Proper Utilization of Iodized Salt and Associated Factors among Rural Community of Hetosa District, Oromia Regional State, South East Ethiopia

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ABSTRACT

Background: *Iodine is one of the essential micronutrients for human physical and mental development. However, little is known about households' use of iodized salt and associated factors. Therefore, this study aimed to assess utilization of iodized salt and associated factors.*

Methods: *A Community-based cross-sectional study was conducted. In this study, a total of 603 participants were included. A systematic random sampling technique was used to select the participants. An iodine rapid test kit was used to determine the level of iodized salt utilization. Binary and multivariable logistic regression analyses were conducted. In all analysis, P values less than 0.05 were considered statistically significant.*

Result: *In this study, the proper utilization of iodized salt among the participants was 38.4%. Education status, knowledge, practice, and level of iodine content in salt were significantly associated with utilization of iodized salt.*

Conclusion: *The households' utilization of proper iodized salt was low. Many factors affecting the proper utilization of iodized salt were identified. Therefore, the regional authorities and other concerned bodies should initiate effective strategies to improve the community's utilization of iodized salt.*

Keywords: *Iodine, Iodized salt, utilization, Ethiopia*

BACKGROUND

Iodine is an essential micronutrient [1]. The human demand for iodine is hundred and fifty mcg/ day [2]. Iodine is a trace element sparsely distributed over the earth's surface [3]. About 90% of iodine comes from food, while 10% from water [4]. It is essential for synthesizing the thyroid hormone, which is necessary for human growth and development[5]. It is present in the body in a minute amount, mainly in the thyroid gland [6]. Its confirmed role is in the synthesis of thyroid hormone [7].

Iodine is an essential dietary nutrient that helps the body to manufacture thyroxin, the hormone that regulates normal growth and development [8]. The quantity of iodine required by an individual is a minute, 150–200μg per day, or a teaspoonful during a lifetime [9]]. According to World Health Organization (WHO), the United Nations International Child Fund(UNICEF), and the International Council for Control of Iodine Deficiency Disorder (ICCIDD), the daily recommended dietary allowance (RDA) is 90, 120, 150, and 200 mcg of iodine for preschool children, school children, adults, and pregnant and lactating women respectively [10]].

Iodine is considered one of the most vital micronutrients for physical and mental changes in anthropological existence [11]. Erosion of soil and deforestation is considered to be the reasons for decreasing iodine level in hilly and mountainous areas [12]. Universal salt iodization (USI) is globally accepted as the most cost-effective public health strategy to prevent iodine deficiency (Goiter) [13]. This strategy is a crucial step to eradicating the problem[14].

Many studies revealed that iodine deficiency disorders contribute to high morbidity and mortality of infants and neonates. It also reduces the quality of life, national productivity, and 13.5 points of the intelligence quotient (IQ) [15]]. If iodine deficiency continued as a problem by 2012-2025, about 12 million children would be born from iodine-deficient mothers; these children would have some point of permanent brain damage (with a decrease in IQ). Economic productivity losses related to iodine deficiency during 2012-2025 are estimated to be US$5 billion [12].

Nearly one-third of the world's population (2.3 billion) is considered to be at risk of iodine deficiency, and a large proportion lives in Southeast Asia [15]. The prevalence of iodine deficiency disorder (IDD) based on the total goiter rates (visible and palpated) is the highest in the Eastern Mediterranean region, 32%, followed by Africa at 20%, European at 15%, and Southeast Asia at 12%. However, it is essential to recognize that these clinical signs are superficially in severe cases and subclinical deficiency, which is also associated with a range of intellectual and behavioral deficits, affects many more individuals [16].

The Ethiopian Public Health Institute 2016 survey reported that national iodized salt utilization coverage was 89.2%. However, only about 26% of the surveyed households had adequately iodized salt (at$\geq$ 15 ppm) [17], despite Ethiopia's national goal of iodization utilization coverage being 95% [18].

It is estimated that almost half of Ethiopia's 80 million population faces iodine deficiency disorder (IDD), raising the alarm in the Horn of Africa [19].In Ethiopia, 50,000 prenatal deaths occur annually because of iodine deficiency disorders, the twenty-sixth of the overall population has a goiter, and 62% of the population is at risk of IDD according to the national survey made by the previous Ethiopian Nutrition Institute [20].

A study in Ethiopia indicated that the prevalence of goiter among school-age children was 36.6% [21]. Besides, a study conducted on the utilization of Iodized Salt at the Household Level in the Zuway Dugda district revealed that only 25.6% of the respondents had utilization of iodized salt [22] correctly. Although iodine deficiency is a significant public health problem that causes morbidity and mortality in Ethiopia, there is no sufficient data that inspired us to conduct this study.

METHODS AND MATERIALS

Study area

The study was carried out in the Hetosa district, Arsi Zone, Oromia regional state. There are 23 rural Kebeles in Hetosa District. The district is located at 160 Kilometers southeast of the capital city Addis Ababa, Ethiopia. The area lies between 08° 08'N-08°13' E latitude and 39° 14' N -39° 23' E longitude. The temperature of the study area ranged from 5 C°- 28 C°. According to the District Health Office 2019 report, there are four Primary Health Care units, including four health centers and 23 health posts. The potential health coverage by health centers was 62.7% in 2019 [23]. The district has an estimated 143,716 population (23).

Study design and period

A community-based cross-section study was conducted among a rural population in Hetosa District, Southeast Ethiopia. The study was conducted between August and September 2019.

Source and study population

Source population

All households located in Hetosa District were the source population of the study.

Study population

All selected households located in Hetosa District were the study subjects. Adults aged 18 years and above and those involved in food item purchasing and preparation/cooking were included. However, those who had a severe illness were excluded.

Sampling procedure

Due to funding constraints, only 30% of the Kebeles were included. The kebeles were stratified based on administrative border. A listing of households was done for each kebele. Proportional sample allocation was done. Finally, using simple random sampling method 603 participants were selected at random.

Study variables

Dependent variable

The outcome variable of this study was proper utilization of iodized salt.

Independent variables

Socio-demographic factors: Sex, responsibility in the household, religion, age, educational status, family income, family size, marital status, occupational status, and house type predictor variables of the study.

Behavioral factors: Knowledge, practice, time of salting, and source of information were also the explanatory variables of the study.

Environmental factors: Place of storage salt, exposure to sunlight, duration of storage, salt container cover, place of usually buy iodized salt, type of salt used, access to Iodized salt, and time travel to buy salt were independent variables.

Data collection procedures

Based on their technical proficiency in collecting the required data, data collectors were selected. Consequently, five health professionals with bachelor's degrees and a wealth of experience in comparable data collection techniques were employed.

Also, Two Master's degree holders who served as supervisors were hired. Two days of training was given to data collectors and supervisors. A structured questionnaire was sued to collect data. The questionnaire was written in English, translated into Amharic, and then back into English to maintain the consistency of the questions. The developed questionnaire was pretested on 5% of the overall sample size. Face-to-face interviews were used to collect data. Additionally, the level of iodine salt was determined using a quick iodine test kit.

The interviewer asks each participant to provide a teaspoon of salt used for food preparation, fill a small cup and spread it out flat. They are then instructed to add two drops of the test solution to the salt's surface by puncturing a white ampoule, compare the color of the salt with a color chart within a minute, and determine the amount of iodine present.

Add up to 5 drops of the recheck solution to the red ampoule and two drops of the test solution to the same area if there was no color change on the salt after a minute. To estimate the amount of iodine present, compare the color to the color chart. The sample was taken out of the salt container and checked for vivid color and an adequate iodine level. This was established using a better-iodized salt field test kit. The only salt that has been fortified with potassium iodate is iodized, and levels vary from zero ppm to light blue for inadequate iodization (less than 15 ppm) and deep blue for adequate iodization (more than 15 ppm). The Kit was effective for visual detection of potassium iodate concentration at the threshold of 15 ppm when the unopened ampoule was utilized, and the result was genuine. The test kit was purchased from the Arsi Zonal Health Department; one vial of the rapid test kit may test up to 50 salt sample tables, bags, or packages.

Figure1. Mbi kits international T.Nagar, Chennai-600 017 India.

As seen in the picture, the red ampoule was used for rechecking, the two white ampoules were used for testing, one white cup was used for taking sample salt, and a Color chart was used to check the presence and absence of iodized salt in the taken sample. The field Iodine test kit's chemical reaction involves free iodine reacting with starch to create the deep blue color shown on the color wheel. Since the iodine test kit was a field kit, we did not perform the Idometrical titration laboratory method, nor were the test kit's sensitivity and specificity our primary concerns.

Operational Definition

Proper utilization of iodized salt:-is adding salt to cooking at the end or right after cooking.

Adequately iodized salt:- Salt is said to be adequately iodized when the test result gives determination of ≥15ppm by using rapid test kit.

Good knowledge:- When respondents answer more than half of knowledge question on Iodine Deficiency Disorder (IDD),iodized salt considered to have good knowledge.

Data quality assurance

Data were cleansed and coded. Checking on the spot and double data entry on EPI INFO-7 was done to ensure the completeness and consistency of the information collected.

Data analysis

After being thoroughly examined and coded in Epi-Info7, all obtained data were exported for analysis to SPSS version 21. Data processing tasks like cleaning, coding, categorization, and transformation were completed before analysis. Initially, descriptive statistics like frequency distribution and summary statistics were used to investigate the characteristics of the study participants. Tables and charts were used to present the results. A binary and multivariable logistic regression analyzes were conducted. In the study process, basic regression was first employed to find independent variables that had a weak relationship to the appropriate use of iodized salt. At a p-value of 0.05, the variables were chosen as candidates for adjusted regression. After correcting for confounding factors, the selected variables were run through a multiple regression model to find factors that were related to the proper use of iodized salt.

Ethical considerations

The Arsi University's ethical review board granted its approval and the Hetosa Woreda provided a formal letter of support. The study's participants and households' heads verbally consented. The participants were given a chance to think about participating in the study and the option to leave at any time if they found the study to be uncomfortable. The data collector asked respondents questions in their language. To maintain confidentiality, neither the respondent's name nor their personal information was included in the questionnaire.

RESULT

Socio-demographic characteristics of respondents

A response rate of 98.8% was achieved with 596 individuals out of the 603 participants that were invited to participate in the study. The participants were 34 years old on average. The majority of the participants (96.8%) were women. 98.2% of participants were Oromo by race, 64.1% were Muslims by faith, 85.2% were married, 83.6% were stay-at-home moms, 47.1% had at least primary education levels (1–8), 58.9% had families with fewer than five members, 35.1% had monthly incomes of more than 1500 ETB, and 508 (85.2%) had iron sheet homes (Table 1).

Table 1: Socio-demographic characteristics of the participants (n=596)

Variables	Frequency	Percentages (%)
Sex		
Male	19	3.2
Female	577	96.8
Age		
18-24	121	20.3
25-34	200	33.4
35-44	157	26.3
>45	118	20
Family size		
<5	351	58.9
>5	245	41.1
Marital status		
Married	508	85.2
Single	73	12.2
Widowed	14	2.3
Divorced	1	0.3
Religious status		
Muslim	382	64
Orthodox	194	32.6
Protestant	20	3.4
Ethnicity		
Oromo	585	98.2
Amhara	11	1.8
Educational status		
Cannot write and read	197	33.1
Can write and read	54	9.1
Primary education(1-8)	281	47.1
Secondary education and above	64	10.7
Students	71	12
Monthly income		
<500 ETB	181	30.4
500-1500 ETB	206	34.5
>1500 ETB	209	35.1
House Type		
Iron sheet house	508	85.2
Non-iron sheet house	88	14.8

Utilization of iodized salt at the household level

In this survey, 62.9% of all respondents reported purchasing iodized salt for their homes during the research period. 35.4% of users in homes with iodized salt typically purchase it on the open market. Among those who purchased iodized salt, 78.5% of respondents travelled for more than 60 minutes to do so. Approximately 55.2% of respondents used unpackaged salt, whereas 44.8% of those who were interviewed said they used packed salt. In terms of time spent storing salt, 95% did so for less than two months. Almost all respondents (97.5%) kept their salt in a dry location, while 92.1% of HHs keep their salt in a covered container. 95.5% of respondents said they had never been exposed (Table 2).

Proportion of adequately iodized salt at the household's level

Samples of salt were taken from 98.8% of the participant's homes. Iodized salt Field Test Kit results revealed that, of the 596 participants who were asked to provide a sample of their salt, more than half (61.1%) had appropriate iodine content (>15ppm), and 17.9% had no iodine content at all. 21% of the salt sample had insufficient iodine levels (less than 15 ppm) (Figure 1).

Table 2: Utilization of iodized salt at the households level (n=596)

Variables	Frequency	Percentages (%)
Do you buy iodized salt in your home		
Yes	375	62.9
No	221	37.1
The place usually buys iodized salt		
Retail shop	97	26
Open market	211	56.3
Store	67	17.7
How often do you buy iodized salt		
Not use	2	0.005
Always	111	30
Sometimes	262	69.995
Time travel to buy iodized salt		
<60 minutes	128	21.5
≥60 minutes	468	78.5
Perceived cost		
Expensive	219	36.7
Cheap	377	63.3
Type of salt used in the home		
Packed	267	44.8
Non-packed	329	55.2
Salt type is most of the time used in home		
Non-iodized salt	267	44.8
Iodized salt	147	24.7
Both	182	30.5
Duration of salt stored		
<2 month	566	95
≥2month	30	5
Storage place		
Dry place	581	97.5
Moisture area	15	2.5
Exposed to sunlight		
Yes	27	4.5
No	569	95.5
Stored with covered Container		
Yes	549	92.1
No	47	7.9
Time salt added to cooking within the last twenty-four hour		
Early at the beginning of cooking	367	61.6
At the end of cooking	229	38.4

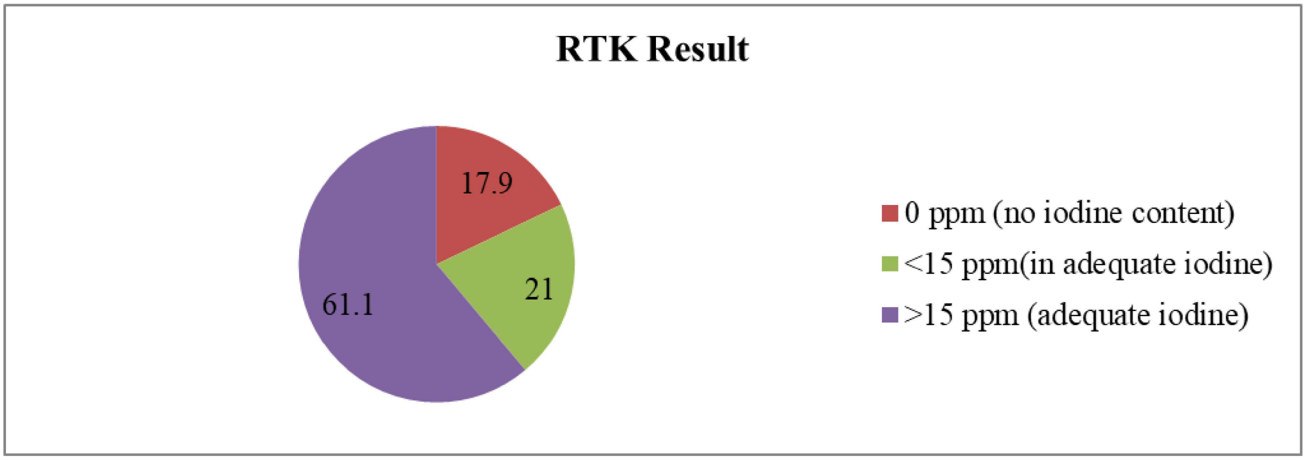

Figure2: Iodine content test result by RTK at household level of communities in Hetosa District (n=596)

Factors associated with proper utilization of iodized salt at the household level

Age, family size, marital status, educational attainment, religious affiliation, monthly income, type of home, and Iodine content level, knowledge, and practice were significantly associated with the proper use of iodized salt in the binary logistic regression analysis, which was selected as a candidate predictor for the multivariable model at P 0.25. Binary and multivariable logistic regression analyses were performed to identify factors associated with proper iodine salt utilization. For the model's fulfillment, Hosmer and Lemeshow's goodness of fit statistics were used. The final model had a goodness score of 0.624 varying from 0.05, suggesting that the entire model's independent variables completely explained the result variables. In the multivariable logistic analysis only four variables were associated with the outcome variable. Participants having formal education were 1.69 times more likely to consume iodized salt [AOR=1.69, with 95%CI: 1.00, 2.85] than the illiterate participants. Participants having good knowledge about iodized salt were 2.31 time higher to used iodized salt [AOR= 2.31, with 95%CI: 1.4, 3.8] than those who had poor knowledge. Participants having good practice about iodized salt were 3.35 time higher to used iodized salt [AOR= 3.35, with 95%CI: 2.2, 5.2] than those who had poor practice. Respondents using adequate (≥15ppm) of iodine salt were 1.67 times more likely to use proper iodine salt [AOR= 1.67, with 95%CI: 1.1, 2.6] than those who did not (Table 3).

Table 3: Multivariable logistic regression analysis with predictor variables of the utilization of iodized salt (n=596)

Variable Category	Proper utilization of iodized salt		COR,95%CI	AOR	95%CI)		P-value
	Yes	No			Lower	Upper	
Educational status							
Formal education	179(44.9)	220(55.1)	2.4(1.6,3.5)	1.7	1.00	2.9	(0.049)**
No formal education	50(25.4)	147(74.6)	1	1			
Knowledge level							
Good	115(63.2)	67(36.8)	4.5(3.,6.5)	2.31	1.4	3.8	(0.001)**
Poor	114(27.5)	300(72.5)	1	1			
Practice level							
Good	164(59.6)	111(40.4)	5.8(4.0,8.4)	3.35	2.2	5.2	(0.000)**
Poor	65(20.2)	256(79.8)	1	1			
Level of iodine							
Adequate (≥15ppm)	175(48.1)	189(51.9)	3.0(2.,4.4)	1.67	1.1	2.6	(0.024)**
Inadequate (<15ppm)	54(23.3)	178(76.7)	1	1			

**: Significant factors on multivariable analysis (p-value ≤0.05)

DISCUSSION

A crucial step in achieving the intended outcome of iodine Fortification is proper household use of iodized salt. The most economical public health measure to prevent iodine deficiency is universal salt iodization, or USI (6). An essential first step in solving the issue is to improve monitoring and salt iodization programs (7). As a result, the current study determined the overall level of appropriate iodine use as well as the elements that contribute to this proper iodine usage, including educational level, the iodine content of salt, good knowledge, and good practices. The final step in addressing IDDs was determining how to properly use iodized salt, which requires that it be added after cooking, is complete both in communal settings and in individual houses (14).

Because of this, only 38.4% of the families in the Hetosa District used iodized salt properly in the current survey. This result was higher than the research done in the Kenyan Province, which was 22.6% in 2015. (33). The study period could be to blame for the disparity. Another study, which utilized them appropriately and was lower than this study area, was undertaken in the

Mecha District 25.7% in 2019, Ahferom District 8.9% in 2012, Sideman Zone Bensa Woreda 10.6% in 2016, and Zuway Dugda District 25.7% in 2019 (14, 26, 38, and 46). In the instance of the Mecha District, the discrepancy may be the result of knowledge status. In the instance of the Ahferom district, the difference may be related to the research methodology. In the instance of Sideman zone Bensa Woreda, the discrepancy may be attributable to the study duration and design. In the instance of the Zuway Dugda district, the gap may be caused by geographic location, respondents' educational status, and the difficulty of accessing awareness-raising and health promotion activities.

Our results, on the other hand, are less significant than those of studies conducted in Andhra Pradesh India (48% in 2019), Laelay May chew district (59.7% in 2015), Asella town (76.8% in 2016), Goba town (57.2% in 2016), and Dega Damot (88.8% in 2019) (29, 37, 40, 41, 45). This variation may result from the study period, study location, access to information, or respondents' knowledge of iodized salt. This statistic is also significantly lower than the Ethiopian Public Health Institute's 2016 survey, which indicated that 89.2% of the country's population used iodized salt (13).

However, the current rate fell far short of the national target of 95% coverage (14). This mismatch is caused by the study's local rather than national focus, the study area's modest size, and the study period's brief duration. Media advertisements raise public awareness and warn that all salt producers and traders must properly iodize their salt to meet the USI objective (7, 41). As a result, it was found that relatively little iodized salt was used properly in the research region.

According to the World Health Organization (WHO), at least 90% of households should use salt that is sufficiently iodized and has 15 ppm or more of iodine (11). If more than 90% of households consume enough iodized salt and are given the necessary support, the iodide deficiency can be eliminated (33). As a result, the current investigation found that 61.1% of the salt samples had iodine concentrations greater than 15 ppm. The households sampled in the Hetosa District had access to sufficient amounts of iodized salt, which was higher than the findings of studies conducted in Parkasan, Andhra Pradesha Indian (42%) in 2019, Kenya (26.2%) in 2015, LaeylaMaychew (33%) in 2015, Lalo Asab (8.7%) in 2016, and Afherehom district (17.5%) in 2012. The discrepancy may be due to factors like community income, education levels, geography, time spent studying, and study methods. In comparison to studies conducted in Iraq (68.3%) in 2012, Asella (62.9%) in 2016, and Dessie (68.8%) in 2018, this finding result was lower (32, 41, 44). In the cases of Asella and Dessie, this discrepancy may be the result of a study period.

The discrepancy may also be caused by the respondents' residence, availability of packaged salt, access to information, and study methodology (37, 43). This finding, which is far from the WHO recommendation of 90% Iodine Universal Salt Iodization to virtually eliminate Iodine Deficiency Disorder by the year 2013, and the Ethiopian National Plan to 90% Iodine Universal Salt Iodization, is far from both of these (45). The mismatch may result from the respondents' varying levels of knowledge or from the lack of salt that is sufficiently iodized.

The level of education is one of the determining elements that helps or hinders the community's proper use of iodized salt (33). Periodic public education about the correct handling and storage of iodized salt should continue until the practice is made mandatory for salt intended for human consumption. Additionally, for there to be a demand for iodized salt, there must be public knowledge and publicity (17). As a result, this study found that study participants who attended formal education were 1.688 times more likely to consume iodized salt than study participants who only received informal education [AOR=1.7, with 95%CI: 1.0, 2.9].

This finding was in line with research conducted in the Sudan in 2017, Iraq in 2012, Laelay Maychew in 2015, Woilata in 2018, and Asella in 2016 (17, 27, 32, 40, 41), which indicated education as a predictor of iodized salt use. The results of this study, however, were lower than those found in the Province of Kenya (3.22) in 2015, Debra Tabor (2.28) in 2019, and Sideman zone (3.34) in 2016 studies (14, 33, 38, 52).

This may be because the information is readily available, but the respondents' workloads may prevent them from accessing it. This difference in chances may be caused by the respondents' level of awareness regarding the use of iodized salt, study design, and study area. This suggests a beneficial association between education and the demand for iodized salt.

It is positive from the perspective of public health that over 90% of the study population already utilized iodized salt within a year of the salt iodization program's commencement (31). AOR=

1.7(1.0, 2.6) shows that having an acceptable quantity of iodized salt at home considerably enhanced the likelihood of using it properly by 66.8% compared to households with an inadequate level of iodized salt. The likelihood of this occurring was lower than that of the study conducted in Ahfeherom District 3.90 in 2019 which used the level of iodized salt contents as a predictor of iodized salt use (46). This mismatch may be caused by the analysis method and the availability of iodized salt at the household level. This suggests a positive association between the demand for iodized salt and the level of iodized salt.

Additionally, it's significant to note that more than 90% of respondents were aware of the link between IDDs and iodized salt (31). Although only 30.5% of people knew how to use iodized salt, this fact does not guarantee that iodized salt will be available and used sufficiently. When compared to their counterparts, individuals with good understanding used iodized salt properly around two and three times more frequently [AOR=2.3, with 95%CI: 1.4, 3]. The results of this study had chances that are higher than those found in Laelay May Chew (2.207) in 2015 (40). The current study period may be the cause of this variance.

Additionally, the different socio-demographic characteristics and participants may have an impact on how iodized salt should be used. The results of this study's odds comparison are less favorable than those of studies conducted in Mecha (3.8) in 2019, Sidama zone (4.66) in 2016, Dabat Woreda (1.49) in 2017, Asella (4.93) in 2016, and DegaDamot district (5.55) in 2019. (14, 38, 41, 45, 53). This mismatch may be the result of the study period, learning environment, or information access. This may show the effect of sound understanding on the demand for and necessity of using iodized salt properly.

For salt fortification to be successful, iodine stability is essential (33). Iodine in iodized salt is also lost due to improper salt storage (54). If the salt is maintained dry, cool, and away from light, the iodine content will remain largely consistent (41). Iodized salt use has become much more prevalent among households. The likelihood of using iodized salt properly increased by 35.2% compared to homes that used it improperly compared to their counterparts [AOR= 3.4, with 95%CI: 2.2, 5.2]. This result was less than that of the Addis Ababa excellent practice study, which was 76.3% (7). This disparity could be caused by setting and information access. This shows a positive association between iodized salt consumption at the household level and iodized salt demand.

CONCLUSION

The households' utilization of iodized salt was found to be low. Many factors affecting the proper utilization of iodized salt were identified. Therefore, the regional authorities and other concerned bodies should initiate effective strategies to improve the community's utilization of iodized salt.

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Abbreviations

AIS-Adequate Iodization Salt

AOR-Adjusted Odd Ratio

BSC-Bachelor of Science

COR-Crude Odd Ratio

ICCIDD-International Council for Control of Iodine Deficiency Disorder

IDD-Iodine Deficiency Disorder

IQ-Intelligence Quotient

IS-Iodized Salt

Mr.-Misters

MPH-Master of Public Health

OR-Odd- Ratio

PPM-Parts Per Million

RTK-Rapid Test Kit

SPSS-Statistical Package for the Social Science

UNICEF-United Nations Children Fund's

USI-Universal Iodization Salt

WHO-World Health Organization

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