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Research Article

Level of Iodine Salt Utilization and Associated Factors among Households in Debre Markos Town, Northwest Ethiopia: A Community-Based Cross-Sectional Study

Mastewal Giza*, **Alebachew Molla**

Department of Public Health, College of Health Sciences, Woldia University, Woldia, Ethiopia

ABSTRACT

Background: Iodine is essential for normal physiological function and the synthesis of thyroid hormones by the thyroid gland. The deficiency of iodine is a significant public health problem in Ethiopia. The problem is more pronounced in pregnant women and young children, with consequences such as perinatal mortality, mental retardation, and brain damage.

Objective: This study aimed to assess the proper utilization of iodized salt at the household level and associated factors in Debre Markos town, Northwest Ethiopia, 2019.

Method: A Community-based cross-sectional study was conducted from March 15 up to 30, 2019 in Debre Markos town, East Gojjam Zone, Northwest Ethiopia. A total of 788 households were selected using a simple random sampling technique. Data were collected from the households using interview questionnaire. The household iodized salt utilization was tested with the iodine rapid test kit. The data were coded, and entered into Epi data version 4.2 and exported to SPSS version 25 for analysis. Bivariable and multivariable logistic regression was used for analysis.

Result: A total of 781 participants were included in this study. The availability of adequately iodized salt was 89.9%. The proportion of proper utilization of iodized salt (>15 ppm) at the household level was 49.8%. Lack of knowledge regarding the use of iodized salt (AOR=0.47, 95% CI (0.33, 0.69)), washing of iodized salt (AOR=0.21, 95% CI (0.10, 0.43)), and low income (AOR=2.7, 95% CI (1.52, 4.79)) were all associated with decreased utilization of iodized salt.

Conclusion and Recommendation: Proper utilization of iodized salt remains low, which was 49.8% in the town, and does not meet the World Health Organization recommendation and the national goal. Lack of knowledge regarding the use of iodized salt, washing of iodized salt, and low income were factors significantly associated with proper utilization of iodized salt in this study. Therefore, the town health officers, health extension workers, and health professionals should work to improve the awareness of the community and the availability of adequately iodized salt and how to use it properly.

Keywords: Iodized salt; household level; concentration; consumption; Debre Marko; Ethiopia

BACKGROUND

Healthy humans require iodine as an essential component of the thyroid hormones, thyroxin, and triiodothyronine. These hormones are involved in the growth, development, and control of metabolic processes in the body [1]. Getting insufficient iodine intake leads to inadequate hormone and pituitary to produce Thyroid-Stimulating Hormone (TSH) which results in goiters. According to World Health Organization (WHO) the daily Recommendation of Dietary Allowance (RDA) of iodine for preschool children, school children, adults, and pregnant and lactating women is 90, 120, 150, and 200 mcg respectively [2,3].

Correspondence to: Mastewal Giza, Department of Public Health, College of Health Sciences, Woldia University, Woldia, Ethiopia, Tel: +251918657923; E-mail: mastewalgiza@gmail.com

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Iodine Deficiency Disorders (IDD) is a significant public health problem in many countries of the world; particularly pregnant and young women in developing countries [4]. Inadequate thyroid hormone production adversely affects different parts of the body like the liver, kidney, heart, and the developing brain which results in Iodine Deficiency Disorders (IDD). These consequences include mental retardation, defects in the development of the nervous system, Goiter (enlarged thyroid); physical sluggishness; Growth retardation, Reproductive failure, increased childhood mortality. The most devastating of these consequences is on the developing human brain [5].

Globally, over two billion or over 38% of the population living in 130 countries are estimated to be at risk of IDD and 260 million people in Africa are at risk and goiter affects 150,000 peoples [6]. In many middle to high-income countries, the problem of iodine deficiency has largely been solved by adding iodine to salt, which then makes into bread processed foods, and salt shakers in homes around the world [7].

Iodine deficiency is the single most important cause of preventable mental retardation/brain damage in the world. Ethiopia is a country with a high prevalence of IDDs. The prevalence of Goiter in the Amhara regional state was higher than 41.86% a sign of severe iodine deficiency [8].

In Ethiopia, IDD has been recognized as a public health problem for many decades. More than 66 million persons in Ethiopia were at risk of iodine deficiency, as only 15% of households had access to iodized salt in 2011 [9]. The utilization of iodized salt coverage at the household level in Ethiopia shows a gradual improvement, 28.4% in 2000, 54.3% in 2005, 15% in 2011, 88.8% in 2014, and 90% in 2016. This indicated that disparities in the level of utilization of iodized salt were detected with residence and regions in Ethiopia [3].

Approximately 1 billion people globally did not have access to iodized salt households in the [6]. The elimination of iodine deficiency, by expedient production, marketing, and universal consumption of iodized salt, represents a significant development effort in public nutrition. Although globally iodine nutrition has improved, 20% to 30% of pregnancies and thus newborns still do not fully benefit from the use of iodized salt [10].

The presence of iodized salt alone is not enough, but practice at the household level is mandatory towards meeting the goal of IDDs elimination. Even though iodine deficiency is the major public health problem and the cause of morbidity and mortality, there were limited studies done on iodized salt utilization at both national and regional household levels. Most of these studies did not address factors affecting proper iodized salt utilization at the household level.

Therefore, the main aim of this study was to determine the level of iodine salt utilization and identify factors affecting proper iodized salt utilization among the households of Debre Markos town, Northwest Ethiopia.

METHODS

Study design, period, and setting

A community-based cross-sectional study was conducted in Debre Markos Town Northwest Ethiopia, from March 15-30, 2019. The town is between 10°17′00″ to 10°21′30″ N Latitudes and 37°42′00″ to 37°45′30″ E longitude. It is 300 Kilometers far from Addis Ababa (the capital city of Ethiopia) and 265 Kilometers from BahirDar (the capital of Amhara National Regional State). The town has 125,636 projected populations from the 2008 census; of which 66,832 are female and 58,804 male. According to the town, administrative health office report the average household of the town is 4.3 the city is divided into 7 urban Kebeles administrations and 7 rural villages. The administrative health office is one of the 21 woreda health offices in the East Gojjam health department. The town administrative health office is providing health care services by 1 Hospital, 3 health centers, and 7 health posts (founded with Keble administration office) [11].

Population and eligibility criteria

The source populations were all households of Debre Markos Town. The study participants were the head of households (18 years of age and above) who live in the Debre Markos town in selected Kebeles. Adults who are household members involved in the preparation of food at the household level were included in the study. However, Subjects who did not prepare their food in the household and unable to communicate properly were excluded from the study.

Sample size and sampling procedure

The required sample size was determined by using a single population proportion formula with the following assumption: 95% CI, 5% margin of error, and 80% power. We tried to calculate the sample size for each main objective by taking a proportion of iodized salt coverage 37% from previous studies [12]. Adding non-response rate=10% the result becomes 394, because of the use of a multi-stage sampling technique the sample size was multiplied by a design effect of 2 the final sample size was 788.

The two-stage sampling process was used to ensure the representation of all residents in the district. At the first stage, by using simple random sampling, 4 Kebeles were selected among all urban Keble administration. In the second stage, villages were selected from each selected Keble proportionally. This means from Kebeles 02 three villages and 93 households and the selected villages a total of 279 households was selected. From Kebeles 04, two villages and 101 households from the selected village's total of 202 households were selected. From Kebeles 06 two villages and 75 households from selected village's total of 150 households were selected and from Kebeles 07 two villages and 75 households from selected village's total of 150 households were selected Figure 1.

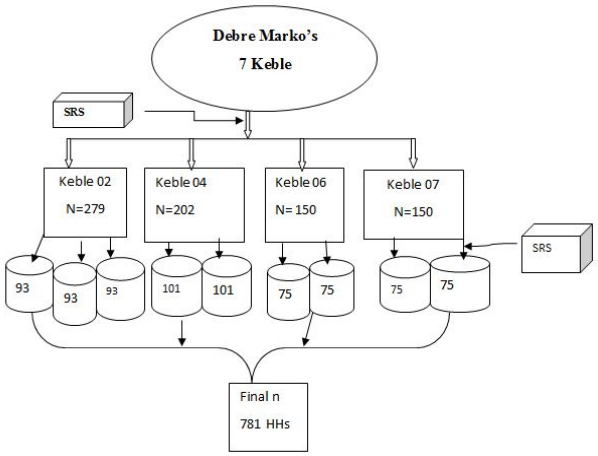

Figure 1: Schematic representation of sampling procedure of Debre Markos town for the study.

Data collection tools and procedures

Data was collected by using a structured interviewer-administered questionnaire. The questionnaire was developed through a review of related literature, and some questions were modified after the pretest was conducted. The data collection instrument is a structured questionnaire, which was prepared in English. The English version of the questionnaire was translated first to Amharic and back to English by the language experts to maintain consistency.

The questionnaire sought information on socio-demographic characteristics, wealth status, and educational status, and knowledge, time of added salt to cooking, environmental factors, availability, and accessibility of iodized salt. During the data collection and administration of questionnaires, the common salt used for cooking in the household was obtained to test the iodine content by the interviewers at the household level using MBI KITS international salt test kits.

Eight trained clinical nurses were recruited. The selected data collectors were receiving two day's training before the data collection and training on how to test the salt to classify as iodized or not iodized. We recruited two BSc Nurse as a supervisor.

Tools: Rapid test kit (MBI KITS International, India) The test kit contains two test solution ampoules of 10 ml, one recheck solution ampoule of 10 ml, one color chart, and one white cup. Two drops of the test solution were added to the surface of the sample salt in the cup.

One minute later the iodine content of the salt was determined by comparing the color on the salt with the color chart. For those samples which showed no color change, up to five drops of the rechecked solution were added to a fresh sample of it and then add 2 drops of test solution on the same spot. Then compare the color with the color chart and determine the iodine content. WHO recommended a strategy with the level of iodization fixed at a minimum of 15 parts per million (ppm) at the consumer level [2].

Operational definitions

Iodized salt concentration: Respondent who used adequate iodized salt ≥ 15 ppm for consumption at the household level [2].

Wealth index: The composite indicator of socio-economic status, which was computed by the application of principal component analysis (PCA). Initially, household asset data were prepared for analysis. Before the PCA, using frequency, important variables that can discriminate households were selected to reduce the number of variables. The binary variables were coded to 0 and 1 and categorical variable options were converted into binary variables and the dummy variable was created as 0 and 1. After data preparation, variables were standardized to change variables to the same scale for comparison by subtracting the mean from each value and then dividing the standard deviation. Once standardized, the variables have a mean of zero and a standard deviation of 1.

In PCA, the sum of components with Eigenvalues greater than one should explain at least 60% of the total variance. Finally, the index was developed by categorizing the sum of components into five equal parts, and the parts were ranked from the poorest to the wealthiest quintile [3].

Knowledge: Respondents who scored 50% and above regarding iodine salt knowledge questions were leveled as good knowledge.

Availability of salt: When the respondent gets the salt within 20 minutes in one trip [13].

Data quality assurance

To ensure the quality of the data Proper training of the data collectors and supervisors was undertaken. Careful design, translation, and retranslation of the questionnaire were used. A pre-test among 79 (10%) households in non-selected urban Kebeles, with close supervision of the data collection procedures, was conducted. Proper categorization and coding of the data were done, and the collected data for accuracy and completeness by data collectors and supervisors were reviewed. The recorded data was checked. The Quality of the test kit was assured by internal and external quality control.

Data processing and analysis

The data entered Epi data version 4.3 and transported to SPSS version 25.0 for further analysis. The results were presented in tables and texts using descriptive statistics such as mean, standard deviation, and percentage to describe the study population about relevant variables.

Multivariable logistic regressions were used to identify the independent factors associated with the level of iodine salt utilization. The strength of the association between independent variables and outcome variables was measured using an odds ratio (OR) with a 95%confidence interval. All variables with a p-value <0.25 at Bi-variable logistic regression analysis were included in the final regression model. In multivariable logistic regression analysis variables with p-value <0.05 were used to declare statistical association.

Ethical Consideration and Consent to Participate

Ethical clearance was obtained from the ethical review committee of Health Science Debre Markos University with institutional research ethics review committee number of (IRB protocol). Permission was obtained from Debre Markos town Health office administrators. All participants were informed about the objective, purpose and procedure of the study before consenting to participate. Written informed consent was obtained from each participant before data collection. Debre Markos University. A participant's name was not included in the data collection format, and the data were not disclosed to any person other than principal investigators.

In this study, 781 study participants out of 788 were participated, making a response rate of 99.1%.

Out of the 781 households who participated in this study, 79.4% (n=620) were female. Regarding religious distribution, the vast majority of the respondents were orthodox Christian followers (93.6%).

The mean age of respondents was 29.2 years. More than half (51.3%) of the participants were married and (45.1%) of the participants were higher educated in their educational status.

Nearly three fourth (71.3%) of the family had less than four family sizes Table 1.

RESULTS

Socio-Demographic characteristics of participants

Table 1: Sociodemographic characteristics of respondents on iodized salt consumption in Debre Markos town, North West Ethiopia, 2019.

Characteristics	Frequency	Percent (%)
Sex		
Female	620	79.4
Male	161	20.6
The relation with the HH family		
Mother	425	54.4%
Father	104	13.3%
Relatives	203	26%
House laborer	49	6.3%
Age		
18-25 years	388	49.7
26-35 years	247	31.6
36-45 years	85	10.9
>45 years	61	7.8
Marital status		
Married	401	51.3%
Single	341	43.7%
Widowed	23	2.9%
Divorced/Separated	16	2.1%
Religion		
Orthodox	731	93.6%
Muslim	31	4.0%
Protestant	16	2.0%

Catholic	3	0.4%
Ethnicity		
Amhara	740	94.8%
Tigre	6	0.8%
Oromo	35	4.5%
Educational level		
Unable to read and write	73	9.3%
Able to read and write	32	4.1%
Primary school	112	14.3%
Secondary school	206	26.4%
Higher education and above	352	45.1%
Occupation		
Student	192	24.6%
Gov't worker	136	17.4%
Private/Merchant	102	13.1%
Daily laborer	45	5.8%
Housewife	254	32.5%
Others*	52	6.7%
Family size		
<4	557	71.3%
5-7	214	27.4%
Above 8	10	1.3%
Wealth index		
The lowest quintile/poorest	152	19.5%
Second quintile	178	22.8%
Middle/Third quintile	130	16.6%
Fourth quintile	174	22.3%
Fifth quintile/richest	147	18.7%

* Job finder, temporary house worker

Availability of adequately iodized salt among households

Out of the 784 respondents, 702 (89.9%) reported that they have used iodized salt, while the rest reported that they did not use iodized salt in their home. Nearly half 389 (49.8%) of the respondents used proper iodized salt (>15 PPM) in the iodine content. Almost all participants 763 (97.7%) heard about iodized salt and 303 (39.7%) of them were heard from television in the source of information followed by heard from health workers and friends 197 (25.8%) and 153 (20.1%) respectively. More than three-fourth 605 (77.5%) of respondents had good knowledge about iodized salt utilization. Almost all 696 (99.1%) of the respondents were bought packaged iodized salt. Six hundred sixty-eight (88.1%) of respondents were not washed the salt to remove impurities from the salt, and 10% of them had exposed the iodized salt for sunlight. Four hundred seventy-two (67.2%) of the respondents was added iodized salt at the end of cooking food Table 2.

Table 2: Iodized salt Concentration of Debre Markos town households, North West Ethiopia, 2019.

Variables	Frequency	Percent (%)
Heard about iodized salt before		
Yes	763	97.7%
No	18	2.3%
Source of information about iodized salt		
Health workers	197	25.8%
Radio	90	11.8%
Television	303	39.7%
Friends/ relatives	153	20.1%
Others	20	2.6%
Important of iodized salt		
To cure goiter	595	76.2%
To remain healthy	326	41.7%
To prevent IDD	195	25%
To grow well	93	11.9%
Better than another salt	100	12.8%
Don't know	19	2.4%
The consequences of iodine deficiency		
Goiter	642	82.2%
Mental retardation	332	45.7%
Growth retardation	177	24.3
Stillbirth/abortion	108	14.9
Loss of learning ability	36	5%
The result of cooking with un iodized salt		
Goiter	597	82.1%
Low blood level	272	37.4%
Stunted growth in children	239	32.9%
Growing learn/ thin	75	10.3%
Don't know	7	0.9%
Every salt contains iodine		
Yes	373	47.8%
No	390	49.9%
Iodized salt has the label of iodine or an expiry date in its container		
Yes	544	69.7%
No	219	28%
The characteristics and standards of iodized salt		

Yes	493	63.1%
No	270	34.6%
The storage of iodized salt kept near heat has a problem		
Yes	590	75.5%
No	173	22.2%
Cooked iodized salt with food for a long time lost its iodate		
Yes	656	84%
No	107	13.7%
Iodine content reduces when iodized salt is not stored in enclosed containers		
Yes	659	84.4%
No	104	13.3%
using iodized salt in their home		
Yes	702	92%
No	61	8%
Place of access iodized salt		
Village shop	610	86.9%
Supermarket	64	9.1%
Market	21	3%
Others	3	0.4%
Distance travel to get iodized salt		
≤ 20 minutes	644	82.5%
More than 20 minutes	137	17.5%
The iodized salt you bought packed		
Yes	696	89.1%
No	6	0.8%
Use of cover for the iodized salt container		
Yes	678	86.8%
No	24	3.1%
Exposed salt to sunlight		
Yes	71	9.1%
No	629	80.5%
Wash's salt to remove impurities from the salt		
Yes	10	1.3%
No	688	88.1%

The salt storage place		
Dry area	669	95.8%
Moist area	8	1.1%
Nearest the fire	21	3%
For how long use the iodized salt after you bought from the market		
Below 2 months	660	84.5%
Above 2 months	42	5.4%
At what time you added iodized salt during the cooking of food		
Early during cooking	6	0.9%
In the middle of cooking	26	3.7%
Late at the end of cooking	472	67.2%
After cooking	198	28.2%
The reasons for not using iodized		
Expensive	13	1.7%
Difficult to find	4	0.5%
Not know their effect	52	6.7%
Others*	10	1.3%

Factors associated with the availability of adequately iodized salt

Among the factors which were associated with the utilization of iodized salt on bivariate analysis, only knowledge, washing iodized salt, and wealth status were significantly and independently associated with iodine salt concentration.

Participants who had poor knowledge of iodized salt were 53% less likely to use iodized salt properly than those who had good knowledge of iodized salt (AOR (95% CI) 0.47 (0.33, 0.69)). Participants who had washed the iodized salt were 78.7% less likely to use adequate iodized salt properly as compared with those who had not to wash the iodine salt (AOR (95% CI) 0.21 (0.10, 0.43)). Those participants who had a middle-income economic level were 2.7 times more likely to be used adequate iodized salt than the richest economic levels (AOR (95% CI) 2.7 (1.52, 4.79)) Table 3.

Table 3: Factors associated with iodine salt concentration among Debre Markos town households, Northwest Ethiopia, 2019.

Characteristics	Adequate iodine salt concentration		COR (95% CI)	AOR (95% CI)	P. value
	No	Yes			
Knowledge					
Good knowledge	275	330	1		
Poor knowledge	117	59	0.42 (0.29, 0.59)	0.47 (0.33, 0.69)	0.001
Environmental factor Washing salt					
No	340	52	1		
Yes	379	10	0.17 (0.08, 0.34)	0.21 (0.10, 0.43)	0.001
Wealth Index					

The lowest quintile/ Poorest	93	141	0.68 (0.42, 1.10)		
Second quintile/ Poorer	102	90	1.18 (0.72, 1.91)		
Middle/Third quintile	82	33	2.58 (1.47, 4.54)	2.70 (1.52, 4.79)	0.001
Fourth quintile/Rich	63	77	0.85 (0.50, 1.42)		
Fifth quintile/richest	49	51	1		

Factors associated with coverage of iodized salt consumption

Bi-variable logistic regression analysis showed that age, educational status, occupation, religion, knowledge, distance travel to get iodine salt, time to add salt, and wealth status were factors significantly associated with iodine salt utilization.

On multivariable logistic regression analysis; age, distance travel to get iodine salt, time to add salt, and wealth status were significantly associated with iodine salt utilization.

Respondents whose age greater than 46 years were 71% times less likely to use iodized salt as compared to respondents whose age was less than 25 years of age (AOR (95% CI 0.29 (0.09, 0.97)). Participants who didn't access iodine salt less than 20 minutes to buy were 90% times less likely to use iodine salt than those respondents who can easily access iodine salt with short travel of fewer than 20 minutes (AOR (95% CI 0.10 (0.05, 0.23)).

On the other hand, participants who added the iodine salt early on cooking were 99.5% less likely to use iodine salt than those who added iodine salt after cooking (AOR (95% CI 0.005 (0.001, 0.02)).

Households who had poor socio-economic status were 99.9% less likely to use as compared to their counterparts (AOR (95% CI 0.06 (0.01, 0.29)) Table 4.

Table 4: Iodine salt consumption among the household respondents, by selected socio-demographic related variables; Debre Markos town, North West Ethiopia, 2019.

Variables	Iodine Salt consumption		COR (95% CI)	AOR (95% CI)	p-value
	No	Yes			
Age					
18-25 years	43	345	1		
26-35 years	14	233	2.07 (1.11, 3.87)		
36-45 years	9	76	1.05 (0.49, 2.25)		
>45 years	13	48	0.46 (0.0.23, 0.91)	0.29(0.09, 0.97)	0.04
Distance travel to get iodized salt (Accessibility)					
≤ 20 minutes (Accessed	43	601	1		
>20 minutes (Not access)	36	101	0.20 (0.12, 0.32)	0.10 (0.05,0.23)	0.001
Time of added iodized salt for cooking food					
Early during cooking	26	6	0.007(0.002, 0.02)	0.05(0.001, 0.02)	0.001
In the middle of cooking	23	26	0.03(0.01, 0.09)	0.03(0.01, 0.12)	0.001
At the end of cooking	24	472	0.59(0.24, 1.48)		

The after cooking	6	198	1	1	
Wealth Index					
The lowest quintile/ Poorest	59	175	0.06 (0.01,0.25)	0.61 (0.01, 0.29)	0.001
Second quintile	8	184	0.46 (0.98,2.25)		
Middle/Third quintile	2	113	1.15 (0.15,8.33)		
Fourth quintile	8	132	0.33 (0.07,1.62)		
Fifth quintile/richest	2	98	1		

DISCUSSION

In this study the proportion of proper utilization of iodized salt with a concentration of iodine ≥ 15 PPM, in Debre Markos Town households was only 49.8% which is lower than the WHO'S recommendation. This finding was higher than study done in Kenya 22.6% (2015) [23], Dabat Gondar 33.2% 2017 [14], Addis Ababa 33.5% 2018 [13], Shebu Town 19% [15], and in Ahferom Tigray 17.5% [8]. The discrepancy might be due to the relatively wide time elapsed between these study periods. Additionaly, the current study was higher than study conducted in Mecha District 25.7% in 2019, [16], Zuway Dugda district 25.7% 2019 [17]. The difference might be due to the variation in the study technique used, the study period and the geographical location of the respondents, the difference in awareness of respondents about the use of iodized salt in the community. Additionally, this may be due to that in recent years the government and ministry of health with other stakeholders were strived to achieve universal salt iodization by implementing different strategies of fortification of salt, proper handling, and utilization.

On the other hand the finding of the current study is lower than study done in Andhra Pradesh Indian 48% 2019 [18], National coverage 53.9% 2014 [19], Laelay Maychew district (59.7%) in 2015 [17], Dessie town 68.8% [12], Asella town 76.8% in 2016 [20], Goba town 57.2% in 2016 [21], Dega Damot 88.8% in 2019 [22]. This difference might be because of the study period, study area, information access, Knowledge about the iodized salt of respondents.

Generally, at the national level there is an overall improvement in the coverage of households using iodized salt from 15.4% in 2011 to 88.9% in 2014. The proportion of households that used iodized salt was found to be 89.9%. Slightly difference as compared as study done in Shebu Town 92.7% [19] and national level 88.8% in 2014 [19] and EDHS 2016 89% [3]. However, the prevalence of the current rate was below the national goal which is planned as 95% of coverage. According to World Health Organization (WHO) recommendation at least 90% of the households should use adequately iodized salt which is ≥ 15 ppm at the household's level [11]. This is because that the awareness of the community on the prevention of IDD and the benefit of iodized salt is maybe on the good track.

The current study also identified the factors that have an association with proper iodine salt utilization among households found that knowledge of the respondent, washing of iodized salt, and low income were factors significantly associated with iodized salt concentration. The finding of this study showed that knowledge of the respondent is strongly associated with adequate iodized salt concentration Households who had poor knowledge were 53% times less likely to be used adequate iodized salt compared with those who had good knowledge. This finding is consistent with the study done in Dabat and Addis Ababa [13,14]. The fact that higher levels of education provide better nutritional awareness about the benefits of iodine increased awareness of the health benefits in diets and raised the use of iodized salt. This is related to the positive effect of respondent's good knowledge of inappropriately using and storing iodized salt.

A previous study also documented that poor iodine knowledge is the risk factor for IDDs.

The finding of this study showed that environmental factor such as washing iodinate salt is associated with inadequate iodine salt concentration. This finding is not supported by previous research.

On the other hand, this study revealed that being better wealth status is associated with better utilization of iodized salt. This finding is consistent with the finding of the study done in Dabat [14], Addis Ababa, and Wolita [13,23].

CONCLUSION

In this study the overall coverage of iodized salt utilization among households was better; however, the proportion of proper iodized salt utilization remains low, which was 49.8%. This doesn't meet the national goal and the daily requirements of the household. Good knowledge, Environmental factor, and wealth status were the factors significantly associated with proper utilization of iodized salt.

RECOMMENDATION

Based on the finding of the study, it forwards the following recommendations. The Debre Markos town health officers and the town health extension workers (HEWs) should give

education to the households regarding proper practices and knowledge of iodized salt utilization. The community should be aware not to expose the salt for heat, adding salt at the end of cooking, and proper storage of the salt in a dry place should be highly recommended for the community. Stakeholders (NGOs) should work on nutritional (micronutrient supplementation). Researchers are recommended to do iodine concentration using a golden standard iodine salt Rapid test kit (urinary iodine to see body iodine level). The health providers should sensitize the community about the importance of iodized salt and its proper utilization at the household level.

Limitation of the study

Rapid test kit shows only colour change which cannot tell the exact amount of iodine concentration in the salt, but because of resource constraint, the gold standard iodine test couldn't be used, which shows the exact concentration. This study didn't triangulate with a qualitative study.

We didn't test urinary iodine to see the body iodine level, testing salt only from households does not assess whether the iodine content of the salt differs as compared to retail shops. The study was done in one region and the findings may not generalize to national levels. The cross-sectional study design limits the factors to establish a temporal relationship; hence inference of causation is not possible.

Data Sharing Statement

All relevant data are within the manuscript and its supporting information files.

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AUTHORS' CONTRIBUTION

All authors contributed to data analysis, drafting, or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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