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# AVAILABILITY OF ADEQUATELY IODIZED SALT AT HOUSEHOLD LEVEL AND ASSOCIATED FACTORS TO IODIZED SALT USE AMONG HOUSEHOLDS IN RURAL COMMUNITIES IN THE HOHOE MUNICIPALITY OF GHANA

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## ABSTRACT

**Background:** Iodine deficiency disorders (IDDs) are a major public health concern affecting an estimated 2 billion people worldwide. In order to eliminate IDDs, the Universal Salt Iodization (USI) regulations mandate salt for human and animal consumption to be iodized. This study was a baseline assessment in four selected rural field sites on the current iodized salt availability and utilization in households and factors contributing to low iodized salt use in the Likpe sub-Municipality of Hohoe municipality. **Methods:** This study was a descriptive cross-sectional baseline survey involving 260 households from four rural communities. A systematic randomized sampling technique was used to select households. Data was collected from household heads using structured questionnaires and rapid field iodine test kits. Descriptive statistics was used for proportions and t-test for difference in means. Chi-square test and binary logistic regression were used to assess the associations between the dependent and independent variables. A p-value <0.05 was considered as statistically significant. **Results:** A total of 260 household heads were surveyed, of which 136 (52.5%) claimed they used iodized salt. Of the 232 (89.2%) households with salt available for testing, (43.0%) were granular, coarse (36.0%) and fine/smooth salt (20.9%) type of salt. Only 16.5% of the household's salt tested contained adequate iodine (≥15ppm), 18.5% contained inadequate iodine (1-14 ppm) and 64.6% contained no iodine (0.0ppm). Smooth/fine salt was found to have 84.6% adequate iodine whilst coarse and granular salt each contained only 7.7% adequate iodine. The main reason for using coarse and granular salt was that it was readily available while fine/smooth salt was used to provide good health. Households with more than 10 people were less likely to use iodized salt [OR=0.05 (95% CI: 0.00, 0.73); p=0.029]. Respondents with at least primary education were more likely to use iodized salt [OR=12.21 (95% CI: 1.01, 159.29); p=0.049]. Even though not statistically significant, salt sold in the market and by mobile van in the rural communities was 0.37 and 0.13 times less likely to contain iodine as compared to those sold in shops [OR= 0.37 (95% CI: 0.08, 1.78); p=0.215] and [OR=0.13 (95% CI: 0.01, 1.22); p=0.074] respectively. The main sources of information were media (35.3%) and health workers (34.6%). **Conclusion:** Information from this baseline survey would be used to introduce some interventions such as awareness creation and counselling programmes in these selected communities. Regulatory bodies must enforce the law and ensure that every salt sold in the market or by mobile van contains adequate iodine.

**KEYWORDS:** Iodized salt, adequate Iodine content, Household, Likpe sub-Municipality, rural community, Hohoe Municipality, Ghana.

## INTRODUCTION

Iodine deficiency disorders are major public health problems in several areas of the world, especially in developing countries. Iodine deficiency resulting from inadequate dietary iodine intake is related to diseases collectively referred to as iodine deficiency disorders (IDDs). Iodine deficiency is the single greatest cause of preventable mental impairment globally and also causes many other adverse effects on growth and development due to inadequate thyroid hormone production.[1,2] Globally, IDDs are associated with many thyroid related diseases including hypothyroidism, hyperthyroidism, goitre and cretinism, and also inherit real risk of coronary artery diseases, autoimmune disorders,

psychiatric disorders, cognitive impairment, and cancer.[3-5]

Iodine deficiency disorder (IDD) has been recognized as a public health problem in India. An estimated 167 million people in India are at risk of IDDs. Of these, 54 million suffer from goitre, 2 million suffer from cretinism, and 6.6 million children have neurological deficits.[6,7]

These IDDs can be effectively and inexpensively prevented by iodizing all salt for human and animal consumption (known as Universal Salt Iodization, USI). Salt iodization programs have been implemented in many countries of the world, and two-thirds of the global population (71%) is estimated to be covered by iodized salt.[8]

According to the Ethiopian Demographic and Health Survey (EDHS), only 15.4% of the households were using iodized salt.[9] Many potential barriers have been identified to receive adequate iodine intake and reducing IDDs. Some of these include household salt washing of impurities in salt, salt packaging, education, and environmental factors (moisture, light, heat and contaminants).

National surveys assessing household coverage of iodized salt in Bangladesh have shown that household use of adequately iodized salt (≥15ppm) had remained relatively constant since 2004: from 51% in 2004-05 to 57% in 2011-12.[10] Despite sustaining this considerable progress, improving the quality of salt iodization beyond these levels and ensuring equitable access remains a major issue in Bangladesh and ensuring access to adequately iodized, packaged salt is a challenge.[11]

The Universal Salt Iodization (USI) regulations mandate salt for human and animal consumption to be iodized.[1] In Ghana, non-iodized salt is banned from sale when it is intended for consumption and people found selling or using non-iodized salt are liable to arrest. Campaigns on iodized salt consumption have also been on-going for several years and iodized salt is readily accessible, at least, in all urban areas.[12]

In the Ghana MICS 2011, testing for iodine content in salt used for cooking was done in two ways: using Rapid Test Kits (RTKs), and through Titration in a laboratory. According to the Ghana MICS (2011), 89% of households salt used for cooking was tested for iodine content by using salt test kits to test for the presence of potassium iodate. It was found that in 10% of households there was no salt available. In 35% of households, salt was found to be adequately iodized (i.e. 15+ ppm). Use of adequately iodized salt was lowest in the Northern (15%), followed by the Volta (18%), and the Upper East (18%) regions; and was highest in the Greater Accra (56%), followed by the Brong Ahafo (45%) and the Western (44%). Also, households in urban areas are more likely to use adequately iodized salt (45%), compared to households in rural areas (23%). It was also interesting to note that more than one in five households (22%) used salt that was not iodized, and 34% used inadequately iodized salt (>0 and <15 ppm). Households in the Volta (59%) and those in the Northern (56%) regions were also more likely to use inadequately iodized salt, compared to households in the other regions.[12]

As part of efforts to achieve the Universal Salt Iodization (USI) goal, the Government of Ghana launched the USI programme backed by an act of parliament to oversee the attainment of this goal. The programme focuses on the promotion of iodized salt consumption which is prevalent in Ghana, and campaigns on iodized salt consumption have been on-going for several years and iodized salt is readily accessible, at least, in all urban areas. As part of the community health assessment activities for the selected field site for SPH-UHAS, a baseline survey was carried out to estimate current household coverage of adequately iodized salt in the four selected rural communities. Information gathered would serve as a baseline and would be used to generate interventions for the rural communities.

## MATERIALS AND METHODS

### Study site

The study was carried out in the Hohoe Municipality, one of the twenty-five administrative districts in the Volta Region of Ghana. It is located within longitude 0.25° E and 0.75° E and latitude 6.75° N and 7.25° N. It shares boundary to the East with the Republic of Togo, on the southeast by Afadjato South District and the southwest with Kpando Municipal, on the northwest with Jasikan District and on the North West with Biakoye District. The Municipality is located in the central part of Volta Region with a population of 167,743 people, of which 48.1% are males and 51.9% are females (Population Census 2010).[13] Hohoe is the Municipal capital with a population of 63,000 people. The municipality covers an area of 1,403 sq. km and has been divided into 7 sub-Municipalities namely; Hohoe, Gbi-Rural, Alavanyo, Agumatsa, Likpe, Akpafu/Santrokofi and Lolobi. The main economic activity is farming and about 55% of the population grows cash crops such as cocoa, maize, cassava, rice, yam and vegetables whilst trading forms about 25%, livestock rearing 15% and other industrial activities represent 5%. The major ethnic groups in the Municipality are Ewes, Akpafus/Lolobis, Santrokofis and Likpes. There are 21 health facilities in the Municipality comprising the Municipal hospital (1), health centres (14), Reproductive and Child Health (RCH) clinic (1) and Community-Based Health Planning and Services (CHPS) compounds (5), (HMHD annual report, 2014).[14]

### Study population

The study was among adults aged 18 years and above. Household heads who consented to participate were included in the study. However, those who had not stayed

in the municipality for three or more months were excluded.

**Study design**
This was a descriptive cross-sectional study to determine the availability of adequately iodized salt in households, as well as the factors influencing its use in the rural communities in the municipality. This cross-sectional survey was conducted in four rural communities by the SPH of UHAS. The total number of households surveyed was 260. The data collectors obtained verbal consent from the household, and a pre-tested standardized questionnaire was administered in every selected household. The respondents were asked questions regarding iodized salt purchasing and consumption habits, salt storage, type of salt preferred, reasons for using iodized salt, sources of salt and information on iodized salt. Rapid iodized salt test kit (MBI kit) was used in the survey to assess iodine content in salt used in the households.

**Sample size**
The sample size required to be representative of the study population was determined using a sample size calculation formula.[15] A z score of 1.96 at 95% confidence level, the margin of error of 5% and proportion of 24.6% expected the prevalence of iodized salt use, were entered into the formula to determine a minimum sample size of 235. However, non-response rate of 10% was added to the minimum sample size, which then increased the required sample size to 258.5 ≈ 260.

**Sampling**
Four communities were randomly sampled in this study. Eligible household heads were selected using the following steps: the selected community was divided into four sectors, the sectors were assigned numbers and one sector was randomly selected. The center of each selected sector was found and a random direction was chosen by spinning a pointed device, the direction of which was followed and the houses were numbered on pieces of paper from the center to the boundary of the selected sector. The first house was chosen at random between 1 and n (i.e. the first house counted from the center to the boundary). This house became the starting point or first house to survey. Where there were more than one eligible households in a selected house only one household was drawn at random and also only one eligible person (household head) in the household was randomly selected using simple random sampling (balloting). Where there were 4 or more eligible households in a house selected, two households were drawn at random and only one eligible person (household head) was randomly selected in each household using simple random sampling (balloting). Where no eligible household was found in a selected house, the next house closest to the previously selected one was selected. This procedure was repeated until the required number of respondents was obtained.

**Data collection**
Face-to-face interview technique using pre-tested structured questionnaire was used to collect data on knowledge on iodized salt and background information of the respondents. A small amount of household salt was obtained from each respondent and Rapid Field Iodine Test Kit was used to test the iodine content.

**Rapid field iodine test**
Rapid field iodine test kit manufactured by MIN KITS INTERNATIONAL, India was used to test the iodine content of household salt, The kit contained stabilized starch-based solution, which causes chemical reaction manifested by color change. The salt sample was taken in a teaspoon, and after shaking the reagent (test solution) bottle well, a drop of the test solution was poured on the salt. The salt turned light blue to dark violet depending on its iodine content. To assess the iodine content, the color of the salt was compared with accompanying chart (0, 7, 15, and 30 parts/million [ppm]). The cut-off proportion of 15 ppm and above was considered as adequately iodized salt using the WHO/United Nations International Children's Emergency Fund reference indicators for monitoring of iodized salt (WHO/UNICEF, 2008).[16]

**Classification of iodine concentration**
Salt without iodine: (0 ppm)
Inadequately iodized salt: (> 0 and < 15 ppm)
Adequately iodized salt: (≥ 15 ppm)

**Data Analysis**
Data was entered using Epidata 3.1 software and then exported to Stata SE 11.0 for analysis. After data was entered, cleaning and validation were done to ensure data quality before analysis was carried out. Descriptive statistics such as proportions and frequency distribution were performed to describe categorical variables and the results were presented in bar charts, pie charts and tables. Inferential statistics such as t-test was used to compare means and Chi-square test and logistic regression were used to assess the associations between the categorical dependent and independent variables. P-value <0.05 was considered as statistically significant.

**Ethical issues**
Participation in the study conformed to the required ethical guidelines regarding the use of human subjects. This study was approved by the Ethical Review Committee of the Ghana Health Services, Research and Development Division, Accra. Participation in the study was voluntary, and consent was sought from the participants.

## RESULTS

**Background characteristics of the Respondents**
Table 1 summarizes the background characteristics of the participants. A total of 260 household heads were included in the survey. The majority of the household heads were men 175 (67.3%) and 85 (32.7) were women.

Of the 260 households, 82 (31.5%) had between 1-3 people in the household, 118 (45.4%) had 4-6 people, 48 (18.5%) had 7-10 and 12 (4.6%) had more than 10 people in the household. About 27 (10.4%) of the population surveyed did not have any formal education, the majority 123 (47.3%) had education up to Junior High School (JHS) level, followed by Senior High School (SHS) 56 (21.5%), primary 39 (15.0%) and 15 (5.8%) tertiary education. More than half of the respondents were married 167 (64.2%), single 47 (18.1%), widowed 27 (10.4%), divorced 19 (7.3%) and co-habiting 14 (5.4%). Most of the participants were Christians 238 (91.5%) followed by Muslims 17 (6.5%) and traditionalists 5 (1.9%).

**Table 1: Background characteristics of respondents in the four communities.**

| Characteristics | Total [N=260] n (%) |
|---|---|
| **Sex** | |
| Male | 175 (67.3) |
| Female | 85 (32.7) |
| **Number of people in a household** | |
| 1-3 | 82 (31.5) |
| 4-6 | 118 (45.4) |
| 7-10 | 48 (18.5) |
| >10 | 12 (4.6) |
| **Religion** | |
| Christian | 238 (91.5) |
| Muslim | 17 (6.5) |
| Traditional | 5 (1.9) |
| **Educational status** | |
| None | 27 (10.4) |
| Primary | 39 (15.0) |
| JHS | 123 (47.3) |
| SHS | 56 (21.5) |
| Tertiary | 15 (5.8) |
| **Marital status** | |
| Single | 47 (18.1) |
| Married/Co-habiting | 167 (64.2) |
| Divorced | 19 (7.3) |
| Widowed | 27 (10.4) |

**Iodized salt usage by households**

Overall, 136 (52.5%) of the respondents claimed they use iodize salt in their households (Figure 1). The main salt type preferred by respondents was granular (43.0%), followed by coarse (36%) and smooth/fine salt (20.9%) (Figure 2).

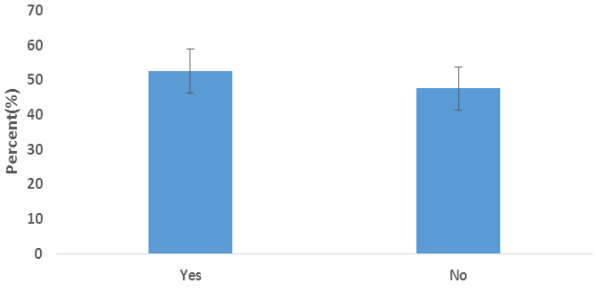


Figure 1. Iodized salt uage by respondents

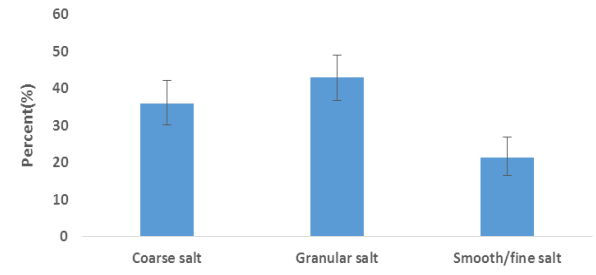


Figure 2. Salt prefernce by respondents in the communities

**Reasons for salt type preference**

The main reason given for preferring granular and coarse salt was that it was readily available, 56.8% and 47.3% respectively. The main reason given by respondents for using smooth/fine salt was for good health (35.2%). Other reasons for using granular salt were affordable (20.7%), "have been using it for a long time" (9.9%), "it gives good health" (3.6%), "it tastes good" (3.6%) and "no reason" (5.4%). Other reasons given by respondents who prefer coarse salt were that they have been using it for a long time (21.5%), "it is affordable" (10.8%), "it tastes good" (9.7%) "it gives good health" (6.5%) and "no specific reason" (4.3%). Other reasons for using fine/smooth salt were "it is readily available" (14.8%), "good taste" (14.8%) "it is affordable" (13.0%), "using it for a long time" (1.9%) and "no specific reason" (20.4%) (Figure 3).

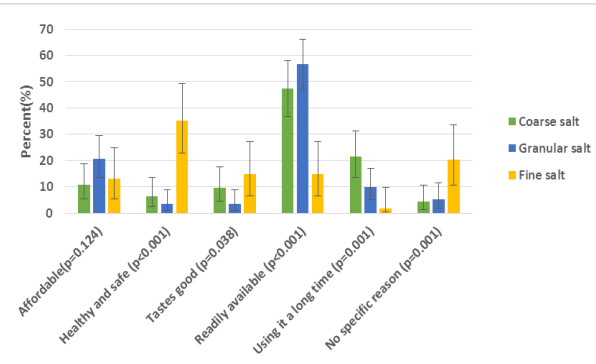


Figure 3. Reasons given by respondents for type of salt used

**Reasons for Non-use of Iodized Salt in the Household**

Out of the 260 respondents, 124(47.7%) claimed they have not been using iodized salt and the reasons given were that the salt was not available 51(41.1%), too expensive 28 (22.6%), were not interested 16 (12.9%), not aware 15 (12.1%) and no reason given 14 (11.3%) (Figure 4).

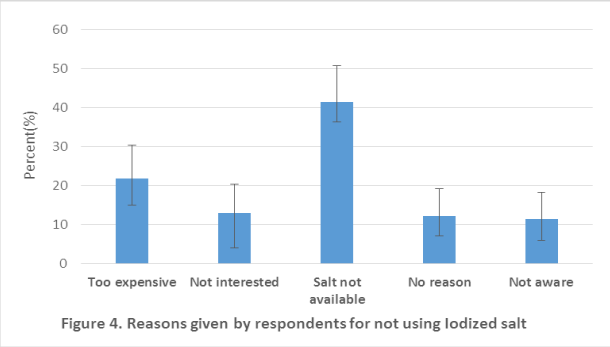


Figure 4. Reasons given by respondents for not using Iodized salt

**Iodine Content of Household Salt**

A total of 232 out of 260 (89.2%) of households provided salt for testing. Of the 232, 150 (64.7%) of the salt tested had no iodine (0.0 ppm), 43 (18.5%) had between 1-14 ppm iodine and only 39 (16.8%) had adequate iodine (≥15.0 ppm) (Figure 5).

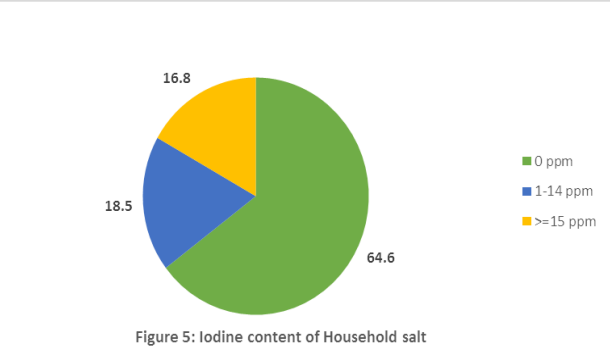


Figure 5: Iodine content of Household salt

**Iodine content in household salt types**

Figure 6 shows that 80.6% of the smooth/fine salt had adequate iodine, only 7.7% of the granular and 7.7% of coarse salt had adequate iodine. No iodine (0.0 ppm) was 55.1% in Granular salt, 34.1% in coarse salt and 10.8% in smooth/fine salt (Figure 6). Iodine content between 1-14 ppm was 69.8% in the coarse salt 25.6% in granular salt and 4.7% was found in smooth fine salt.

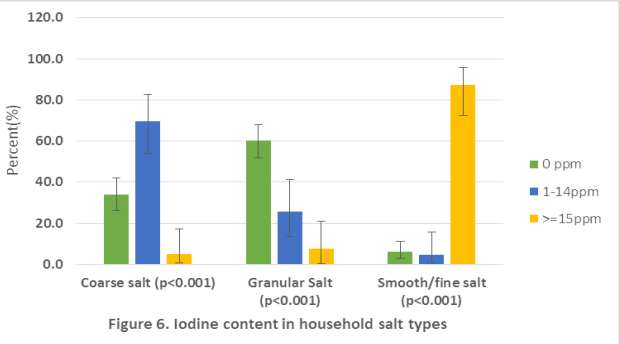


Figure 6. Iodine content in household salt types

**Household Salt Storage Practices**

Figure 7 shows that most (59.1%) households stored their salt in covered containers. Other storage facilities were uncovered containers (17.0%), polythene bags (17.0%) and original packaging materials (6.9%).

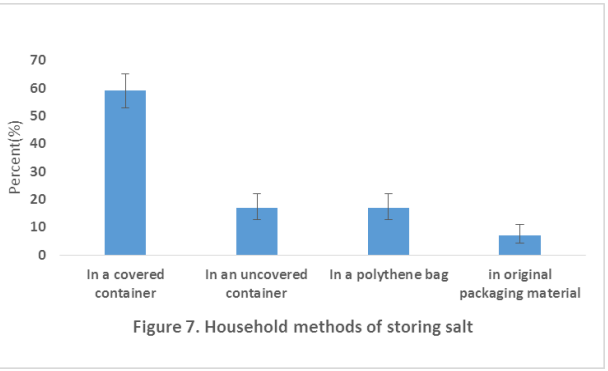


Figure 7. Household methods of storing salt

**Knowledge on benefits and effects of not using Iodized Salt**

About 47.8% of the respondents knew that the benefits of iodized salt intake was to prevents IDDs, other benefits mentioned were better taste (37.8%) and better digestion (14.4%) (Figure 8). Some of the effects mentioned of not using iodized salts were Goitre (77.8%), heart pain (15.6%) and retardation of child's development (6.7%) (Figure 9).

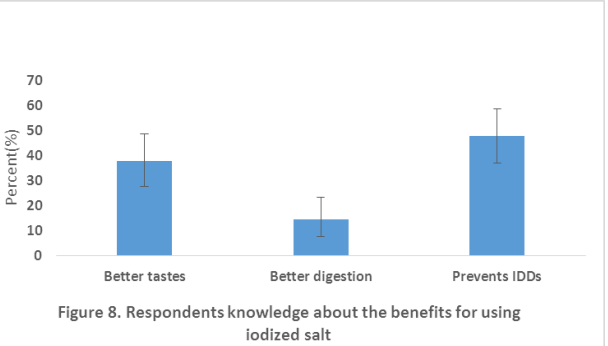


Figure 8. Respondents knowledge about the benefits for using iodized salt

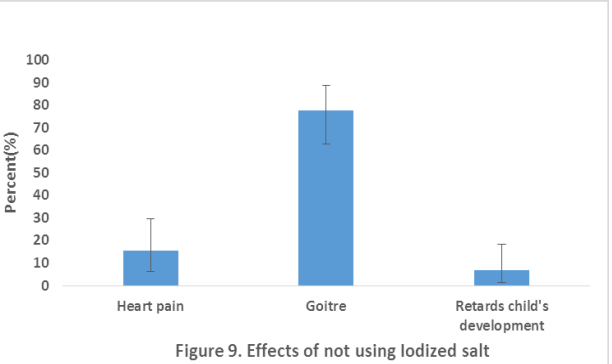


Figure 9. Effects of not using Iodized salt

**Respondents' Source of Information on Iodized Salt**

The main sources of information on iodized salt for the respondents were the media 48 (35.3%), Health workers 47 (34.6), community durbars 26 (19.1%) and relatives 15 (11.0%) (Figure 10).

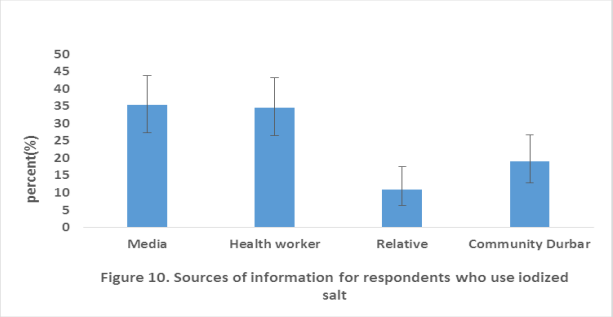


Figure 10. Sources of information for respondents who use iodized salt

**Associations between Iodized Salt Use and Background Characteristics**

Table 2 shows that there was no significant association between the location of the community, sex and Number of people in the household and iodized salt use ($\chi^2$=0.05, p=0.820, α=0.05) and ($\chi^2$=2.64, p=0.104, α=0.05) and ($\chi^2$=4.80, p=0.187, α=0.05) respectively. There was no significant association between religion and iodized salt use ($\chi^2$=2.16, p=0.339, α=0.05). There was also no significant association between salt source, the source of information and iodized salt use ($\chi^2$=5.21, p=0.074, α=0.05) and ($\chi^2$=6.06, p=0.109, α=0.05) respectively (Table 2). However, there were significant associations between community size, educational level, marital status and iodized salt use ($\chi^2$=10.21, p=0.001, α=0.05), ($\chi^2$=21.46, p<0.001, α=0.05) and ($\chi^2$=8.88, p=0.031, α=0.05) respectively. There was also a significant association between salt type and iodized salt use ($\chi^2$=21.07, p<0.001, α=0.05). Source of salt was however not significantly associated with iodized salt use ($\chi^2$=5.21, p=0.074, α=0.05).

**Table 2: Background characteristics of respondents and the odds of iodized salt use.**

| Characteristics | Not Using [N=124] N (%) | Using [N=136] N (%) | Chi-square ($\chi^2$) | p-value | Adjusted OR (95% CI) | p-value |
|---|---|---|---|---|---|---|
| **Landscape** | | | | | | |
| High land | 58 (47.2) | 66 (48.5) | | | | |
| Low land | 65 (52.9) | 70 (51.5) | 0.05 | 0.82 | 1.25 ( 0.56, 2.78) | 0.587 |
| **Size of community** | | | | | | |
| Small | 42 (34.2) | 23 (16.9) | | | | |
| Big | 81 ( 65.9) | 113 (83.1) | 10.21 | 0.001 | 1.17 (0.45, 3.02) | 0.752 |
| **Gender** | | | | | | |
| Male | 77 (62.6) | 98 (72.1) | | | | |
| Female | 46 (37.4) | 38 (27.9) | 2.64 | 0.104 | 1.28 (0.57, 2.90) | 0.553 |
| **Number of people in household** | | | | | | |
| 1-3 | 32 (26.0) | 50 (36.8) | | | | |
| 4-6 | 60 (48.8) | 57 (41.9) | | | 0.50 (0.22, 1.17) | 0.112 |
| 7-10 | 23 (18.7) | 25 (18.4) | | | 0.74 (0.26, 2.11) | 0.577 |
| > 10 | 8 (6.5) | 4 (2.9) | 4.80 | 0.187 | 0.05 (0.00, 0.73) | 0.029 |
| **Religion** | | | | | | |
| Christian | 111 (90.2) | 126 (92.7) | | | | |
| Muslim | 8 (6.5) | 9 (6.6) | | | 12.81 (0.87,188.29) | 0.063 |
| Traditionalist | 4 (3.3) | 1 (0.7) | 2.16 | 0.339 | 0.10 (0.00, 14.40) | 0.367 |
| **Educational level** | | | | | | |
| None | 20 (16.3) | 7 (5.2) | | | | |
| Primary | 23 (18.7) | 15 (11.0) | | | 12.71(1.01, 159.29) | 0.049 |
| JHS | 60 (48.8) | 63 (46.3) | | | 3.79 (0.46, 30.82) | 0.213 |
| SHS | 17 (13.8) | 39 (28.7) | | | 5.53(0.57, 53.42) | 0.140 |
| Tertiary | 3 (2.4) | 12 (8.8) | 21.46 | <0.001 | 9.82(0.82, 117.18) | 0.071 |
| **Marital status** | | | | | | |
| Single | 16 13.0) | 30 (22.1) | - | - | - | - |
| Married/Co-habiting | 80 (65.0) | 87 (64.0) | | | 0.19 (.03, 1.37) | 0.099 |
| Divorced | 8 (6.5) | 11 (8.1) | | | 0.25(0.02, 3.09) | 0.282 |
| Widowed | 19 (15.5) | 8 (5.9) | 8.88 | 0.031 | 0.15 (0.01, 3.05) | 0.218 |
| **Salt type** | | | | | | |
| Smooth/fine salt | 7 (5.7) | 29 (21.5) | | - | - | - |
| Coarse salt | 62 (50.4) | 37 (27.4) | - | - | 0.29 (0.04, 2.01) | 0.208 |
| Granular Salt | 54 (43.9) | 69 (51.1) | 21.07 | <0.001 | 0.50 (0.07, 3.31) | 0.470 |
| **Salt source** | | | | | | |
| Shop | 15 (12.2) | 29 (21.3) | | | | |
| Market | 95 (77.2) | 88 (64.7) | - | - | 0.37 (0.08, 1.78) | 0.215 |
| Mobile van | 13(10.6) | 19(14.0) | 5.21 | 0.074 | 0.13 (0.01, 1.22) | 0.074 |

**Associations between socio-demographic characteristics and the odds of iodized salt use**

Using the adjusted logistic regression model, female respondents were 1.28 times more likely to use iodized salt as compared to males but the difference was not statistically significant [OR= 1.28 (95% CI: (0.57, 2.90); p=0.553]. Table 2 also shows that households with more than ten people were 0.05 times less likely to use iodized salt as compared to those who had between 1-3 people; however, the difference was statistically significant [OR= 0.50(95% CI: 0.00, 0.73); p=0.029]. Households with 4-6 and 7-10 people were 0.50 and 0.74 times less likely to use iodized salt as compared to those with 1-3 people, but the differences were not statistically significant [OR=0.50(95% CI:0.22, 1.17); p=0.112] and [OR= 0.74 (95% CI: (0.26, 2.11); p=0.577] respectively.

Muslims respondents were 12.81 times more likely to use iodized salt as compare to Christians, but the difference was however not statistically significant [OR= 12.81 (95% CI: 0.87, 188. 29); p=0.063]. Respondents who were traditionalist were 0.10 less likely to use iodized salt as compared to Christians, but the difference was also not statistically significant [OR= 0.10 (95% CI: 0.00, 14.40); p=0.367] (Table 2).

Table 2 shows that there was an association between educational level attained and iodized salt use. Respondents who attained primary school level of education were 12.71 times more likely to use iodized salt as compared to no formal education and the difference was statistically significant [OR= 12.71 (95% CI: 1.01, 159.29); p=0.049]. Respondents who attained JHS, SHS and tertiary level of education were 3.79, 5.53 and 9.82 times more likely to use iodized salt as compared to no formal education however, the differences were not statistically significant [OR= 3.79 (95% CI: 0.46, 30.82); p=0.213], [OR= 5.53 (95% CI: 0.57, 53.42); p=0.140] and [OR= 9.82 (95% CI: 0.82, 117.18); p=0.071] respectively.

There was also an association between marital status and iodized salt use. Respondents who were Married/Co-habiting, Divorced and Widowed 0.19, 0.25 and 0.15 times less likely to use iodized salt as compared to those who were single, however, the differences were not statistically significant [OR= 0.19 (95% CI: 0.03, 1.37); p=0.099], [OR=0. 25 (95% CI: 0.02, 3.09); p=0.282] and [OR= 0.15 (95% CI: 0.01, 3.05); p=0.218] respectively.

Households who used coarse salt and granular salt were 0.29 and 0.50 times less likely to use iodized salt as compared to those who used smooth/fine salt, but the differences were not statistically significant [OR= 0.29 (95% CI: 0.04, 2.01); p=0.208] and [OR=0.50 (95% CI: 0.07, 3.31); p=0.470] respectively. Households who got salt from the market and mobile vans were 0.37 and 0.13 times less likely to use iodized salt as compared to those who got their salt from the shop, though the differences were not statistically significant [OR= 0.37 (95% CI: 0.08, 1.78); p=0.215] and [OR=0.13 (95% CI: 0.01, 1.22); p=0.074] respectively.

## DISCUSSION

The mandatory USI was recommended by WHO/UNICEF/ICCIDD for the eradication of iodine deficiency disorders with a 90% recommended coverage for countries with high Iodine deficiency including Ghana.[17] This study assessed the availability of adequately iodized salt in the household and collected information on the types of salt consumed, sources of salt and information about iodized salt, reasons for preference, as well as determining factors influencing iodized salt use. Data from this study revealed that availability of adequately iodized salt was low 16.8% as compared to the national rural coverage of 25.1% and the Volta regional coverage of 18% in 2011. Household access to fine/smooth salt (found to be generally adequately iodized) as compared to coarse and granular salt (found to be non- or inadequately iodized) was found to be the factor most significantly associated with salt iodine content. Coarse and granular salt were more readily available in the market and by mobile vans in rural areas (47.6%). The main reasons for non-use of Iodized salt in the household were non-availability 51(41.1%) and expensive 28 (22.6%). In addition, the majority of respondents in these communities reported sourcing salt from the market (70.4%) and mobile vans (12.3%)

This study found that 52.5% of households claimed they use iodized salt and only 16.5% of household salt contained adequate iodine. This is in agreement with what was reported by the Ghana MICS where it was reported that adequate iodized salt usage was 18% in the Volta Region.[12] It also agreed with findings from Bangladesh where they found 15%. However, a similar study conducted in Pakistan revealed that rural households were more likely not to use iodized salt.[18]

The findings in this study is lower than what was reported by Agbozo et al.,[19] and by Nicholas et al.,[20] that 35.0% and 24.2% of households in the municipality consumed adequately iodized salt of ≥15ppm respectively. This lower percentage from our study could possibly because our study was confined to rural communities and did not include urban communities. Studies have shown that availability of adequately iodized salt was higher in urban than rural areas.[12]

Findings from this study are similar to what was reported by EDHS[9] where the national coverage of iodized salt in Ethiopia was 15.4%. The Ethiopia study also reported that urban dwellers use iodized salt more as compared to rural dwellers as evidenced from EDHS.[9]

Based on the findings of this study, we can conclude that availability of adequately iodized salt at household level was very low in the rural communities. Using packed salt, not exposing salt to sunlight, shorter storage of salt

at household and good knowledge of participants about iodized salt were identified as factors associated with the availability of adequately iodized salt at the household level. Hence, households should be sensitized on the importance of iodized salt and its proper handling at the household level.

This study found that majority (77.8%) of the respondents identified goitre to be associated with iodine deficiency. This is in agreement with what was found by Nicholas et al.,[20] and by Buxton & Baguune,[21] who reported that 79.3% and 69.3% of the participants identified Goitre as a sign of iodine deficiency, respectively.

Respondents' main sources of information on iodized salt were the media (35.3%), particularly local radio stations and television and health workers (34.6%). This is similar to what was reported by Nicholas et al.,[20] where they also found Media (38.7%) and health workers (20.2%) as the main sources of information. Similarly, Khan et al.,[18] reported television as the respondents' main source of information (75%) on iodized salt. Another study conducted in the Bia district of Ghana, however, reported that only 16.6% of participants mentioned television as their source of information about iodized salt. The difference in the sources of information might be that in the Bia district, half of the respondents were farmers and spent most hours of the day working on their farms.[21] Findings from this study suggest that information on iodized salt from media mainly radio and Health workers are the most effective, therefore should be improved and sustained in the municipality. This can also be used to develop awareness campaigns to increase iodized salt intake.

Iodized salt depreciates its iodine content when not stored in closed plastic bags, sealed waterproof materials or closed containers. This study found that the majority (59.1%) of the respondents stored their salt in covered containers. This means that the household salt cannot easily lose their iodine content as they are covered in air-tight containers. This is in agreement with findings by Bruxton and Baguune[21] and Nicholas et al[20] who reported that (62.6%) and (69.8%) respectively of the respondents stored their salt in covered containers. This study found that 17.0% of salt was not covered and 17.0% was put in polythene bags whilst 6.9% remained in the original pack, which can easily lose their iodine content. This might have contributed to the 18.5% inadequate iodized salt found in the households.

This study has revealed that there was an association between iodized salt use and formal level of educational attainment (P=0.049). This is in agreement with findings reported Nicholas et al.,[20] who also found an association between iodized salt use and level of education (P<0.001). Education increases knowledge and decision making levels of individuals, therefore, education should be one of the main ways of communicating information on IDDs. This study has shown that those with Primary, JHS, SHS and tertiary education are 12.71, 3.79, 5.53 and 9.82 times respectively more likely to use iodized salt as compared to those with no formal education. This is similar to findings by Gidey et al.,[22] and Nicholas et al,[20] who found a positive association between iodized salt use and level of education, and that respondents with formal education were more likely to use iodized salt than those with no education.

The current study has revealed that there was an association between iodized salt use and the number of people in a household (P=0.029). This implies that households with large families were not able to afford iodized salt.

**Study limitation**

The limitation of this study is that salt in the markets and the mobile vans were not tested to determine their iodine content. We can, therefore, not conclude that iodine content of salt was lost at the household level or at the market level.

## CONCLUSION

Only about 1 out of 6 households was consuming salt with adequate iodine, and this was very low compared to the 90% recommended coverage by WHO/UNICEF/ICCIDD.[1] There was a high preference for coarse and granular salt because of their availability. Coarse and granular salt contain low iodine; however, these types of salt are readily available in the communities. Most salt sold by mobile vans or on the market contain low iodine compared to that sold in the shops There was a high preference of common (coarse and granular) salt because that was readily available, and a good proportion stored their salt in covered containers. Respondents with some formal education were more likely to use iodized salt. Households with a large number of people are less likely to use iodized salt. Based on this and the very low household coverage of adequately iodized salt in these rural communities the survey results suggest that a large proportion of the population in these areas of the Hohoe municipality are at high risk of iodine deficiency.

## RECOMMENDATIONS

There is the need to intensify awareness at the community level to help alleviate IDDs and its effects.

An innovative review of USI-related strategy and policies is recommended to improve the quality of iodization of all salt produced in Ghana. Need to improve strategies to make quality iodized salt available and accessible in rural areas. Regulatory bodies and security agencies should enforce laws and regulations to punish offenders to serve as a deterrent to others. They should also intensify their monitoring activities to ensure that all salt produced in the country are fortified with iodine.

## ABBREVIATIONS

IDDs- Iodine Deficiency Disorders MICS- Multiple Indicator Cluster Survey, EDHS- Ethiopian Demographic Health Survey, UNICEF- United Nations Children's Fund, USI- Universal Salt Iodization, VRHD - Volta Regional Health Directorate, NCDS- Non-Communicable Diseases, RTKs- Rapid Test Kits, GHS - Ghana Health Service, PI- Principal Investigator, NIH - National Institute of Health, WHO-World Health Organization, DALYs- Disability-Adjusted Life-Years, CHPS- Community Health Planning and Services, CI - Confidence Interval, HMHD-Hohoe Municipal Health Directorate, GHS ERC - Ghana Health Service Ethical Review Committee, ppm.

## DECLARATIONS

**Availability of data and material**
Available upon request
**Competing interests**
The authors declare that they have no competing interests
**Funding**
None

## AUTHORS' CONTRIBUTIONS

MK and PP conceived the study, MK, WT, WKA, and MA did the data analysis and wrote the methods section. MK, PP, MT, ET and FB were responsible for the initial draft of the manuscript. All authors reviewed and approved the final version of the manuscript.

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