FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

Knowledge and practices of iodized salt utilization, health consequences, and iodine concentration on dietary salts at retailer and households in Jigjiga town, Somali, Ethiopia

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Abstract: To warrant adequate supplementation of iodine at the consumer level, monitoring and evaluating the concentration of iodine in salt is an essential element of a programme to eliminate iodine deficiencies. This study aimed to determine the adequacy level of iodine concentration in dietary salt at the retailers and household level, and also to assess the level of knowledge and practices of iodized salt utilization in Jigjiga, Somali, Ethiopia. A community-based cross-sectional study using simple random systematic sampling was employed. Salt samples were collected from 90 households and 30 retailer shops. Nearly 88% of households and 80% of retailers had iodized salt. However, only 31.1% and 30% of the households and retailer shops had adequately iodized salt, respectively. Three-fourth (75%) of the participants ever heard about iodized salt. Only 31.3% and 8% of participants obtained information about adverse health effect of iodine and its preventive mechanisms from mass media and health workers, respectively. More than one-thirds (40.6%) of the participants’ never used iodized salt due to its high price. The presence of iodine in the salt affected 38% of the

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PUBLIC INTEREST STATEMENT
Iodine in different food vehicles has a public health significance at all human life cycle. Despite this fact, the knowledge about iodized salt utilization, inadequate iodine usage on health and iodine concentration in the most important food vehicle, especially iodized salt and dietary salt from market to household in the study area is limited. Therefore, this study was designed to investigate iodized salt utilization, health consequences and iodine content determination from iodized and dietary salts at different sellers and household. Thus, the finding of this study would help for designing intervention activities to improve the iodized salt utilization including awareness creation on the importance of iodine on human health, dietary source of iodine including iodized salt, and setting appropriate monitoring strategy for maintaining the availability and affordability of iodized salt along the iodized salt value chain.
participant’s taste. About 88% of the participants were storing dietary salt in a container with lid and/or polyethylene bag. Therefore, consistent and regular monitoring of iodized salt along the value chain should consider the availability and affordability.

**Subjects:** Nutrition; Food Additives & Ingredients; Food Chemistry; Food Laws & Regulations; Health & Society; Sociology of Health and Illness

**Keywords:** iodized salt; household; retailer; dietary salt; Jigjiga; Somali

1. Introduction

Iodine deficiency is one of the most important causes of preventable mental impairment around the world (WHO/UNICEF/ICCIDD, 2007). Iodine deficiency is among the causes for inadequate thyroid hormone production, which causes many adverse effects on growth and development (Zimmermann & Andersson, 2012). Many of these adverse consequences are collectively referred to as iodine deficiency disorders (IDD) (Mannar & Dunn, 1995). The most devastating of these consequences are on the developing human brain (Abuye et al., 2007a). IDDs are major public health problems in several areas of the world, especially in developing countries (Adu & David, 2017). It has been reported that about two billion people (33.3%) of the world’s population live in areas with iodine deficiency and are at risk of its complications (WHO, 2004; Wisnu, 2008), of which at least 321 million Africans are at risk of iodine deficiency (Andersson et al., 2012). Thus, iodine deficiency is among the public health problem in Ethiopia (Ethiopian Public Health Institute (EPHI), 2016). Endemic goiter is one of the observable manifestations of IDD (WHO, 2004). In Ethiopia, the prevalence of goiter has been increased from 29% (2000) to 31% (2004) to 39.9% which covers more than 4 million school age children in 2007 (Abuye et al., 2007a; MICAH, 2006). The national prevalence rate of goiter among women in the age of 15 to 49 years was also 35.8% representing more than 6 million women (Abuye and Berhane 2007). According to the recent national micronutrient survey report, the prevalence of iodine deficiency in children aged 5 to 14 years and women aged 15 to 49 years was 48 and 52%, respectively (Ethiopian Public Health Institute (EPHI), 2016).

Universal salt iodization (USI) has been a major focus and the most widely practiced intervention strategy for eliminating iodine deficiency problem globally. It is also an effective and preferable long-term public health intervention for achieving optimal iodine nutrition in deficient areas (Gebretsadikan & Troen, 2016a; Gerensea et al., 2016). Accordingly, studies in different African countries including Tanzania, Burundi, Kenya, Nigeria, Uganda, Tunisia, Namibia, Zimbabwe, Libya and Nigeria showed that the coverage of iodized salt in the households is dramatically increased and more than 80% after USI initiated in the countries (Gebretsadikan & Troen, 2016a; Assey et al., 2009). The national micronutrient survey in Ethiopia also reported that the national household iodized salt coverage was 85%; however, only 26% of the total households had salt with adequate amount of iodine (Ethiopian Public Health Institute (EPHI), 2016). However, these vary significantly from region to region, and rural to urban in the country.

Salt iodine testing is an important process indicator for monitoring progress toward USI (Knowles et al., 2017). To warrant adequate supplementation of iodine at the consumer level, monitoring and evaluating the concentration of iodine in salt (in particular by measuring iodine concentrations) is an essential element of a program to eliminate IDs, beside monitoring the extent of population at the risk of insufficient intake of iodine.

Despite many researches have been conducted in different areas of Ethiopia related with iodine deficiency at different vulnerable groups, and identified the iodine contents at the salt production, retailer, and household levels, to the best of the authors knowledge, there is no independent study conducted in Somali region except the two recent national studies: Ethiopian Demographic and Health Survey and Ethiopian micronutrient survey (Ethiopian Public Health Institute (EPHI), 2016; CSA, 2017). Therefore, this study was initiated to explore the knowledge and practices on IDD, iodized
salt, and iodine source diets; and identify the iodine concentration at the retailer and household levels in the Jigjiga town, a capital of Somali Regional State in the eastern part of Ethiopia.

2. Materials and methods

2.1. Study area and period
A community-based cross-sectional study was conducted between April 1 and May 31, 2016 in Jigjiga town, eastern part of Ethiopia. Jigjiga is a capital city of Somali Regional State, located in the eastern part of Ethiopia, which is far from Addis Ababa by 630 km. The town has an estimated total population of 125,876 (CSA, 2008). Moreover, the town has a latitude and longitude of 9°21'N 42°48'E with an elevation of 1,609 m above sea level.

2.2. Sample size determination and sampling procedure
All the households in the five kebeles of the town were eligible for this study. Sample size calculation was conducted using the single proportion population formula using the assumption of 95% confidence level, 5% marginal error and 50% prevalence (p) of iodine deficiency (ID), so that the final sample size was 384. For salt sample analysis, 90 households were sub-sampled from the total 384 households included in the study. Further, 30 salt samples were also collected from 30 retailer shops in the Jigjiga town. Two stage systematic random sampling was applied in order to get the households participated in this study. First, the urban kebeles in the Jigjiga town was listed, followed by selecting the five populous kebeles out of the ten kebeles in the Jigjiga town. Then, the numbers of households in the five kebeles were identified and the total sample taken from each kebele was identified based on the population proportion to size. The samples allocated for each five kebeles were drawn after the first households were identified and the next households were included using systematic random sampling approach. Similar approach was also applied for sampling salts from the retailer shops that participated in this study.

2.3. Data collection
The socio-demographic and economic characteristics, knowledge, and practices on iodized salt, iodine diet sources, and IDDs were collected using pre-tested and interviewer administered questionnaire. The questionnaire used was pre-tested in the 5% of the total sample considered in the study. Following this, data collection was carried out by five BSc graduating students in the Food Science and Nutrition department, at the Jigjiga University.

2.4. Salt sample collection and iodine content determination
About 100 g of salt samples was collected from each household and retailer shops kept in a closed plastic bag in dark room till analysis was done. Samplings were done from the top, middle, and bottom of the pack bag/containers to ensure the representativeness of the sample by using moisture-free, clean plastic container. Analysis was done in the laboratory of the department of Chemistry, Jigjiga University. An iodometric titration method was used to analyze the iodine content of salt samples using standard method (Shawel et al., 2010). Briefly, about 15 g of salt was dissolved in distilled water and made up to 50 mL solution. 1 mL of 2 N sulphuric acid and 5 mL 10% potassium iodide was added, which in the presence of iodine was turned yellow. The liberated iodine was titrated with 0.005 M sodium thiosulphate solution using 1 mL of 1% starch indicator near the end of titration. The level of thiosulphate in the burette was recorded and converted to parts per million (ppm) or mg/kg using a conversion table recommended by (Mannar & Dunn, 1995). The iodine concentration of the salt was calculated following the formula:

\[ \text{Mg/kg (ppm) iodine} = \text{titration volume in mL} \times 21.15 \times \text{Normality of sodium thiosulfate} \times 1000/ \text{salt sample weight in g} \]

2.5. Data analysis
Data were entered, cleaned, and checked before data analysis. The descriptive statistics was presented as frequency and percentage. Statistical analysis was conducted using SPSS version 20 IBM Corporation, New York, United States of America.
2.6. Ethics consideration and consent to participate

To conduct the research, ethical clearance was requested from the research publication and technology transfer directorate office of the Jigjiga University and approval was obtained. Then, support letter was written to each of the five kebele administrations. Additionally, the purpose of the study was explained to the participants and informed consent was obtained. The participants were also told that the information obtained from them were confidential and only used for the purpose of this study. Each participant was also informed to withdraw from the study in the course of the data collection whenever they felt to stop from involving in the study.

3. Results

3.1. Socio-demographic and economic characteristics

In this study, a total of 361 participants were included, with a response rate of 94.01%. Majority (67.9%) of the respondents were male. Half of the participants (49.4%) were between in the age range of 21–30 years. Almost one-thirds (32.4%) of the participants attended secondary education. Four out of ten participants had a monthly income between 2001 and 5000 Ethiopian birr (Table 1).

3.2. Knowledge of respondents regarding iodized salt and IDD's

Majority (74.8%) of the participants reported that they heard about iodized salt. However, 59.6% and 55.1% of the participants had awareness about iodine deficiency disorder (IDD) and its health consequences, respectively. Among the participants, more than half (52.1%) were aware of goiter as IDD, whereas the proportions of participants who were aware of retarded growth, and still birth amongst the IDDs were 18.8% and 10.5%, respectively. However, those participants who believed that heart pain, retarded mental development of children, and memory loss, and reduced memory are among the IDDs were <10% separately. In our study, television/radio (31.3%), school (21.3%) and health workers (8%) were the three top source of information about IDD and its prevention mechanisms. Among the participants included in this study, about 61% knew the existence of iodine deficiency problems in the country (Table 2).

3.3. Household level utilization of iodized salt and iodine sources diets

More than one-third (38.0%) of the participants did not consume seafood at all times at household level. It was reported that iodized salt was utilized in slightly more than half (53.2%) of the households. Common reasons reported for using iodized salt that they knew importance of iodized

| Table 1. Socio-demographic and economic characteristics of respondents on dietary salt utilization, Jigjiga, Ethiopia, 2016 (n = 361) |
|---------------------------------------------------------------|
| **Variable** | **Categories** | **Frequency (%)** |
|----------------|----------------|------------------|
| Sex            | Female         | 116 (32.1)       |
|                | Male           | 245 (67.9)       |
| Age            | 15–20          | 29 (8.0)         |
|                | 21–30          | 178 (49.4)       |
|                | 31–40          | 98 (27.1)        |
|                | >40            | 56 (15.5)        |
| Educational Status | Higher education | 90 (25.0)      |
|                | Secondary      | 117 (32.4)       |
|                | Primary        | 56 (15.5)        |
|                | Illiterate     | 98 (27.1)        |
| Income level (Ethiopian birr) | ≤1000 birr | 76 (21.1)       |
|                | 1001–2000      | 137 (37.9)       |
|                | 2001–5000      | 148 (41.0)       |
salt (65%). High cost of iodized salt (40.6%) and not knowing its importance (37.5%) were among the reasons reported for not using iodized salt. Substantial proportion of the participants mentioned that they were storing salt in container with lid, whereas the rest were storing in the polyethylene bag (16.4%) and container without lid (12.6%). Regarding the perception of iodized salt use on taste of food, 62.3% of the participants believed that taste was not affected. Conversely, 37.7% of the participants perceived that adding iodized salt could affect the taste of the food (Table 3).

Table 3. Knowledge of participants on iodized salt and IDDs, Jigjiga, Ethiopia, 2016 (n = 361)

| Variable(s)                                | Frequency (%) |
|--------------------------------------------|---------------|
| Heard about iodized salt                   |               |
| Yes                                        | 270 (74.8)    |
| No                                         | 91 (25.2)     |
| Awareness about iodine deficiency problems |               |
| Yes                                        | 215 (59.6)    |
| No                                         | 146 (40.4)    |
| Effect of iodine deficiency in human body  |               |
| Yes                                        | 199 (55.1)    |
| No                                         | 162 (44.9)    |
| Types of IDD                               |               |
| Still birth                                | 38 (10.5)     |
| Retarded growth                            | 68 (18.8)     |
| Goiter                                     | 188 (52.1)    |
| Heart pain                                 | 24 (6.6)      |
| Retarded mental development of children    | 19 (5.3)      |
| Memory loss                                | 17 (4.7)      |
| Reduced immunity                           | 20 (5.5)      |
| Source of information about IDD and its prevention |         |
| Printed materials                          | 5 (1.4)       |
| Television/Radio                          | 113 (31.3)    |
| Health workers                            | 29 (8.0)      |
| Family                                     | 19 (5.3)      |
| School                                     | 77 (21.3)     |
| Others                                     | 43 (11.9)     |
| Existence of iodine deficiency problems in Ethiopia |          |
| Yes                                        | 219 (60.9)    |
| No                                         | 19 (5.5)      |
| I do not know                              | 122 (33.8)    |

3.4. Participant’s practices on dietary salt to be purchased
About half of the participants (53.2%) mentioned that the salt they were consuming in their home usually purchased from mini-shops surrounding their home, while about 39% of the participants purchased from bazaars. About six out of the ten participants (64%) were not reading the information available on the salt packaging whether it was iodized or not, whereas the rest (36%) read carefully the information provided in the packaging material of the salt they were purchasing. More than half of the participants (52.6%) believed that the packaging materials were not informative. Moreover, it was reported that more than two-thirds of the packages had no information about iodization (66.5%) or the logo of manufacturer's
However, over one-thirds of the respondents (39.2%) reported that they usually check the weight of the packaged salt (Table 4).

3.5. Iodine content of salt samples collected at household and retailer

Of the total salt samples collected from 90 households, 12.2% had no iodine, while about more than half (56.7%) had iodine concentrations between 1 and 14.99 ppm, whereas salt in 31.1% of the household was with ≥15 ppm. Similarly, among the salt samples collected from the retailer shops, those with no iodine, 1–14.99 ppm, and ≥15 ppm iodine contents were 20, 50, and 30%, respectively (Figure 1).

4. Discussion

Our study is focused on the knowledge and practices of iodized salt utilization, IDD and its relations to iodine, and determination of iodine concentration in dietary salts consumed and sold at both household and retailer shops, respectively, in Jigjiga town, Somali region, eastern Ethiopia. Accordingly, our study revealed that three fourth (75%) of the participants ever heard about

Table 3. Practices of respondents regarding the use of iodized salt and iodine source, Jigjiga, Ethiopia (n = 361)

| Practice of respondents | n (%) |
|-------------------------|-------|
| How often you consume seafood in a family |       |
| Every day | 53 (14.7) |
| Every week | 17 (4.7) |
| Once a month | 30 (8.3) |
| From time to time | 26 (7.2) |
| Very rarely | 98 (27.1) |
| Not at all | 137 (38.0) |
| Reasons not to utilize iodized salt (n = 160) |       |
| I do not know its importance | 60 (37.5) |
| It is usually more expensive | 65 (40.6) |
| Members of my family don’t advise me | 11 (6.9) |
| I never heard about it | 24 (15.0) |
| Why you use iodized salt (n = 182) |       |
| I know that it is healthy | 118 (64.8) |
| Other kinds of salt are not available | 17 (9.3) |
| An advice from a physician | 26 (14.3) |
| The sales person advocacy | 4 (2.2) |
| Family influence | 8 (4.4) |
| Friends | 2 (1.1) |
| Colleagues influence | 3 (1.7) |
| Neighbors influence | 4 (2.2) |
| Type of container used to store salt at home (n = 317) |       |
| Container with lid | 225 (71.0) |
| Container without lid | 40 (12.6) |
| Polyethylene bag | 52 (16.4) |
| Presence of iodine in a salt affects a taste |       |
| Yes | 136 (37.7) |
| No | 225 (62.3) |
iodized salt. This result is higher than found in the study conducted in Ada district (26%), Gondar town (25.2%), Mecha district (32.7%), Wolaita zone (53.6%) and rural Sidama (9.3%) in Ethiopia (Tariku, 2019; Mekonen et al., 2018; Haji et al., 2017; Gebremariam et al., 2013; Buxton & Baguune, 2012a; Bazezew et al., 2018; Fereja et al., 2018; Ersino et al., 2015). However, it is lower than found in Axum town (94%), Dessie and Kombolcha town (80.6%) and Addis Ababa (88.3%) in Ethiopia, and Bia district in Ghana (90.4%) (Mekonen et al., 2018; Buxton & Baguune, 2012a; Bazezew et al., 2018; Fereja et al., 2018; Gerensea et al., 2016). In our study, about 55% of the participants had awareness about the effect of iodine deficiency on human body, which is lower than found in the study conducted in Axum (81%), Dessie and Kombolcha (75.2%) towns, and Addis Ababa (79.4%)

| Variables                                      | Frequency (%) |
|------------------------------------------------|---------------|
| The place where salt is usually purchased      |               |
| Mini-shop                                      | 192 (53.2)    |
| Bazaar                                        | 140 (38.8)    |
| Other                                         | 29 (8.0)      |
| Packaging material pertains information to buyer's |             |
| Yes                                            | 171 (47.4)    |
| No                                             | 190 (52.6)    |
| Availability of the word “Iodized salt” on packaging |         |
| Present                                        | 121 (33.5)    |
| Absent                                         | 240 (66.5)    |
| Existence of logo on salt packaging            |               |
| Present                                        | 118 (32.7)    |
| Absent                                         | 243 (67.3)    |
| Information observed on salt packaging (n = 341) |             |
| Weight                                         | 142 (41.6)    |
| Content                                        | 48 (13.3)     |
| Health value                                   | 76 (21.3)     |
| Period of storage                              | 27 (7.9)      |
(Bazezew et al., 2018; Buxton & Baguune, 2012; Gerensea et al., 2016). Haji and colleagues revealed that one-third (34.6%) of the food handlers in Wolaita town mentioned goiter, as one of the iodine deficiency disorders, which is lower than found in the present study (Haji et al., 2017) [21]. The observed differences could be due to the variation in the study groups, the level of education, income, and the study place and periods.

Only one-third of the respondents (31.3%) obtained information about IDD and its prevention mechanisms from mass media (radio and TV), which is comparable with, the study finding in Ada district (32%) and Dessie and Kombolcha (35.2%) towns (Fereja et al., 2018; Mekonen et al., 2018). Whereas, very few (1.4%) of participants obtained information from printed materials, which is consistent with Axum town (2%), but lower than Addis Ababa city (12.4%) (Bazezew et al., 2018; Gerensea et al., 2016). This could indicate that the dissemination of information related with the importance of iodine, dietary sources, and its deficiency disorders is very limited at national and regional level mass-medias. Additionally, perhaps it indicated that the distribution of information related to iodine in the printed material is only limited to Addis Ababa regardless of regional towns.

Alarmingly, the information about IDD and its prevention mechanisms obtained from the health workers in our study was lower (8%) than found (10.3–40%) in studies conducted elsewhere in Ethiopia (Fereja et al., 2018; Gerensea et al., 2016; Mekonen et al., 2018; Tariku, 2019). In general, this indicates that the issue of iodine did not get attention by the health professionals in the Jigjiga town and Somali region at large, which may urge capacity building on the importance of iodine consumption, dietary source, proper use of iodized salt, the adverse effects of iodine deficiency, and the severity of its deficiency toward the vulnerable target group.

Iodine is naturally low in most foods and beverages (Haldimann et al., 2005). Generally, common food sources provide 3–80 mg per serving (Haldimann et al., 2005), but the content largely depends on the foods origin and is usually insufficient to meet daily requirements. Sea foods are the main source of iodine for human consumption. In the present study the consumption of seafood was low and only 14.7% of households consume in daily basis. Nevertheless, large proportions of the households were not eating any of seafood's at all or rarely. This might be related with less awareness on dietary iodine source including iodized salt, because more than half of the study participants mentioned that they did not use iodized salt due to less knowledge in the same study. Furthermore, an unavailability and highest price of iodized salt at the market place. This result was in line with previous studies in Ethiopia, in which the consumption of animal source foods including fish was very low in all regions including Somali, where this study was conducted (Ethiopian Public Health Institute (EPHI), 2013a). Therefore, nutrition education activities, which will improve the consumption of iodine source foods should be promoted.

Knowledge about the importance of iodized salt use or physician advice increases the proportion of iodized salt users in the study area. Despite this, about 10% of the participants mentioned that they were forced to use iodized salt as a result of no ordinary salt available in the market. The possible reason could be related with the perception of iodized salt could affect the taste of the food, as it is mention in about 40% of the study participants in this study. Furthermore, 40.6% of the participants mentioned that the higher price is one of the challenges to use iodized salt in this study. Earlier studies indicated that perceived prices of iodized salt was one of the factors that influenced their decision to use ordinary salt over iodized salt (Buxton & Baguune, 2012; Tololu et al., 2016). Expensive price and ignorance by the consumers were also mentioned as a reason in a study done in Ghana (Chirawurah et al., 2015). Therefore, further research and activities should be done in taste and the price of iodized salt, which could be one of the challenges for achieving the USI targets.

Proper storage is one of the factors for maintaining iodine concentration in the iodized salt, as iodine has volatile nature (Yeon & Jung, 2017). About 88% of the study participants were storing dietary salt in a container with lid and/or polyethylene bag, which is comparably as good practice
as observed by other studies in Shebe and Asela towns of Ethiopia (87–97%) (Howas et al., 2016; Takele & Bekele, 2003). Despite the dietary storage mechanisms which have been used in the households in the present study area was higher, further education should be done to reduce the reduction of iodine content in the household to minimize the intake of inadequate salt from diet. Further research should be done on the effect of storage time on iodine content of the iodized salt at household level.

Regarding the perception on purchasing dietary salt, most (92%) of the participants mentioned that they usually bought dietary salt from small shops from their surrounding or from bazaars whenever available in the Jigjiga town. However, less than half (47.4%) of the participants believed that the packaging material of the salt they had purchased provide information to buyers. Furthermore, about one-third of the participants observed the information “iodized salt” and logo or name of the manufacturer in the packaging of salt they used to buy. Likewise, less than half of the participants found information like weight or contents, health values, or shelf life on the packaging of the salt they were using for household consumption. About 88% of the sampled salt from the households included in this study had iodized salt, which is comparable with the reports for the urban households iodized salt coverage for Ethiopia (89.5%), Senegal (89.6%), and the regional household coverage for Somali region in Ethiopia (84.9%) where the present study was conducted (Ethiopian Public Health Institute [EPHI], 2016; Knowles et al., 2017). Our result was higher than found in the study conducted in Mecha district (77.3%), South Wollo (83%), Addis Ababa city (69.9%), Wolaita (59.1%) in Ethiopia, and Senegal (56%) (Bazezew et al., 2018; Kumma et al., 2018; Mekonen et al., 2018; Ndiaye et al., 2015; Tariku, 2019). Whereas, the adequate iodized salt coverage (≥15ppm) at the household level in the present study was 31.1%, which is in line with the result found in the study conducted in Aira district (33%), Northwest (33.2%) and Southeast (30%) Ethiopia (Abebe et al., 2017; Keno et al., 2017; Tolalu et al., 2016). But, higher than found in Hawassa town (0%), Metekel zone (10%) and northern part of Ethiopia (17.5%), and Niger (6.2%) (Desta et al., 2019; Girma et al., 2012; G Kibatu et al., 2014; Knowles et al., 2017). However, our finding was lower than in the studies conducted in Dire Dawa (49%), Wolaita town (37.7%), Ada district (39.3%), Arsi zone (90.1%), Mecha district (63.3%), Somali region (49.4%), and south Wollo zone (68.2%) in Ethiopia, and national coverage of Bangladesh (50.5%), India (78.1%), Indonesia (55.1%), Tanzania (67.9%) and Uganda (97%) (Ethiopian Public Health Institute [EPHI], 2016; Knowles et al., 2017; (Tariku, 2019); (Mekonen et al., 2018); (Fereje et al., 2018); (Kumma et al., 2018); (Ferede, 2018); Ftwi et al., 2018). Similarly, the coverage of iodized salt at the retailers’ shop was 80% in this study, which is in line with found in south-eastern Nigeria (81%) (Umenwanne & Akinyele, 2000). But, it was lower than the found (100%) in the study conducted in Shebe town, southwest Ethiopia, and the proportion of iodized salt at the producer level in South Africa (93.6%) (Jooste, 2003; Takele & Bekele, 2003). However, the coverage of adequately iodized salt (≥15ppm) at the retailer shop level was 30%, which is lower than even the proportion of retailer shop with adequately iodized salt (≥50ppm), which was 80% in the Shebe town, and the prevalence of iodized salt concentration ≥15ppm in the market of Accra (81.8%) in Ghana and in the retailer shops of south-eastern part of Nigeria (66.7%) (Doku & Bortey, 2018; Takele & Bekele, 2003; Umenwanne & Akinyele, 2000). In general, the knowledge on proper storage and utilization of iodized salt in the community should be improved, besides monitoring of iodized salt along the market value chain in a regular manner. The strength of this study includes, iodine concentration in salt sample was determined using iodometric titration technique, which is a standard quantitative analytical method, and this study was conducted for the first time in Somali region in Ethiopia. However, the study did include only urban setting of Somali region, Ethiopia.

In conclusion, the knowledge and practices on the importance of iodine on human health, handling, storage, and utilization was poor at the household level Jigjiga town, Somali, Ethiopia. The price and the taste of iodized salt were among the major challenge for iodized salt utilization and coverage at the household level. Therefore, activities, which will improve the iodized salt utilization should include awareness creation on the importance of iodine on human health, dietary source of iodine including iodized salt.
Although the proportion of households consuming iodized salt is increasing after the start of a national programme, the current study indicated that there is an inadequate iodine (<15ppm) concentration of salt at the household and retailer shops in Jigjiga town. The coverage of adequately iodized salt in the households of the study area is still below the international recommendation (90%). The concentrations of iodine in the salt at the household and retailer shops were consistently lower than the recommendation. Furthermore, there should be consistent and regular monitoring of iodized salt along the market value chain including the availability and affordability. Further research on the palatability of the iodized salt should also get equally important at the consumer level.

Abbreviations
CSA: Central Statistical Agency of Ethiopia; ID: Iodine deficiency; IDD: Iodine deficiency disorders; SPSS: Statistical Package for Social Science; USI: Universal salt iodization; WHO: World Health Organization

Acknowledgements
We, the authors would like to thank the respondents for their participation in the study. We are also grateful to Jigjiga town city administration allowing us to proceed with the study. Moreover, we have great appreciation for Jigjiga University for its financial support. Finally, we also appreciated the data collectors for their unreserved contribution in data collection.

Funding
This study was funded by Jigjiga University, Ethiopia. The funding organization was not involved in the design, data collection, analysis, and interpretation of the study.

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Availability of data and materials
Data will be available upon request from the corresponding author.

Authors' contribution
AM and FT conceived the study, developed the tool, funding acquisition, coordinated the data collection activity, carried out the statistical analysis and drafted the manuscript. BBD involved in drafting, reviewing, and editing the manuscript. AKD involved in reviewing and editing the manuscript. All authors read and approved the final manuscript.

Competing interest
The authors declare that they have no competing interests.

Consent for publication
Not applicable.

Citation information
Cite this article as: Knowledge and practices of iodized salt utilization, health consequences, and iodine concentration on dietary salts at retailer and households in Jigjiga town, Somali, Ethiopia, Ambissa Muleta Senbeta, Firew Tafesse Mamo, Beruk Berhanu Desalegn & Alemneh Kabita Daba, Cogent Food & Agriculture (2021), 7: 1911421.

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