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Availability of adequate iodized salt at household level in rural communities in Farta district, Northwest, Ethiopia: a cross-sectional study

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Abstract

Introduction Iodine is a crucial trace element for thyroid hormone synthesis. All age groups are affected by iodine deficiency disorders (IDD), especially pregnant women, young women, and children. Iodine deficiency disorder has been recognized as a serious public health issue in Ethiopia. Therefore, the aim of the current study was to assess the availability of iodized salt and associated factors at the household (HH) level in the Farta district, northwest, Ethiopia.

Methods A community-based cross-sectional study was conducted involving 704 participants in Farta District, Northwest Ethiopia, between February and March 2021. A multi-stage sampling technique was employed to recruit participants. Data were collected using pretested and structured questionnaires administered by face-to-face interviewers. The data were entered into Epi-data version 4.6 software and exported into Stata version 14 for the purpose of analysis. Both bivariable and multivariable logistic regression analyses were used to identify factors associated with the availability of iodized salt. Statistical significance was declared at a p-value ≤ 0.05 with a corresponding 95% confidence interval.

Results The availability of adequately iodized salt in the study area was 26.6% (CI = 23.8%, 29.4%) of households. Good knowledge about iodine deficiency disorder (IDD) and iodized salt (AOR = 3.85, 95% CI: 3.65, 6.11); short-term storage of salt at the HH [AOR = 2.76, 95% CI: 1.98, 3.23]; and stored in covered containers (AOR = 1.57, 95% CI: 1.11, 1.78) were significantly associated with the outcome variable.

Conclusion The availability of adequate iodized salt at the HH level was far below the WHO target (more than 90%) in the study area. Knowledge about IDD and iodized salt, stored in covered containers, and short-term storage of salt at the HH were significantly associated with the availability of iodized salt. Hence, at the household level, increasing awareness and disseminating information about the benefits of using iodized salt could be effective. Moreover, education about the proper storage and handling of iodized salt, as well as the recommended storage duration of salt in the home, should be provided as part of our community outreach programs.

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Keywords Iodized salt, Household level, Farta district, Ethiopia

Introduction

In order to synthesize thyroid hormone (TH), iodine is required. It regulates the body's growth, development, reproduction, and metabolism [1]. Humans suffer from iodine deficiency disorders (IDDs) when they do not receive enough iodine on a daily basis [2]. These disorders can lead to endemic goiters, hypothyroidism, reproductive problems, or dwarfism. Iodization of salt is considered one of the most cost-effective, widely used, and low-cost interventions for reaching the general population with iodine [1, 2].

Iodine deficiency affects less than 10% of the world's population [3]. IDDs affect people of all age groups, though young children, reproductive-age women, pregnant women, and postpartum women are most vulnerable [4]. There is still a public health concern regarding IDDs. Several studies have shown that households in South Asia and sub-Saharan Africa don't have access to iodized salt [5]. According to Ethiopian pocket-area studies, many households used insufficient amounts of iodized salt compared to the universal standard [6–8]. Nevertheless, according to the 2016 Ethiopian Demographic Health Survey, 89% of HHs consume enough iodized salt [9].

A number of factors determine the availability of iodized salt, such as using packed salt, not exposing salt to sunlight, storing salt in a dry area, storing the salt for a short period of time, adding salt late after cooking, and knowing about iodized salt and IDDs [6–8, 10]. In the past, iodine content was evaluated qualitatively using a rapid test kit, but it was not reliable (low specificity). Titration with iodometry (IDTM) is the most efficient and preferred method. In order to determine salt's iodine content, this method is reliable [11–13].

In order to prevent IDD, salt should contain sufficient iodine content at the HH level. It is important to give attention to how much-iodized salt should be stored [14, 15]. According to the literatures, iodine is highly volatile and will be lost during cooking due to high humidity and boiling. Even if the effect is small, light or dry heat causes iodine to be lost from the salt [14–16]. In Ethiopia, there is a lack of consistency in findings, and no studies have been conducted using the titration method in the study area. Furthermore, the current study was conducted in highland areas, that is, areas with a high prevalence of goiter, whereas the previous studies were conducted in lowland areas [17–21]. Hence, this study used the gold standard IDTM to assess the prevalence of adequately iodized salt usage and associated factors in Farta district, Northwest Ethiopia.

Methods

A community-based cross-sectional study was conducted in Farta district, northwest Ethiopia, from February to March 2021. The district has 34 kebeles (the lowest administrative unit), and it is 671 km from Ethiopia's capital, Addis Ababa. Nearly half of the district's population (49.7%) is female. A total of 23 health posts and six health centers serve the catchment area's residents.

Study participants

The source population was comprised of all households in the Farta district. The study population was comprised of all households in the selected kebeles of the Farta district. Individuals with severe illnesses and those unable to prepare food at home were excluded from the study.

Sample size determination and sampling procedures

Based on a single population proportion formula, a sample size of 704 was calculated, taking into account the following statistical assumptions: a margin of error of 5% (0.05), a Z-value of 1.96, 10% non-response rates, a design effect of 2, and 29.7% of the proportion of availability of iodized salt at HH level (22).

We used a multistage sampling technique stratified by kebeles in urban and rural areas. Using simple random sampling, 10 rural kebeles and 1 urban kebele were selected from the 32 rural and two urban kebeles found in the district. Based on the household identification numbers in the health extension workers' registration book (family folders), a sampling frame was prepared. Frames containing study subjects were formed for each selected kebele using the household identification numbers. After that, the proportional allocation technique was used to determine the study participants from each kebele. From the existing sampling frame, households were selected using a simple random sampling technique (Open Epi Random Program version 3).

Laboratory procedures

IDTM was done to determine the iodine content in the salt. From each systematically selected household, a 50 g mixed (homogenized) salt sample was taken using a moisture-free, clean, airtight plastic container. The sample was labeled and coded with the date of sampling, source of salt, and batch number. To calculate the iodine concentration, each sample was analyzed in triplicate, and the average sample concentration was used. Sulphuric acid, potassium iodate, and potassium iodide are used as principal reagents, standardized sodium thio-sulphates are used as a titrant, and the starch solution is used as an indicator. Based on the titration results, the

samples were classified according to their iodine content. The outcome variable, adequately iodized salt utilization measured as parts per million (ppm) < 15 was considered inadequately iodized, while ≥ 15 ppm is considered adequately iodized. The test was carried out in an Ethiopian public health institution's laboratory [22]. Knowledge about IDD and iodized salt was categorized as "poor," "average," and "good" for those respondents who scored less than 3, 3–5, and greater than or equal to 6 from nine questions, respectively. The duration of storage was operationalized as less than or equal to two months being considered short-term storage of salt at the household level, while those who stored greater than two months were considered to be in long-term storage [23].

Table 1 Sociodemographic and other related factors in the HH level in Farta district, northwest, Ethiopia

| Variables | Frequency (N) | Percentage (%) |
|--------------------------------------|---------------|----------------|
| Place of residence | | |
| Rural | 599 | 85.1 |
| Urban | 105 | 14.9 |
| Education of the participant | | |
| No formal education | 499 | 70.9 |
| Formal education | 205 | 29.1 |
| Marital status | | |
| Currently married | 434 | 61.6 |
| Unmarried | 270 | 38.4 |
| Age in years | | |
| 18–29 | 256 | 36.3 |
| 30–44 | 237 | 33.7 |
| 45–65 | 211 | 30 |
| Salt container | | |
| With cover | 571 | 81.1 |
| Not cover | 133 | 18.9 |
| Knowledge | | |
| Good | 291 | 41.3 |
| Average | 229 | 32.5 |
| Poor | 187 | 26.2 |
| Duration of storage in months | | |
| ≤ 2 months | 320 | 45.5 |
| > 2 months | 384 | 54.5 |
| Place of storage | | |
| Dry area | 589 | 83.7 |
| Moist and hot area | 115 | 16.3 |
| Distance travel to buy salt | | |
| ≤ 1 hour walking | 515 | 73.1 |
| > 1 hour walking | 189 | 26.9 |
| Exposed to sunlight | | |
| Yes | 169 | 24 |
| No | 535 | 76 |

Data collection tools and quality control

Based on a review of related literature conducted in different regions of Ethiopia, a structured interviewer-administered questionnaire was developed [1, 24–26]. Data collection was carried out by eight female BSc midwives (data collectors) and two supervisors with experience in research and fieldwork coordination. Orientation and training were provided for two days to data collectors and supervisors on how to interview and use bias-control mechanisms. Pretests were conducted on 35 study participants (5%) in the Fogera district, and modifications were made based on the results.

Data processing and analysis

We manually checked the collected data for completeness and consistency. For cleaning, coding, and analysis, the data was imported into Epi-data version 4.6 and exported to Stata version 14. Frequencies, percentages, means, and standard deviations were used to describe descriptive statistics. The distribution of continuous variables was examined using normality tests, such as kurtosis and skewness.

Using variance inflation factors (VIF), we checked for multicollinearity among independent variables; one of them (exposure to sunlight) had VIF values of greater than 10, so it was excluded from the analysis [27]. We conducted a binary logistic regression analysis. In the multivariable model, independent variables with a p-value of 0.2 were considered. A p-value less than 0.05 was considered statistically significant. To examine the strength and direction of the association, the AOR was calculated with its 95% CI.

Results

In total, 704 households responded to the study, with a 100% response rate. The average age of respondents was 31.5 years, with a standard deviation ± 5.02 . More than one-third of the respondents (36.3%) were between the ages of 18 and 29. Most of the study participants did not have formal education (70.9%) and lived in rural areas (85.1%). There were 434 respondents (61.6%) who were married. Regarding salt containers, 571 people (81.1%) stored their salt in covered containers. Over two-fifths of the study participants (41.3%) had good knowledge of IDD and iodized salt (Table 1).

Associated factors of adequate iodized salt

According to the current study, 26.6% of respondents had adequately iodized salt (CI=23.8%, 29.4%). The median iodine content of the sampled salt was 16.26 ppm, with an interquartile range of 9.87 ppm to 25.39 ppm. Households with good knowledge of IDD were 3.85 times more likely to have iodized salt than those with poor knowledge (AOR=3.85, 95% CI: 3.65, 6.11). Compared to the

participants who did not store their salt in a covered container, those who did have a 1.57-fold higher likelihood of having adequately iodized salt (AOR=1.57, 95% CI: 1.11, 1.78). The odds of having adequately iodized salt were 2.76 times higher among those who stored ≤ 2 months after purchasing as compared to their counterparts (AOR=2.76, 95% CI: 1.98, 3.23) (Table 2).

Table 2 Factors associated with adequate iodized salt at HH levels in Farta district, Northwest, Ethiopia

| Variables | Availability of iodized salt in household level | | COR (95% of CI) | AOR (95% of CI) |
|-------------------------------|---|------------|-------------------|-------------------|
| | ≥ 15 ppm | < 15 ppm | | |
| Education of the participant | | | | |
| No formal education | 133 | 366 | 1 | 1 |
| Formal education | 52 | 153 | 0.94 (0.59, 1.71) | 1.25 (0.98, 1.43) |
| Marital status | | | | |
| Currently married | 122 | 312 | 1.28 (0.85, 2.19) | 1.21 (0.89, 1.48) |
| Unmarried | 63 | 207 | 1 | 1 |
| Age in years | | | | |
| 18–29 | 79 | 177 | 1.74 (0.95, 2.35) | 1.55 (0.97, 2.14) |
| 30–44 | 63 | 174 | 1.42 (1.02, 1.98) | 1.33 (0.89, 1.76) |
| 45–65 | 43 | 168 | 1 | 1 |
| Salt container | | | | |
| With cover | 157 | 414 | 1.42 (1.03, 1.89) | 1.57 (1.11, 1.78) |
| Not cover | 28 | 105 | 1 | 1 |
| Knowledge | | | | |
| Good | 106 | 185 | 4.09 (3.79, 6.21) | 3.85 (3.65, 6.11) |
| Average | 56 | 173 3979 | 2.31 (1.16, 3.23) | 1.85 (0.98, 2.37) |
| Poor | 23 | 164 | 1 | 1 |
| Duration of storage in months | | | | |
| ≤ 2 months | 119 | 201 | 2.85 (1.91, 3.87) | 2.76 (1.98, 3.23) |
| > 2 months | 66 | 318 | 1 | 1 |
| Place of storage | | | | |
| Dry area | 166 | 423 | 1.98 (1.12, 2.68) | 1.54 (0.93, 2.79) |
| Moist and hot area | 19 | 96 | 1 | 1 |
| Distance travel to buy salt | | | | |
| ≤ 1 hour waking | 146 | 369 | 1.52 (0.71, 3.57) | 1.41 (0.60, 2.24) |
| > 1 hour waking | 39 | 150 | 1 | 1 |

Discussion

This study showed that 26.6% of households had adequately iodized salt; this study was consistent with a study done in Gondar town, northwest Ethiopia [28], but this was lower than those found in studies from Ethiopia [1, 13, 19], Saudi Arabia [29], Bangladesh [29], Nepal [24]. This difference may be explained by using IDTM in the current study, different study populations and study settings, poor community awareness of the prevention of IDD, and the benefits of iodized salt [8, 24, 28].

In this study, the odds of having adequately iodized salt at a HH level were higher among participants who had good knowledge about IDD and iodized salt utilization compared to those who had poor knowledge. This finding is consistent with the studies done in Ethiopia [7] and Ghana [13]. The reason for this may be that those who had good knowledge of IDD and iodized salt stored it properly, handled the salt properly, and followed the recommended salt storage duration [13].

Furthermore, participants who stored salt in covered containers had a higher chance of having adequately iodized salt at the HH level than those who did not. This study is supported by studies in Ethiopia [30, 31]. This could be due to the fact that the iodine content of the salt may be retained or maintained in the covered container [26]. Moreover, salt in a covered container is not exposed to sunlight [31].

The odds of adequate iodized salt usage were more likely among those who stored ≤ 2 months after purchasing as compared to their counterparts. Which is in line with the studies done in northern Ethiopia [13, 28]. While being stored and distributed, iodine becomes easily volatile when exposed to heat, humidity, moisture, and light [32]. Furthermore, iodized salt loses 28–51% of its iodine after three months, 35–52% after six months, and up to 66% after 12 months. Iodized salt lost 30–98% of its original iodine content due to high humidity levels [28, 32].

This finding show only one-fourth of households had adequate amounts of iodized salt in their homes, which implies the majority of the population suffers from IDDs. Because of IDDs, endemic goiter, hypothyroidism, reproductive failure, or dwarfism can occur. Therefore, it is crucial to counteract the problem by working to increase the availability of iodized salt at the household level. This study has its own limitation, the study was done in one region of the highland, and the findings may not be generalizable to national levels. The cross-sectional nature of the study makes it impossible to determine cause-and-effect relationships. Further, there was no triangulation with qualitative research in this study.

Conclusion

In conclusion, the availability of adequate iodized salt at the HH level was far below the WHO target (more than 90%) in the study area. Knowledge about IDD and iodized salt, stored in covered containers, and short-term storage of salt at the HH were significantly associated with the availability of iodized salt. Hence, at the household level, increasing awareness and disseminating information about the benefits of using iodized salt could be effective. Moreover, education about the proper storage and handling of iodized salt, as well as the recommended storage duration of salt in the home, should be provided as part of our community outreach programs.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40795-023-00728-7>.

Supplementary Material 1

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Authors' contributions

YFS conceived the idea for this study. DBA, DGB, and YFS developed the proposal and supervised fieldwork, made the analysis, interpretation, and manuscript write-up. WDN, DGB, and HB assisted in the conception of the study, involved in the method development, analysis, and interpretation of the findings. All the authors read, revised, and approved the final manuscript.

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Data Availability

All the data generated in this study are included in this manuscript. The datasets used and/or analyzed to produce the current manuscript will be obtained from the corresponding author whenever required.

Declarations

Competing interests

The authors declare that they have no competing interests.

Ethical approval

Ethical clearance was obtained from the Institutional Review Board (IRB) of the University of Gondar, College of Medicine and Health Sciences, Institute of Public Health. Similarly, a support letter was taken from the district administrative office and handed to the selected kebeles. After a brief explanation of the study's objective and purpose, written informed consent was obtained from each participant. For those who had no formal education, thumb-printed consent was obtained from each participant. Participants were also informed that participation was voluntary and that they had the right to withdraw from the study at any time during the data collection. Furthermore, all data obtained from participants was kept confidential and used only for this study. The study was also conducted according to the Helsinki Declarations.

Consent for publication

Not applicable.

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