

Goiter prevalence and median urinary iodine concentration in Ethiopian reproductive age women and school age children

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Abstract

Background: Iodine deficiency occurs when the diet is low in iodine. Goiter prevalence in school-age children is an important indicator of iodine deficiency disorders in a population. Urinary iodine concentration is the prime indicator of a person's recent nutritional iodine intake. The effectiveness of universal salt iodization is reflected by an increase in urinary iodine excretion in school age children.

Objective: To assess goiter rate and urinary iodine level in reproductive age women and school age children in Ethiopia.

Method: National and regional representative cross-sectional study was conducted. Data was collected from 356 enumeration areas across the country. Households with in each enumeration area were selected randomly. Goiter examination was done by trained data collectors with background of nursing, laboratory technician and nutritionists using WHO goiter categorization. Urine samples were collected from reproductive age women and school age children. Urinary iodine excretion was determined by the Sandell-Kolthoff reaction method.

Results: The prevalence of goiter was 10.8% in reproductive age women and 3.7% in school age children. Highest goiter rate was found in Benishangul/Gumuz (28%) and Tigray (20%) regions. There was goiter rate and median urinary iodine concentration difference between regions. Median urinary iodine concentration was 106 µg/l in school age children and 98 µg/l in reproductive age women with cumulative median urinary iodine at national level of 101.1µg/l. Half of school age children and reproductive age women were getting adequate iodine intake. Based on rapid test kit assessment, the coverage of iodized salt was around 85%, but only 26% of the household gets adequate iodized salt (>15 ppm).

Conclusion: There is promising progress to eliminate iodine deficiency disorder in Ethiopia. Adequately iodized salt intake is very limited in both age groups. Considering that the presence of both iodine deficiency and excessive intake in Ethiopia, health planners and programmers needs to focus on standardizing salt iodization process and strengthening control of illegal non-iodized salt trading.

Key words: Goiter, Iodine Deficiency Disorder, salt, urinary iodine.

Introduction:

Iodine deficiency disorder (IDD) is a global public health issue (Li et al. 2010) and claimed to be the world's single most preventable cause of brain damage and mental retardation (Mannar and Dunn 1995). Iodine is needed to make thyroid hormones which are essential for normal metabolism, growth, and brain development (WHO 2007). Different environmental and individual factors are involved in the etiology of goiter, but iodine deficiency is the most important epidemiologic factor (Brauer et al. 2006). Iodine status is known to be directly related to intake (Chakraborty et al. 2010) and the sources of dietary iodine are water, food and iodized salt available in the household (Chandra et al. 2008). Iodine deficiency primarily occurs when the diet is low in iodine due to low levels in foods from plants and animals. The enlargement of the thyroid gland

due to dietary iodine intake consistently lower than 50 µg/day which usually results in iodine deficiency called goiter. Goiter prevalence in school-age children is an important indicator of iodine deficiency disorders in a population (Zimmermann et al. 2004) and the concentration of iodine in the urine is the prime indicator of a person's nutritional iodine status.

The effectiveness of universal salt iodization is reflected by an increase in urinary iodine excretion (Gomo et al. 1999). Iodized salt is the best means for providing iodine to iodine-deficient populations (Mannar and Dunn 1995) and has greatly reduced the prevalence of severe iodine deficiency disorders in the world. Ethiopia is a country with a 25% national goiter prevalence and high prevalence of iodine deficiency disorders which continues to affect a large number of the population (Cherinet and

Kelbessa 2000) associated with low iodine intake (Tebib 1993). Another study also shows that iodine deficiency rate of 35.8% which significantly. The problem of iodine deficiency is also very high in school children. A study conducted in ten different villages of school children measured by palpation has shown more than 53% goiter prevalence and was higher in females (Cherinet and Kelbessa 2000). Urinary iodine is the most important biochemical indicator that indicates current state of iodine nutrition and also used as a valuable indicator for the assessment of IDD because 90% body's iodine is excreted through urine (Chandra et al. 2008).

Recognizing the burden of the problem, the Government of Ethiopia implemented national program for the control of iodine deficiency disorders including, legislation decree for universal salt iodization in the country (Ethiopian Parliament 2010). However, there is a need to undertake regular cyclic surveys to assess the urinary iodine excretion and reduction of goiter problem in the country. As to the knowledge of authors of this paper, there is no recent nationally available evidence on the concentrations of urinary iodine and total goiter rate in Ethiopia. This finding provides the current status of iodine nutrition and status of universal salt iodization in the country which will helpful for health planners, program implementers and control authorities to design appropriate interventions.

Materials and Methods

A national and regional representative population based cross-sectional study was conducted. The study was conducted in 9 regions and 2 city administrations and samples were selected from 356 enumeration areas and 3805 households were visited. Two stages of sampling were applied. In the first stage, national list of enumeration areas (EAs) was obtained from the Central Statistics Agency (CSA) and used as sampling frame. The CSA randomly selected EAs using probability proportional to size and provided to survey team. At the second stage of sampling, EAs were visited by team of data collectors to conduct a quick listing of all the households within the boundary of each selected EAs. Within each EAs, households were selected randomly. All participants involved in this study were asked to their consent. All the eligible reproductive age women and school age

associated with reproductive failure (Abuye and Berhane 2007).

children were clinically examined for the enlargement of thyroid (goiter) by trained data collectors using palpation method. Goiter grading was done based on WHO/UNICEF/ICCIDD criteria [Grade 0: no goiter; Grade1: palpable thyroid but not visible; Grade 2: visible thyroid with neck in normal position (WHO 2007).

Ten ml urine sample was collected from reproductive age women and school age children for urinary iodine measurement. Subjects were provided with a pre-labeled 60 ml urine collection plastic container and asked to provide urine sample. Upon receiving the urine sample, the team ensured the screw cap was fastened and the tube was dry. Urine tube was placed in ice box and transported to the nearest health facility at the end of each day. Upon arrival at the health facility, the laboratory technologist counter checked the sample label with the laboratory control checklist. The urine samples were then transferred into two same label 5ml cryovial tubes and each set of urine samples were placed into a separate cryovial box and frozen at -20°C until shipment to the EPHI.

A onetime thawing of the urine samples was conducted and analysis of urinary iodine was done at the Food Science and Nutrition Laboratory of EPHI. The urinary iodine test was done based on the Sandel Kolthoff reaction method which utilizes the catalytic effect of iodide on the oxidation reduction of Cerium ions (Ce^{4+}) and Arsenite (As^{3+}) accompanied by color change. The speed of the color disappearance is proportional to the concentration of iodide catalyzing the reaction. To quantify the iodine content in salt samples, about 20 g of salt from each household was collected and the salt samples were kept at room temperature in the laboratory until analysis. Sample of salt collected from each household was measured for iodine level using the iodometric titration method.

Results

Of the total listed individuals from all households nearly 26% were school age children. Sex composition was almost similar in all age groups. A total of 2155 reproductive age women and 2156 school age children were assessed for goiter.

Table1: Percentage distribution by age and sex of the study participants

Sex	N	<5 years	6-14 years	15-49 years	>49 years
Male	8216	18.7	26.2	44.1	11.1
Female	8652	17.0	25.5	46.7	10.8
Total	16868	17.8	25.8	45.4	10.9

Goiter rate among reproductive age women:

National goiter rate was 10.8% in reproductive age women. Highest total goiter rate was found in Benishangul Gumuz region (28%). Tigray region has

the highest visible goiter rate (11%). Lowest prevalence of all forms of goiter was examined in Afar region. There was no goiter case examined in Somali region among reproductive age women.

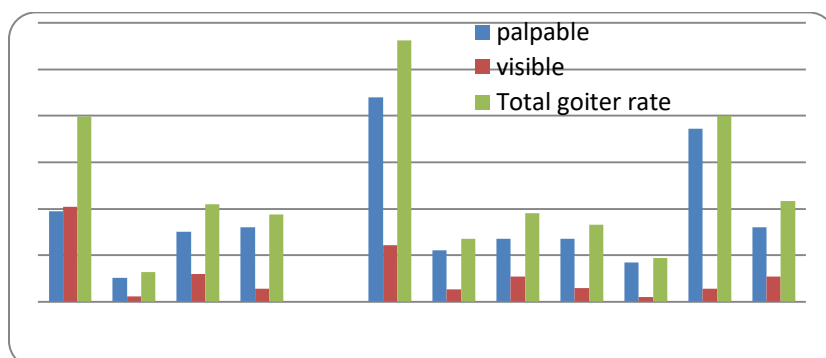


Figure1: Prevalence of goiter rate among reproductive age women, Ethiopia, 2015

Goiter rate among school age children: Nationally, school age children total goiter was found to be 3.7% with highest rate in Dire Dawa (14.1%) and Benishangul Gumuz (11.4%). Except for Oromia, SNNPR and Gambela regions, total goiter rate in

school age children was above the national level. Visible and palpable goiter cases were not found in Addis Ababa, Afar and Somali regions among school age children.

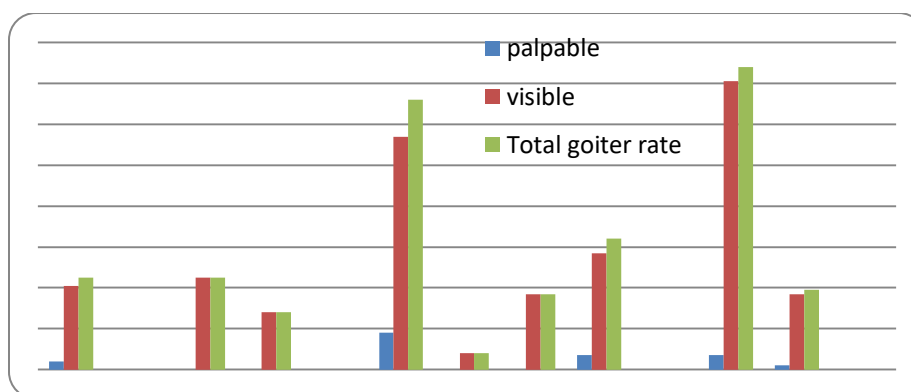


Figure2: Prevalence of goiter rate in school age children, Ethiopia, 2015

Median urinary iodine concentration: Nearly half of the reproductive age women and 54.2% of school age children had adequate iodine intake at the national level. Proportion of urine samples with adequate iodine concentration from reproductive age women of Somali, Afar and Dire Dawa regions were 88, 86 and 73 µg/l, respectively with national median urinary iodine concentration of was 98.18 µg/l. The highest and lowest concentrations were observed in Afar and Amhara regions, respectively (Table 2). The median urinary iodine concentration in school age was 105.59 µg/l. The highest median urinary iodine

was measured in Afar, Somali and Tigray regions respectively and lowest intake of iodine was measured in Amhara, Oromia and SNNPR region (Table 3).

Household Iodized salt coverage in Ethiopia: From 3200 households, only 26% of them were getting more than 15 ppm iodine in salt. The highest coverage of adequately iodized salt was found in Tigray, Somali, Dire Dawa and Oromia regions, respectively while there is lowest coverage in Gambela and SNNPR regions. High variability in

proportion of households with salt iodine content was found across the country.

Table 2: Median urinary iodine concentration of reproductive age women, Ethiopia, 2015

Region	n	Median UIC	Urinary iodine concentration % urinary Iodine concentration WHO Cutoff points				
			µg/l	<20 µg/dl	20-49 µg/dl	50-99 µg/dl	>100µg/dl
Tigray	219	82.51	7.8	19.6	31.1	41.6	
Afar	81	217.09	2.5	7.4	3.7	86.4	
Amhara	227	68.26	4.8	26	39.2	30	
Oromia	225	105.63	5.3	11.1	30.7	52.9	
Somali	110	208.22	0	1.8	10	88.2	
B/Gumuz	124	73.56	1.6	21.8	43.5	33.1	
SNNPR	180	112.36	0.6	14.4	31.1	53.9	
Gambela	119	69.6	2.5	25.2	36.2	36.1	
Harar	210	89.3	3.8	19.5	34.8	41.9	
Dire Dawa	136	139.92	1.5	4.4	20.6	73.5	
A.A	182	95.16	2.2	8.8	42.8	46.2	
National	1813	98.28	3.4	15.	31.5	49.5	

Table 3: Median urinary iodine concentration of school age children, Ethiopia, 2015

Region	N	<15 ppm Iodine	≥15 ppm Iodine
Tigray	344	44.8	55.2
Afar	193	83.4	16.6
Amhara	447	85	15
Oromia	382	76.7	23.3
Somali	257	50.6	49.4
B/Gumuz	240	79.6	20.4
SNNPR	300	86.3	13.7
Gambela	137	90.5	9.5
Harar	298	77.2	22.8
Dire Dawa	244	70.9	29.1
Addis Ababa	379	78.1	21.9
National	3221	74.2	25.8

Region	n	Urinary Iodine Concentration				
		Median UIC	% Urinary iodine concentration WHO Cutoff points			
		µg/l	<20 µg/l	20-49 µg/l	50-99 µg/l	>100µg/l
Tigray	239	206.58	1.3	2.9	17.1	78.7
Afar	124	339.79	0.7	2.2	5.2	91.9

Table 4: Household iodized salt coverage in by region

Amhara	229	72.14	3	27.1	40.6	29.3
Oromia	262	80.81	0.8	19.1	43.1	37
Somali	109	333.19	0	2.8	6.4	90.8
B/Gumuz	111	85.58	2.7	15.3	48.6	33.3
SNNPR	175	80.34	14.9	16	29.1	40
Gambela	101	103.28	5	14.9	26.6	53.5
Harar	263	95.97	1.1	13.3	37.6	47.9
Dire Dawa	123	140.73	0	4.1	20.3	75.6
Addis Ababa	116	94.33	0.9	13.8	39.7	45.7
National	1852	105.59	2.7	12.9	30.2	54.2

Discussion

In this study, goiter rate found 10.8 % in reproductive age women, which is a major public health concern based on classification of WHO/UNICEF/ ICCIDD. Prevalence of goiter in school age children of Ethiopia was high and varied among regions (Abuye and Berhane 2007; Kidane and Woldegebriel 2006). In this study, total goiter rate in school age children is below 5%, which is not considered as a public health problem but similar to past studies varies across the regions (Tebib 1993). This change may be attributed to the mandatory fortification program done in the country which is similar to the success of South Asia countries by large scale IDD control programs (UNICEF 2002). Quantification of urinary iodine is accepted as a valuable estimation of the recent iodine intake (Als et al. 2003). In Ethiopia there is no evidence on median urinary iodine concentration for reproductive age women at national level but the median urinary iodine for children was reported 24µg/l (Cherinet and Kelbessa 2000). In this study, the median urinary iodine in reproductive age women and school children was found 98µg/l and 106µg/l respectively. This value is close to the recommended for reproductive age women and within the recommended range for children. We have also found big variation in urinary iodine concentration among regions. The difference might be due to homogeneity problem during salt fortification and instability of iodine in the salt.

Conclusion

The problem of iodine deficiency disorder is decreasing in reproductive age women and school age children. Goiter rate reduction is promising to make iodine deficiency as no more public health problem in Ethiopia. To maintain the current progress, health planners and programmers needs to focus on standardizing salt fortification process and strengthening control of trading system in Ethiopia.

Acknowledgements: The authors would like to acknowledge Ethiopian public health institute, regions, individual respondents, regional coordinators, supervisors and data collectors.

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