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Assessment of Handling Practices, Utilization and Concentration of Iodine in Iodized Salt at *Wondo Genet town,* Southern Ethiopia: A Crossectional Study

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Abstract- **Iodine deficiency is severe public health problem in Ethiopia. One out of every 1000 population is mentally handicapped due to a congenital thyroid deficiency, and about 50,000 prenatal deaths are occurring annually due to iodine deficiency disorders. Even though the problem is serious, there were no adequate researches conducted. Therefore, this study focuses on assessment of handling practices of iodized salt and the amount of iodine concentration retained in iodized salts at households and retailers level in Wondo Genet town. The objective of this study was to assess handling practices and concentration of iodine across iodized salt consumption in retailers and households level. Two hundred ninety four households and seventh six retailers were selected by systematic random sampling method for survey using questionnaire and rapid test kit method was used to measure iodine concentration of salt used by the households. The result of this study indicated that iodized salt coverage was found to be 100 % at households and retailers level. Iodine level in the salt examined by iodometric titration, in this study was 4.4 to 70.9 ppm. This indicates the need for further improvement of handling practices of iodized salt. Iodine level in the salt examined by iodometric titration in this study was 60.54% of households and 65.79% retailers salt samples had 15 – 40 ppm iodine concentration. This shows that in the iodized salt there is no adequate iodine content in accordance with the recommendation. Majority of the households 37.4% add iodized salt half way during boiling of the food/coffee. Although the coverage of iodized salt in the study area was high but availability of adequate iodized salt at household level was low as compared to the WHO recommendation.**

There for this shows that handling practice of iodized salt at the household and retailer level and utilization practice at the household level is poor.

Index Terms- **Iodized salt, Iodine concentration, Households, Retailers, awareness, utilization, handling practices**

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I. INTRODUCTION

Iodine is a vital nutrient which is used in the production of thyroid hormones that are fundamental for the normal development of the nervous system (Yarrington and Pearce, 2011). Limited hormone secretion negatively affects tissues of the nervous system and other parts of the body resulting in the disease states generally known as Iodine Deficiency Disorders (IDD). IDD include mental retardation, defects in development of the nervous system, goiter, physical sluggishness, growth retardation, reproductive failure, increased childhood mortality and economic stagnation.

The most shocking of these effects are on the developing human brain most importantly during fatuous and early childhood (Venkatesh and John, 1995) Iodine deficiency remains a major global threat to health and development, because it is the most common cause of preventable mental impairment worldwide(Zimmermann *etal.,* 2008). Severe iodine deficiency during pregnancy also increases the risk of spontaneous abortion, stillbirth, reduced brainpower, neurological cretinism, poor cognitive functions, and late
psychomotor developments (Yarrington and Pearce, 2011) (Zimmermann 2009). Iodine deficiency is severe public health problem in Ethiopia (Abuye and Berhane 2007). One out of every 1000 population is mentally handicapped, due to a congenital thyroid deficiency, and about 50,000 prenatal deaths are occurring annually due to iodine deficiency disorders (Hailay *etal*., 2013). It is striking that of the total population, 26% have goiter and 62% are at risk of IDD according to national survey made by the previous Ethiopian Nutrition (Hailay *etal*., 2013). According to the World Health Organization (WHO) recommendation, minimum Iodine intake is (population requirement) 150 μg/day for adults and adolescents 13 years of age and older, 200 μg/day for women during pregnancy and lactation, 120 μg/day for children 6–12 years of age,

and 90 μg/day for children 0–59 months of age (WHO, 2004). Based on the current estimates, worldwide, the iodine intake of 29.8% or 240.9 million populations are insufficient. Of these, 5.2% have iodine intakes that are severely deficient, 8.1% have iodine intakes that are moderately deficient, and 15.9% have mildly deficient intakes (Andersson *etal*.,2012) [9]. Nearly two billion (28%) of the world's population, of whom more than 321 million (39%) are Africans, are at risk of insufficient iodine intake (Andersson *etal*., 2011). Based on the global data of iodine nutrition, Ethiopia is categorized among moderately iodine deficient countries (Andersson *etal*., 2011). Thus, iodine deficiency has been identified as a serious public health problem for the Ethiopian population. As a result a national regulatory provision for mandatory universal salt iodization was offered in 2011. Iodization of salt has been taken as the most efficient way to tackle the problems associated with inadequate intake of Iodine. Even if progress is being made at national level in tackling the problem of Iodine deficiency, issues about awareness about uses of Iodized salt, lose of the Iodine from the Iodized salt due to improper handling, cooking methods and storage at household level remain a big challenge Thus, iodine deficiency has been identified as a serious public health problem for the Ethiopian population. As a result a national regulatory provision for mandatory universal salt iodization was offered in 2011. Iodization of salt has been taken as the most efficient way to tackle the problems associated with inadequate intake of Iodine. Even if progress is being made at national level in tackling the problem of Iodine deficiency, issues about awareness about uses of Iodized salt, lose of the Iodine from the Iodized salt due to improper handling, cooking methods and storage at household level remain a big challenge.. For example, recent studies conducted in Gondar, rural parts of Hawassa Town and Haromaya summarized factors related to utilization of Iodized salt as place of residence highlighted that according to the Ethiopian Demographic and Health Survey (EDHS), in 2010, only 15.4 percent of the households were using iodized salt (Abuye and Berhane 2007) (Hailay *etal*., 2013). A recent indicated more than 80% coverage of utilization of Iodized salt in Ethiopia (EHNRI report unpublished). The same report also indicated that here is significant lose of iodine from iodized salt by the time the salt is at household level. The problems in cooking and washing the iodized salt at household level were indicated in the literature. In addition, lack of awareness at household level about health benefits of iodized salt compared to the non iodized salt was indicated as one of the biggest obstacles in expanding utilization of Iodized salt in Ethiopia Abuye and Berhane 2007) (Hailay *etal*., 2013)(Haji *eta*l.,2014).

Ethiopia is one of the African countries with the highest prevalence of IDD and with the weakest program to prevent IDD. From 34.5% to 37% of the childbearing women in the country have goiter (Abuye and Berhane, 2007). .Furthermore, the percentage of households that use iodized salt was higher in urban areas than in rural areas; that is 23.2% in urban and 13.3% in rural (CSA and ICF, 2012). According to recent ENMS (2014) report**,** the coverage of iodized salt at national level seen as 88.8% and 94.4% by Rapid Test Kit (RTK) and iodometric titration respectively, but adequacy (>15ppm) was reported to be only 42.7%. Whereas, the coverage of iodized salt at SNNP regional level was 80.9% by RTK and 33.5% by iodometric titration, but adequacy (>= 15ppm) was reported to be only 27% (EPHI, 2014). Even though the problem is series, there were no adequate researches conducted. Therefore, this study helps to identify the handling practices of iodized salt and the amount of iodine concentration retained in iodized salts at retailers and households level.

II. MATERIALS AND METHODS

A. Study Area

Sidama zone is one of the 13 zones found in the Southern Nations, Nationalities and Peoples Regional Government (SNNPRG) with estimated total population in about 3 million most of which reside in rural areas. In the zone there are 19 Woredas and 2 town administrations. The potential health service coverage of the zone in 2005 was 38%. This study was conducted at one of randomly selected *kebeles* in Wondo Genet town at sidama zone.

B. Study Densign and Period

Community based cross sectional study design was used to collect data from Feb - Mar, 2016.

C. Source Population

All retailers engaged in trading of salt as well as all households in Wondo Genet town was taken as our source population.

D. Study Population

Randomly selected retailers engaged in trading of iodized salt and households in Wondo Genet town were taken as our study population.

E. Sampling Technique

Multistage random sampling technique was used in the following procedure. Wondo Genet woreda is randomly selected from sidama zone woredas. One Kebele was randomly selected from Wondo Genet town.

F. Sample Size Calculation

Calculation of statistically representative sample households was based on population. The population

proportion value in the following formula was 54% which is the proportion of households with salt iodine concentration less than 15ppm. Thus, the sample size calculation is done using the following formula.

$$n=Z^2_{(1-\alpha/2)}\, pq/d^2$$

Where Z is 1.96,
p is the proportion of households with iodine concentration less than 15ppm i.e 54%
q is 1-p which is 46%
d is 0.05
Finally substituting the above values in the formula,
$n= (1.96)^2 (0.54)(0.46)/0.0025=$**381**

G. Inclusion and Exclusion Criteria

All households who were permanent resident of Wondo Genet town were included in this study, but those who were not permanent resident of Wondo genet town were excluded**.**

H. Data Collection

Information about awareness and handling practices of iodized salt were collected using structured questionnaire using a face-to-face interview technique. Salt samples were collected from whole sellers, retailers and households for laboratory analysis at Hawassa University.

I. Pre Test

The structured questionnaire were pre-tested on 5% of sample size in one kebele which was out of the selected kebele of Wondo Genet town having similar socio-demographic characteristics with the study population. Based on the findings of the pre-test, necessary comments were incorporated to the questionnaire prior to the actual survey. All retailers and households who were included in the pre-testing were excluded from the actual study.

J. Testing Salt for Iiodine Cintent at Households and Rentailers

The salt sample was tested for iodine content in all sampled households and retailers and using iodometric titration..

K. Salt Sample Collection

Approximately 20 gram of salt sample used for cooking and retailing was collected from the randomly selected households and retailers in the study area. All the collected salt samples from the two areas were packed with air tight plastic vials and covered with plaster in order to prevent it from light. And finally samples were transported to the laboratory of the department of Human Nutrition at Hawassa University for analysis.

L. Data Collectors

Four data collectors were recruited and trained on the research topic as well as on the questionnaires for two days prior to the pre- test. The data collectors were recruited based on their Amharic and Sidamu Afo/ language capacity. The investigators supervised the data collectors at the time of data collection. Data was cleaned and checked for completeness at daily basis by the investigators.

M. Data Analysis

The principal investigator drafted dummy tables with consideration of the main research questions after designing the questionnaires. The collected data were categorized and coded on a pre-drafted coding sheet. Data entry, cleaning and analysis was done using SPSS software program version 20. Descriptive data was summarized with tables and graphs. The qualitative data was transcribed and summarized manually.

N. Ethical Considerations

Ethical clearance was obtained from IRB of the Hawassa University. Then the concerned officials from the town at each level are communicated through formal letter. The purpose of the study was explained in detail to the respondents and their consents were obtained.

Respondents were interviewed only when they agreed and signed the consent forms.

III. RESULT

A. Iodine Concentration of Salts from the Retailers

Iodine concentration of retailers' salt sample was shown in figure 2. The highest percentage 65.79% was recorded for iodine concentration of 15 to 40 ppm range and the remaining 21.04% and 13.16% was recorded for iodine concentration of greater than 40 ppm and less than 15 ppm.

Table 1. Awareness and handling practices on iodized salt at retailer's 2016

Characteristics		No	%
Selling of iodized salt	Yes	76	100
	No	0	0
ace of purchasing iodized salt	Local market	48	63.2
	Shop	10	13.2
	Other	18	23.7
Length of storage of iodized salt:	For a week	17	22.4
	For 2 – 3 weeks	17	22.4
	For a month	24	31.6
	For 6 months and above	18	23.6
Awareness on benefit of iodized salt:	Prevents from IDDs	60	78.9
	Do not know	12	15.8
	Other	4	5.3
Awareness on prevention of goiter:	Eating sea food	6	7.9
	Using iodized salt	66	86.8
	Drinking holy water '*tsebel*'	2	2.6
	Other	2	2.6
Storage place for iodized salt:	At home	68	89.5
	In the market place	4	5.3
	In the warehouse	4	5.3
Container type to store iodized salt:	Container with cover	18	23.7
	A plastic or a container used to buy the salt	50	65.8
	A plastic or a polyethylene bag	8	10.5
Washing practice of iodized salt:	Yes	10	13.2
	No	66	86.8
Sun Drying practice of iodized salt:	Yes	8	10.5
	No	68	89.5
Type of market place for iodized salt:	Market place with shading	72	94.7
	Market place without shading	4	5.3
Packing status of iodized salt:	Unpacked	51	67.1
		25	32.9

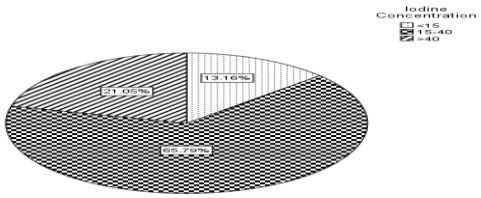

Figure . Iodine Concentration of retailers' salt sample in the study area, 2016 (a)

B. Awareness and Handling Practices on Iodized Salt of Retailers

The result of retailer's awareness and handling practice was shown in Table 4. It was indicated that 78.9% of the respondents had awareness on iodized salt that Iodized Salt prevents Iodine Deficiency Disorders (IDDs). The highest percentage 86.8% of respondents said using iodized salt prevents goiter, 7.9% said eating sea foods prevents goiter, 2.6% said drinking holy water prevents goiter.89.4% of the respondents stored their iodized salt at their home and 5.3% stored in shops and similarly 5.3% in warehouses. In the result it was showed that 65.8% of the respondents stored the iodized salt in a plastic or a container used to buy the salt, 23.7% stored in container with cover and the remaining 10. 5% stored in plastic or a polyethylene bag. It was reported that 86.8% of the respondents didn't wash their salt whereas the rest 13.3% washed their salt when it was contaminated with soil during retailing. Regarding sun drying of the salt 89.5% of the respondents dried their salt on sun whereas the remaining 10.5 didn't do it. The market place for iodized salt reported was 94.7% was in market place with shading the remaining 5.3% was in without shading. 67.1% of the packaging states of iodized salt was packed and the remaining 32.9% was unpacked in the retailers' shops.

C. Iodine concentration of salt samples from the households in the study area

As indicated in the above pie chart, 60.54% of the collected salt samples had 15 – 40 ppm iodine concentration, 20.41% had less than 15 ppm iodine concentration and 19.05% had more than 40ppm iodine concentration.

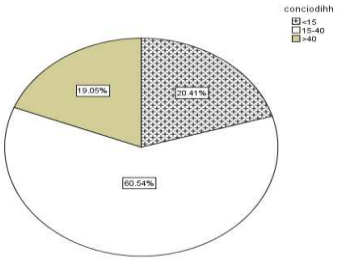

Figure. Iodine concentration of salt samples from the households in the study area, 2016 (b)

D. Household's awareness and handling practices on iodized salt

.All respondents had information about iodized salt and 57.1% got the information from radio broadcast; 22.1 from health workers and 10.5% from neighborhood friends. 70.4% of the respondents had awareness that iodized salt deficiency disorder was prevented by Iodized salt whereas 20.4% didn't have awareness about the same issue. 73.5% of the respondents indicated that using iodized salt prevents goiter. 58.2% bought iodized salt in once in a week interval, 28.2% bought once in a month and 12.2% once in every 2or 3 weeks. 86.1% of the respondents stored their salt in the container of this 82.3% with cover whereas 13.9% stored without container that means they stored in a plastic or a polyethylene bag in which the salt brought. 79.9% of the respondents didn't wash the salt and 20.1% washed; 47.5% washed it because of different color from the usual salt color, and 30.6% because of impurity.

Regarding to sun drying practice of iodized salt 81% of the respondents didn't dry their salt and the remaining 19 % did dry their salt on sun. It was showed that 56.5% of the respondents used packed iodized salt and 43.5 used unpacked iodized salt. Practice of salt addition in food/coffee was indicated in the Table 6; 37.4% of the respondents added salt half way during boiling of the food/coffee, 36.1% added after removing the food/coffee from the fire, 18.7% added

immediately after placing the food/coffee on fire and the remaining 7.8 added irregularly. It was showed that 93.5% of the respondents drink coffee and from this figure 74.9% added salt on their coffee.

IV. DISCUSSION

Availability and consumption of adequately iodized salt must be granted for sustainable elimination of IDD. According to WHO and International Council for Control of Iodine Deficiency Disorders (ICCIDD) standard, elimination of IDD will be possible if more than 90% of the households consume adequately iodized salt. Ethiopia, in its national guideline for control and prevention of micronutrient deficiencies, has set a goal to virtually eliminate IDD by the year 2015 through universal salt iodization (USI) and an objective to increase access to iodized salt among households up to 80% (FMOH, 2010). However according to the EDHS 2011 report, the national coverage of USI was only 15.4% (CSA and ICF 2012)

At household level, the recommended iodine concentration in salt should be 20-40 ppm in order to provide adequate iodine (WHO, 2007). This study showed that iodized salt was found in households and retailers were 100% which is comparable with the Southern Nation Nationalities and

Peoples (SNNP) region. However, iodine concentration of salt varied from 4.4 to 70.9 ppm, which indicates the need to further improvement in handling practice at households and retailers. Iodine level in the salt examined by iodometric titration in this study was 60.54% of households and 65.79% retailers salt samples had 15 – 40 ppm iodine concentration. This is higher than the report in Southern Nation Nationalities and Peoples (SNNP) region in which 33.5% of the people use adequately iodized salt (≥15ppm). The lower amount of ioden might be due to traditional salt production process (Chuko etal., 2015) and miss handling practices. The finding of this study is very high as compared to the study conducted in Laelay Maychew district, which showed that 33% of households had adequately iodized salt (Gidey *etal.,* 2015).

Similarly, study conducted in Bensa woreda, Sidama zone, which showed 35.6% and 39.3% of households in rural and urban had adequately iodized salt within the recommended range (Masresha etal., 2016).This finding is high as compared to EDHS 2011 report; the national coverage of iodized salt in Ethiopia was 15.4% (CSA and ICF 2012). This difference might be due to study area differences. EDHS was conducted both in urban and rural areas but the present study was conducted entirely in urban setting. Urban dwellers use iodized salt more as compared to rural dwellers as evidenced from EDHS 2011(CSA and ICF 2012). Regarding to the household's awareness and handling practices on iodized salt majority of the households 56.8 % used common salt (Coarse and iodized) without plastic package. This finding is lower than a study conducted in Laelay Maychew district, which showed that 72.7 % of households used common salts (Izzeldin, 2010). Majority of iodized salt user 75.9% purchase iodized salt from shop. The most frequently mentioned sources of information on iodized salt in this study were mass media like radio and television (57.1%) followed by the health worker. This might be due to this study was conducted urban setting majority of them have access to radio and Television. Majority of the households 37.4% add iodized salt half way during boiling of the food/coffee similarly a study conducted in Laelay Maychew district showed a similar result, 40.3% add salt in the early beginning and in the middle of cooking (Izzeldin, 2010)

Table 2 Awareness and handling practices on iodized salt at household's 2016

Characteristic		No 294	%
Type of salt used by households	Fine and iodized fine	127	43.2
	Coarse and iodized	167	56.8
Place of purchasing iodized salt	Local market	69	23.5
	Shop	223	75.9
	Other	2	0.7
Have information about iodized salt	Yes	294	100
	No	0	0
Source of information	Health workers	65	22.1
	Radio	168	57.1
	NGO	9	3.1
	Family	5	1.7
	Neighbors/friends	31	10.5
	I do no exactly	8	2.7
	Other	8	2.7
Benefit of using iodized salt	Prevents from IDDs	207	70.4
	I do no anything	60	20.4
	Other	27	9.2
Prevention of Goiter	Eating sea food	32	10.9
	Using iodized salt	216	73.5
	Eating fish	4	1.4
	Drinking holy water	2	0.7
	'Tesbel'	18	6.1
	Making Tatu	22	7.5
	Other		
Interval to buy iodized salt	Once in a month	83	28.2
	Once in every 2or 3 wks	36	12.2
		171	58.2
	Once in a week	4	1.4
	Other		
Amount of salt purchased once	< 1 kg	189	64.3
	1 kg	87	29.6
	2-5 kg	16	5.4
	≥ 10 kg	2	0.7
Place of storage	Dry and cool place	281	95.6
	Moist area	11	3.7
	Near to fire	2	0.7
Having container to store the salt	Yes	253	86.1
	No	41	13.9
Container type to store iodized salt	Container with cover	242	82.3
	Container without cover	6	2
	A plastic or a polyethylene bag in which the salt brought	46	15.6
Washing practice of iodized salt:	Yes	59	20.1
	No	235	79.9
Reason for washing iodized salt:	Because of different color from the usual salt color	28	47.5
	To remove impurities	8	30.6
	Other	23	38.9
Sun Drying practice of iodized salt	Yes	56	19
	No	238	81
Type of iodized salt used:	Packed	128	43.5
	Unpacked	166	56.5
Practice of salt addition salt in food/coffee:	Immediately after placing the food/coffee on fire	55	18.7
	Half way during boiling of the food/coffee	110	37.4
	After removing the food/coffee from the fire	106	36.1
	Irregularly	23	7.8
Adding practice of salt in the coffee	Yes	206	74.9
	No	69	25.1

V. CONCLUSION AND RECOMMENDATION

A. Conclusion

Although the coverage of iodized salt in the study area was high but availability of adequate iodized salt at household level was low as compared to the WHO recommendation to prevent IDD. The handling and utilization practice at the household level is poor.

B. Recommendation

- It would be better if the work of awareness creation on the utilization and handling practice of iodized salt by government or other Nongovernmental organization being strengthened.
- It would be better if further research work is done on factors associated with handing and utilization of adequately iodized salt.
- Further research on examining the iodine concentration of cooked food/coffee also recommended at the households' level.

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