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RESEARCH

# Availability of adequately iodised salt at household level and its associated factors in Robe town, Bale Zone, South East Ethiopia: community-based cross-sectional study

**Nagasa Dida[a]*, Abiyot Legese[b], Abdurhim Aman[b], Bilkisa Muhamed[b], Teshome Damise[b], Tizita Birhanu[b], Sintayehu Hailu[c], Jiregna Darega[a], Bedasa Woldamichael[c] and Eshetu Gadisa[d]**

[a]*Department of Public Health, Medicine and Health Science College, Ambo University, Ambo, Ethiopia*
[b]*Department of Public Health Nursing, Goba Referral Hospital, Madda Walabu University, Bale-Goba, Ethiopia*
[c]*Department of Nursing, Goba Referral Hospital, Madda Walabu University, Bale-Goba, Ethiopia*
[d]*Department of Microbiology, Goba Referral Hospital, Madda Walabu University, Bale-Goba, Ethiopia*
**Corresponding author, Email: nadibefe@yahoo.com*



**Background:** Iodine is a micronutrient required by the body in small amounts to prevent iodine deficiency disorder (IDD), which is a global public health concern. There were no specific data at household level of adequately iodised salt in the study area. Thus this study aimed to assess availability of adequately iodised salt and its associated factors at household level in Bale-Robe, South East Ethiopia.
**Methods:** A community-based cross-sectional study was conducted in Robe town, Bale Zone, South East Ethiopia in April 2015. Data were collected through interviewer-administered questionnaires from a total of 367 households, which were identified through systematic random sampling. Salt iodine content was estimated using rapid testing kits at the household level. Descriptive statistics was used to determine the prevalence, and association between dependent and independent variables was computed by using bivariate and multivariable logistic regression. A *p*-value of $< 0.05$ was used to determine statistical significance.
**Results:** Of 374 samples, 370 respondents were interviewed yielding a response rate of 99%. One-third (32.7%) of the household levels used adequately iodised salt. Respondents' educational status, exposure to information on how to handle iodised salt and type of salt used by the respondents were independent factors for availability of adequately iodised salt at the household level. Salt that had been stored in a dry place was twice as likely to have an adequate iodine content compared with salt stored in a high-moisture area or near a fire (AOR = 2.13, CI = 1.19–3.72).
**Conclusion:** Availability of adequately iodised salt at the household level was very low. Factors that were associated with household levels' access to adequately iodised salt included educational level, age of the respondents and place where salt is stored, and had an effect on whether households iodise salt adequately. Strategies to educate residents regarding the appropriate storage conditions to minimise iodine losses in iodised salt are required in Bale-Robe district of South East Ethiopia.

**Keywords** availability of adequately iodised salt, associated factors, Ethiopia

## Background

Iodine is an essential micronutrient for the biosynthesis of thyroid hormones produced by the thyroid gland.[1] Iodine is a chemical element required for the structure of the thyroid hormone. This hormone influences the manufacture of key proteins in the liver, kidneys, muscles, heart, and the developing brain and is therefore essential for normal growth and development.[2,3]

Salt is an ideal vehicle to provide iodine for all human beings through their diet as it has been consumed by nearly every person. As a result WHO and UNICEF initiated iodisation of all salt for human and animal consumption (Universal Salt Iodization) as a safe, cost-effective strategy suitable for elimination of iodine deficiency disorder (IDD).[4] However, in East Africa the household-level consumption of iodised salt has been reported to vary from 96% in Uganda to 6.7% in Somalia. In Ethiopia only 15.4% of the total population use iodised salt, but this varies across regions, ranging from the highest prevalence of 40% in Benishangul-Gumuz and the lowest of 6% in the Dire Dawa and Harari regions. The WHO recommends 90% of households should have access to iodised salt in order to eliminate IDD through universal salt iodisation.[5]

Iodine deficiency is the world's major cause of preventable mental retardation.[4,6] Around 2 billion people in 130 countries worldwide have insufficient intakes of iodine. Europe (57%), the Eastern Mediterranean (54%), Africa (43%), Southeast Asia (40%), the Western Pacific (24%), and the Americas (10%) are the countries most affected.[4,7] Nearly 38 million newborns in developing countries every year remain unprotected from the lifelong effect of brain damage due to iodine deficiency disorders (IDD).[8] In Africa about 260 million people have inadequate iodine intake resulting in iodine deficiency states, which may be related to a 10–15% lowering of average intellectual capacity.[9] Severity of iodine deficiency can range from mild intellectual blunting to frank cretinism. Impairment of the developing brain results in individuals being poorly equipped to achieve their intellectual potential, work effectively and have healthy birth outcomes. The consequences of iodine deficiency disorders affect all stages of life from foetus to adulthood as well as old age.[4,8,10]

In 2007 about 6 million Ethiopian women aged between 15 and 49 years were affected by goitre. Women living in highly goitre-endemic areas are more likely to experience miscarriage and stillbirth.[8] Hence the present study was conducted to determine the availability of adequately iodised salt at household level and its associated factors. This in turn provides relevant information for further planning and intervention.

## Methods

### Study setting and participation

A community-based cross-sectional study was conducted in Robe town, Bale Zone of Oromia Regional State, South East Ethiopia among 374 households. Robe town is a zonal and administrative town from which the rest of the districts in Bale Zone collect their food supplies including salt. Thus, conducting the study in this town can reflect the access of other districts to iodised salt. Robe is located 430 km away from Addis Ababa to the south-east of the country. Altitudinally found between 2 510 and 2 800 metres above sea level, it receives rain twice a year (in two seasons), with downfalls ranging from 800 to 900 mm on average. Robe town has three kebeles (sub-districts, smallest administrative unit) with total households numbering 12 883 and a total population of 61 839, of which 31 410 (50.8%) are male. In Robe town there is one preparatory, two high schools, 13 first-cycle primary schools (grade 1–4 elementary school) and 36 different public and private health facilities.[11]

The sampling frame comprised all households in Robe town. The sample size was determined by using a single population proportion formula using an assumption of 95% confidence interval, 0.05 margin of error and the proportion of households with access to adequately iodised salt in Laelay Maychew District, which was 33%.[5] Considering a 10% non-response rate the final sample became 374. This sample was identified proportionally from all kebeles using systematic random sampling at an interval of 34 (k for the systematic random sampling was 12 883/374 = 34) households in the town. For the interviews, the household-level members who were responsible for food preparation were recruited.

A structured questionnaire was adapted by reviewing the available literature[5,12,13] to develop an 80-item survey that included sociodemographic characteristics, knowledge regarding adequacy of iodised salt and practices related to the use of iodised salt. The iodine content of salt in the household was determined by data collectors using the rapid test kits (RTK), BMI KITS (International 85, Chennai, India), at the end of the interview. Data were collected by face-to-face interviewer-administered questionnaires, translated into the local language (Afan Oromo and Amharic) and retranslated back into English to be checked for consistency by language experts. The questionnaire was piloted in 5% of the sample before the actual study. Investigators cross-checked questionnaire responses on a daily basis.

### Data processing and management

Data were entered into SPSS Windows version 20.0 (IBM Corp, Armonk, NY, USA) and analysis was done after data cleaning. Both descriptive and analytical statistics were used. Descriptive results are presented using tables and graphs. Bivariate logistic regression analysis was used to identify associations between variables. The possible effects of confounders were controlled through multivariate logistic regression analysis to identify the predictor of the study variables. Association between the explanatory and dependent variables was assessed at a *p*-value of 0.05.

### Determination of iodine content of iodised salt

Using standardised procedures recommended by the WHO, one drop of starch solution was squeezed onto a half-teaspoon sample of table salt obtained in each household. If the colour changed (from light blue to dark violet), it was matched to a colour chart provided with the test kit and the iodine concentration classified as $< 15$ or $\geq 15$ ppm. If the initial test was negative (no change in colour), a second confirmatory test, adding an acid-based solution in addition to the starch solution, was done. If the colour of the salt did not change even after the confirmatory test, the salt sample was considered to contain no iodine.[4]

### Ethical considerations

Permission for this study was obtained from Ethical Review Committee of the Public Health Department, Madda Walabu University. After a supportive letter had been obtained from the Department of Public Health, communication was made with the town health office. Verbal consent was obtained from the study participants after clarifying the aim of the study. The respondents had the right to respond fully or partially to the questionnaire. All the information given by the respondents was used for research purposes only and confidentiality was maintained by omitting the name of the respondents.

## Results

### Sociodemographic characteristics

Of the 374 households, 370 respondents were interviewed, yielding a response rate of 99%. Nearly half (46.2%) of the respondents were Muslim followed by Orthodox Christians. Ethnically 73.8% of the respondents belonged to the Oromo ethnic group. About two-thirds (64.4%) of the respondents were married; occupationally 43% were housewives and 43.8% of the respondents had attended elementary school. One-third (33%) of the respondents on average earn a family income of 1 500 Ethiopian Birr (Table 1).

### Awareness of iodised salt

In total, 71% of respondents had previously heard about iodised salt and the remainder had never heard of iodised salt. Some 55% of respondents had knowledge of iodised salt's importance for goitre prevention, but 64.9% of respondents did not know that the iodine content can be reduced when iodised salt is not stored in closed containers. Regarding sources of information on iodised salt, 28%% of the respondents obtained their information from television (Table 2).

### Behaviours related to iodised salt use

Altogether, 71% of the respondents had used iodised coarse salt (salt packed in 50 kg sacks and sold on a smaller scale to consumers) while the remainder used smooth/fine iodised salt. Most respondents (88.9%) stored salt in containers that had covers. Some 93% of respondents stored salt for less than two months after purchase; the remaining 7% stored the salt for longer than two months after purchase. Nearly 49.7% of the participants usually added salt late in the middle of cooking while 21.9% added salt at the end of cooking. Of the 370 salt samples collected from households, 32.7% had adequate iodine i.e. $\geq 15$ ppm, but the remainder had inadequate iodine concentrations (Table 3).

### *Factors associated with the availability of adequately iodised salt at household level*

To identify factors associated with availability of adequately iodised salt both binary and multivariate logistic regression models were used. Accordingly, factors that were associated with household access to adequately iodised salt were identified through binary logistic regression models and included age of the respondents, respondents' educational status, exposure to information on how to handle iodised salt, knowledge of respondents on iodine content reduction when salt is not stored in closed containers, perceived taste difference between iodised salt and common salt, attitude toward iodised salt usage, type of salt used by the respondents, place where salt is stored and where the respondents accessed iodised salt. When those variables that showed a significant association with the availability of adequately iodised salt were adjusted for confounders using

**Table 1:** Sociodemographic characteristics of the respondents in Robe Town, Bale Zone, South East Ethiopia, April 2015

| Variables | | Frequency | |
|---|---|---|---|
| | | Number (*n*) | Percent (%) |
| Age of respondent | 18–29 | 201 | 54.3 |
| | 30–44 | 108 | 29.2 |
| | > 45 | 61 | 16.5 |
| Sex | Male | 31 | 8.4 |
| | Female | 339 | 91.6 |
| Respondent relationship | Mother | 282 | 76.2 |
| | Father | 26 | 7.0 |
| | Grandmother | 15 | 4.1 |
| | Relative | 37 | 10.0 |
| | Other | 10 | 2.7 |
| Marital status | Married | 239 | 64.6 |
| | Single | 83 | 22.4 |
| | Divorced | 20 | 5.4 |
| | Widowed | 26 | 7.0 |
| | Other | 2 | 0.5 |
| Religion | Orthodox | 153 | 41.4 |
| | Muslims | 171 | 46.2 |
| | Protestants | 44 | 11.9 |
| | Other | 2 | 0.5 |
| Ethnicity | Oromo | 273 | 73.8 |
| | Amhara | 83 | 22.4 |
| | Tigre | 6 | 1.6 |
| | Other | 8 | 2.2 |
| Educational status | No formal education | 102 | 27.6 |
| | Elementary school | 162 | 43.8 |
| | High school | 77 | 20.8 |
| | Certificate and above | 29 | 7.8 |
| Occupation | Housewife | 159 | 43.0 |
| | Employee | 73 | 19.7 |
| | Merchant | 47 | 12.7 |
| | Housemaid | 9 | 2.4 |
| | Daily labourer | 14 | 3.8 |
| | Student | 60 | 16.2 |
| | Other | 8 | 2.2 |
| How many family members live in the house | < 5 | 244 | 65.9 |
| | > 5 | 126 | 34.1 |
| Average family monthly income of the respondent | < 500 Birr | 115 | 31.1 |
| | 500–1 500 Birr | 129 | 34.9 |
| | > 1 500 Birr | 122 | 33.0 |
| | Not known | 4 | 1.1 |

**Table 2:** Awareness of respondents regarding adequately iodised salt in Robe Town, Bale Zone, South East Ethiopia, April 2015

| Variables | | Frequency | |
|---|---|---|---|
| | | Number (*n*) | Percent (%) |
| Have ever heard about iodised salt | Yes | 263 | 71.1 |
| | No | 107 | 28.9 |
| Source of information | Television | 106 | 28.6 |
| | Radio | 14 | 3.8 |
| | Newspapers/ documents | 32 | 8.6 |
| | The neighbours/ relative | 20 | 5.4 |
| | Health professional/ health facility | 72 | 19.5 |
| | Other | 19 | 5.1 |
| Do you think that goitre is caused by iodine deficiency | Yes | 253 | 68.4 |
| | No | 7 | 1.9 |
| | I don't know | 110 | 29.7 |
| Why intake of iodised salt is important | To cure goitre | 204 | 55.1 |
| | To keep healthy | 38 | 10.3 |
| | To prevent IDDs | 41 | 11.1 |
| | To grow well | 1 | .3 |
| | I do not know | 86 | 23.2 |
| All salt contains iodine | Yes | 42 | 11.4 |
| | No | 201 | 54.3 |
| | I do not know | 127 | 34.3 |
| Iodine deficiency can lead to growth retardation | Yes | 184 | 49.7 |
| | No | 19 | 5.1 |
| | I do not know | 167 | 45.1 |
| Iodine content reduces when iodised salt is not stored in closed containers | Yes | 92 | 24.9 |
| | No | 38 | 10.3 |
| | I don't know | 240 | 64.9 |
| The taste of iodised salt is different from that of common salt | Yes | 145 | 39.2 |
| | No | 57 | 15.4 |
| | Do not know | 168 | 45.4 |
| What are the major causes of goitre? | Not eating iodised salt | 261 | 70.5 |
| | Not eating enough food | 58 | 15.7 |
| | Drinking dirty water | 39 | 10.5 |
| | Others | 12 | 3.2 |
| How can goitre be prevented? | Eating iodised salt | 263 | 71.1 |
| | Eating seafood such as fish | 7 | 1.9 |
| | Eating eggs | 42 | 11.4 |
| | Drinking of holy water | 48 | 13.0 |
| | Others | 10 | 2.7 |

**Table 3:** Practice of use of iodised salt in Robe Town, Bale Zone, South East Ethiopia, April 2015

| Variables | | Frequency | |
|---|---|---|---|
| | | Number (*n*) | Percent (%) |
| What type of salt do you use? | Iodised smooth/ fine packed salt | 107 | 28.9 |
| | Iodised coarse salt | 263 | 71.1 |
| Where do you store your salt? | Dry area | 329 | 88.9 |
| | Moist area | 30 | 8.1 |
| | Near to fire | 11 | 3.0 |
| Where do you access the iodised salt? | Small shop | 109 | 29.5 |
| | Large shop and supermarket | 37 | 10.0 |
| | Market | 194 | 52.4 |
| | Other | 30 | 8.1 |
| How far do you travel to get iodised salt? | Close and convenient | 280 | 75.7 |
| | Far, but travel easily | 82 | 22.2 |
| | Not known | 8 | 2.2 |
| Your salt container | With cover | 356 | 96.2 |
| | Without cover | 14 | 3.8 |
| Duration of salt storage at household level | ≤ 2 months | 344 | 93.0 |
| | > 2 months | 26 | 7.0 |
| At what time do you add iodised salt during cooking of food? | Early during cooking | 103 | 27.8 |
| | In the middle of cooking | 184 | 49.7 |
| | At the end of cooking | 81 | 21.9 |
| | Other | 2 | .5 |
| What are the reasons for not using iodised salt? | Expensive | 166 | 44.9 |
| | Is too salty | 14 | 3.8 |
| | Not salty | 7 | 1.9 |
| | Not available | 59 | 15.9 |
| | Other | 3 | 0.8 |
| Iodine content of salt determined by using a rapid testing kit | 0 ppm | 14 | 3.8 |
| | < 15 ppm | 235 | 63.5 |
| | > = 15 ppm | 121 | 32.7 |

multivariate logistic regression models, all were independent predictor variables for adequately iodised salt except for perceived taste difference between iodised salt and common salt, attitudes toward iodised salt usage and where the respondents purchased iodised salt (Table 4).

Respondents aged between 18 and 29 years were less likely to have access to adequately iodised salt compared with older adults aged 45+ years with odds of 0.12 (AOR = 0.12, CI = 0.02–0.77). The odds of presence of adequately iodised salt were higher among respondents who used iodised packed salt than those respondents using coarse non-packed salt (AOR = 10.91, CI = 8.57–50.67). Regarding storage of salt, salt stored in a dry place was twice as likely to contain adequate iodine compared with salt stored in a high-moisture area or near a fire (AOR = 2.13, CI = 1.19–3.72) (see Table 4).

## Discussion

Addition of small amounts of iodine to salt is the easiest and least expensive of all strategies for the prevention of iodine deficiency disorders because people generally consume salt daily.[14] It is therefore important to identify the level of iodine content in salt used within households. The present study result showed that only 32.7% of the households sampled in South Eastern Ethiopia had access to adequately iodised salt, which is far lower than the WHO recommendation of 90% of households.[4] Similarly, adequately iodised salt at household level in Odisha, India of 62%,[15] South Africa 62.4%[16] and Ghana 64.6%[17] were observed.

More households utilise adequately iodised salt in this study sample area compared with Jigjiga town in Eastern Ethiopia, where the prevalence is 26.6%.[18] In Dabat and Laelay Maychew districts of Northern Ethiopia similar adequately iodised salt utilisation was observed.[5,19]

Levels of iodine in salt can be affected by many factors. In the current study the age of the respondents, their educational status and the place where salt is stored showed statistically significant associations with salt being iodised. This is similar to findings reported from the Laelay Maychew District, Northern Ethiopia. Those respondents who had formal and higher education in Laelay Maychew District and in this study showed better odds of having adequately iodised salt compared with those who have no formal education.[5]

The odds of presence of adequately iodised salt were higher among respondents who used iodised packed salt than those respondents using coarse non-packed salt. A similar finding has been reported from Dabat District, Northern Ethiopia[19] as well as in Ghana.[20]

Storage of salt in a dry place was associated with a greater likelihood of salt containing adequate amounts of iodine, as has been reported in Jigjiga town.[18]

In this study, higher educational status was associated with greater access to adequately iodised salt. Similarly, in Dabat and Laelay Maychew districts of Northern Ethiopia those who had attended formal education were more likely to have access to adequately iodised salt.[5,19] In Ghana too iodised salt is used more by those respondents who attended formal education. In both Ghana and the current study salt that has been purchased from the marketplace had a lower quantity of iodine compared with salt purchased from a shop.[20]

Even though this study determines access of households to adequately iodised salt, it does not indicate the consumption of adequately iodised salt by individual household members. It also does not identify whether the iodine level of salt was affected before or after it reached the households. Another major limitation of the study is the lack of data on the iodine status of household members, which is usually assessed using urinary iodine concentrations.

## Conclusion and recommendations

Despite considerable efforts to improve access to iodised salt, availability of adequately iodised salt at household level is very low in a district of South East Ethiopia. Modifiable risk factors that could be targeted in health education strategies to improve access to iodine in salt include advice on appropriate storage of iodised salt. However, since iodine in salt can be lost at any stage in the chain of its distribution, efforts should be made at community and national level to reduce iodine

**Table 4:** Factors associated with adequate iodised salt at household level in Robe town, Bale Zone, South East Ethiopia, April 2015

| Covariates | | Iodine contents of salt | | Crude OR (95% CI) | Adjusted OR (95% CI) |
|---|---|---|---|---|---|
| | | Inadequate | Adequate | | |
| Age of respondents | 18–29 years | 126 | 75 | 4.59 (1.99–10.61) | 0.12 (0.02–0.77)* |
| | 30–44 years | 69 | 39 | 4.36 (1.81–10.51) | 0.23 (0.04–1.51) |
| | > = 45 years | 54 | 7 | 1.00 | 1.00 |
| Respondents Educational status | No formal education | 95 | 7 | 0.10 (0.04–0.30) | 0.43 (0.04–5.16) |
| | Elementary | 109 | 53 | 0.69 (0.31–1.55) | 11.60 (1.14–18.16)* |
| | High school | 28 | 49 | 2.48 (1.04–5.93) | 6.46 (0.64–65.14) |
| | Certificate and above | 17 | 12 | 1.00 | 1.00 |
| Heard how to handle iodised salt | Yes | 152 | 111 | 7.08 (3.53–14.20) | 0.16 (0.03–0.82)* |
| | No | 97 | 10 | 1.00 | 1.00 |
| Iodine content reduces when iodised salt is not stored in closed containers | Yes | 53 | 39 | 2.16 (1.30–3.58) | 1.75 (0.58–5.28) |
| | No | 17 | 21 | 3.63 (1.80–7.322) | 5.57 (1.15–26.99)* |
| | I don't know | 179 | 61 | 1.00 | 1.00 |
| Taste of iodised salt is different from that of common salt | Yes | 76 | 69 | 6.03 (3.46–10.49) | 2.31 (0.47–11.37) |
| | No | 27 | 30 | 7.37 (3.71–14.65) | 4.22 (0.75–23.82) |
| | Do not know | 146 | 22 | 1.00 | 1.00 |
| Attitude towards iodised salt usage | Negative | 96 | 77 | 0.36 (0.23–0.56) | 0.68 (0.23–2.01) |
| | Positive | 153 | 44 | 1.00 | 1.00 |
| Type of salt you use | Iodised packed salt | 4 | 103 | 22.9 (8.80–59.40) | 10.91 (8.57–50.67)* |
| | Coarse salt (non-packed) | 245 | 18 | 1.00 | 1.00 |
| Where do you store your salt? | Dry area | 229 | 100 | 2.40 (1.25–4.63) | 2.13 (1.19–3.72)* |
| | Moist area and/or near to fire | 20 | 21 | 1.00 | 1.00 |
| Where do you access the iodised salt? | Small shop | 34 | 75 | 26.32 (13.54–51.17) | 1.89 (0.57–6.24) |
| | Large shop/ supermarket/ | 36 | 31 | 10.28 (5.04–20.96) | 0.61 (0.11–3.32) |
| | market | 179 | 15 | 1.00 | 1.00 |
| Does all salt contain iodine? | Yes | 24 | 18 | 6.58 (2.84–15.21) | 5.34 (0.89–32.14) |
| | No | 111 | 90 | 7.11 (3.76–13.45) | 6.50 (1.36–31.07)* |
| | I don't know | 114 | 13 | 1.00 | 1.00 |

*$p$-value < 0.05; OR = odds ratio; CI = confidence interval; statistically significant variables in binary logistic regression models were adjusted for each other under the multivariate logistic regression models.

losses from salt. It is recommended that further research identifies the critical point where iodine loss occurs.

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

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