.

Table 4: Village wise assessment of iodine nutrition based on median urinary iodine excretion.

Village	Total sample taken	<20 (Severe iodine deficiency)		20-49 (Moderate iodine deficiency)		50-99 (Mild iodine deficiency)		100-199 (Optimal)		200-299 (Risk of iodine induced disorders)		>300 (Risk of adverse consequence)	
	No	No	%	No	%	No	%	No	%	No	%	No	%
Ahwa	126	5	1.3	10	2.6	45	11.6	65	16.8	0	0	1	0.3
Dhodhalpada	73	4	1.0	25	6.5	32	8.3	12	3.1	0	0	0	0
Chikar	54	6	1.6	20	5.2	26	6.7	2	0.5	0	0	0	0
Malegav	72	3	0.8	20	5.2	20	5.2	23	5.9	4	1.0	2	0.5
Sunaniya	62	7	1.8	10	2.6	16	4.1	19	4.9	6	1.6	4	1.0
Total	387	25	6.5	85	22.0	139	35.9	121	31.3	10	2.6	7	1.8

Almost 64.4% of children had median urinary iodine excretion of <100 µg/l, suggested iodine deficiency among them. Out of 387 samples, 31.3% of samples had optimal median urinary iodine excretion (100-199 µg/l) and few samples (4.4%) had median urinary iodine excretion of >200 µg/l. According to WHO guideline, if samples with median urinary iodine level <50 µg/l among surveyed population is less than 20%, it suggests adequate iodine nutrition. In this study, proportion of samples with urinary iodine <50 µg/l was 28.5%, which suggest inadequate iodine nutrition among study population (Table 4).

DISCUSSION

Urinary iodine concentration is the most suitable biochemical indicator for assessment of iodine nourishment. Insufficient iodine nutrition is a precursor of future increase in range of iodine deficiency disorders. In addition, excessive iodine intake has also adverse health consequences. Optimum median urinary iodine excretion is 100-199 µg/l, which suggest adequate iodine intake. If the person is having adequate iodine intake, chances of occurrence of iodine deficiency disorders would be less.¹¹ In our study, if we consider a median urinary iodine excretion of total urine samples, it was just 70 µg/l, which suggest mild iodine deficiency in our study population. In contrast, study carried out in Amreli, Jammu and Delhi median urinary iodine excretion is ≥100 µg/l, suggest adequate iodine intake.¹²

Median urinary iodine excretion of ≥100 µg/l was not found in any of the age between 6 to 12 years. Median urinary iodine excretion was lowest in children of 8 years (45 µg/l) age and highest in children aged 12 years (90 µg/l). In our study, about 35.7% of the surveyed population showed median urinary iodine level ≥100 µg/l. In contrast, study carried out in Dahod district of Gujarat, about 57% of surveyed population showed median urinary iodine level ≥100 µg/l. Proportion of children with urinary iodine excretion less than 100 µg/l was lowest (47.9%) among 12 years students and highest (85.7%) in 6 years students where as in Dahod study, proportion of children with median urinary iodine

excretion <100 µg/l, was lowest in children of 6 years age (36.8%) and highest in children aged 10 years (47.5%).

In this study, about one third (31.3%) of analysed samples showed adequate iodine nutrition. In the study of Dahod, Amreli and Gandhinagar, about 57%, 61% and 78% analysed samples showed adequate iodine nutrition, respectively.^{1,12,13} In our study, proportion of samples with urinary iodine excretion <50 µg/l was 28.5%, suggestive of inadequate iodine nutrition according to the WHO guideline of “Assessment of iodine deficiency disorders and monitoring their elimination”. In contrast, in the study of Dahod, proportion of samples with urinary iodine excretion <50 µg/l was found to be 15.6%, which is <20%, corresponds to the category of adequate iodine nutrition as per WHO guidelines for monitoring for IDD.¹

Based on median urinary iodine excretion, among total analysed samples, about 6.5% samples confirmed severe iodine deficiency, 22% samples showed moderate iodine deficiency & about 36% samples indicated mild iodine deficiency. In the study carried out in Amreli, about 5.95% samples endorsed severe iodine deficiency, 6.67% samples indicated moderate iodine deficiency and about 25.95% samples suggested mild iodine deficiency.¹²

Various studies revealed that single urinary iodine measurement is not representative of an individual's nutritional iodine status. Urinary iodine concentrations are useful, when used in cross sectional epidemiological surveys with appropriate samples size.¹⁴⁻¹⁶

CONCLUSION

From the finding of this study, it has been noted that about one third (31.3%) of the surveyed population had adequate iodine intake while majority (64.4%) of them had inadequate iodine intake.

Recommendations

There is a need of doing a detailed research with adequate sample size which can represent real scenario of iodine nutrition in the Dang District.

Limitations

Only five schools with limited sample size has been included in this study. We have not assessed amount of salt consumption as well as iodine content of the salt.

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