Central African Journal of Public Health
2016; 2(1): 1-10
http://www.sciencepublishinggroup.com/j/cajph
doi: 10.11648/j.cajph.20160201.11

Knowledge on Iodized Salt Use and Iodine Content of Salt Among Households in the Hohoe Municipality, Volta Region - Ghana

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To cite this article:
Nicholas Aku Sarah, Appiah Kubi Prince, Ahiabor Seth Yao, Asalu Adebayo Geoffrey, Takramah Kwami Wisdom, Kweku Margaret. Knowledge on Iodized Salt Use and Iodine Content of Salt Among Households in the Hohoe Municipality, Volta Region - Ghana. *Central African Journal of Public Health*. Vol. 2, No. 1, 2016, pp. 1-10. doi: 10.11648/j.cajph.20160201.11

Received: July 8, 2016; **Accepted**: August 19, 2016; **Published**: September 6, 2016

Abstract: *Background:* Micronutrient deficiencies particularly, Iodine, Zinc, Iron and Vitamin A, continue to inflict substantial health, economic and social encumbrances globally. Ghana is among the world's population that resides in areas with high iodine deficiency. In the Volta region of Ghana, only 24.6% of households consume iodized salt, and this is far below the 90% WHO/UNICEF mandatory recommendation of Universal Salt Iodization (USI) for countries with high iodine deficiency. This study was to estimate the iodine content of household salt, and knowledge on iodized salt use in the Hohoe municipality, Volta Region, Ghana. *Methods:* This study was descriptive cross-sectional in design, using a multi-stage sampling technique to select respondents from all the seven sub-municipalities in the municipality. Data was collected from women in charge of household meals preparation using structured questionnaires and rapid field iodine test kits. The collected data was entered into Epi data version 3.1 and then exported to Stata version 11. Descriptive statistics such as determination of proportions, frequencies, mean and standard deviation were used in describing the population. Chi-square test and 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:* Four hundred and fifty women with a mean age of 40.4 years (±2.1 SD) were surveyed. Respondents had quite a good knowledge (59.3%) on iodine, 41.1% knew the benefits and deficiencies of iodine, and 69.8% stored their salt in covered containers. However, only 24.2% of household salt contained adequate iodine of ≥15ppm. In addition, majority (75%) consumed local salt with little (<15ppm) or no iodine (0ppm). Also, those with secondary and tertiary education were more likely to use iodized salt (*P* <.001). Rural households were more likely to use iodized salt (*P* =.002) than the urban households. *Conclusions:* The results suggest that respondents' knowledge did not necessarily translate into iodized salt use. Enforcement of existing laws and policies on universal salt iodization and quality assurance of iodized salt from the production to the distribution point should be enforced, and offenders punish to serve as a deterrent.

Keywords: Iodine Content, Iodized Salt, Knowledge, Household, Hohoe Municipality, Ghana

1. Introduction

Micronutrient deficiencies (hidden hunger) especially Zinc, Iron, Iodine and vitamin A continue to inflict substantial health, economic and social encumbrances globally. Iodine deficiency is one of the major public health problems fronting populations throughout the world, predominantly pregnant women and young children [1-2]. Human beings require iodine for various purposes including psychological, metabolic and physiological functions [3].

Iodine is one of the essential micronutrients needed by the body for growth and development [4]. Iodine is a constituent of the thyroid hormones: thyroxin (T4) and triiodothyronine (T3). These hormones are essential for the appropriate

functioning of the body due to their influence on physiological and biological processes [5]. About 150µg of iodine is needed by the human body per day for normal functioning [6].

Iodine deficiency in individuals is typically characterized by low levels of thyroxin and high levels of thyroid-stimulating hormone [5]. The main factor responsible for iodine deficiency in humans is inadequate amount of iodine in diet. This mostly occurs among populations living in areas where the soil has a low iodine concentration due to the repeated leaching effects of snow, water and heavy rainfalls, hence, crops grown in such soil will not have enough iodine and therefore cannot provide adequate amount of iodine when consumed by people [7] Deficiency of iodine leads to a wide range of negative consequences on various organs and muscles functions, particularly the heart, liver, kidney, and most overwhelming the development of the brain [8]. These effects will result in inability to learn and work effectively and pleasingly, increasing risk of congenital anomalies, stillbirth, miscarriage, perinatal mortality, infant mortality, mental retardation, goitre and cretinism. However, the most widely known sign of iodine deficiency is goitre [9].

Iodine-deficiency disorders (IDDs) are wide spread public health issues with 118 countries highly affected globally with approximately 1.5 billion people at risk [10]. Furthermore, 38 million infants are born without the protection that iodine offers the growing brain, with some 18 million children mentally impaired as a result [1]. About 31% of the world's population is estimated to have insufficient iodine intake, with the most affected regions being South-East Asia and Europe [11]. Every year, 38 million newborns in developing countries remain unprotected from the lifelong effect of brain damage coupled with iodine deficiency, and only 69% of households in the developing countries and 53% of the least developed countries are consuming iodized salt [12].

A survey carried out between 1993 and 2003 estimated the prevalence of goitre among African school-age children (6-12 years) to be 91.2% [13]. Also, in 2011, it was estimated that in Ethiopia only 15% of households had access to adequately iodized salt with some 6 million people unprotected from iodine deficiencies [14]. The first baseline survey on the state of IDDs in Ghana conducted between 1991 and 1994 in 27 districts discovered a varying degree of endemicity of Total Goitre Rates ranging from mild to severe [15]. Based on the Total Goitre Rate survey, another study conducted in 110 districts revealed that IDDs were 33% [16]. Also, a market survey conducted in the Western Region of Ghana in 2007 revealed that the level of patronage of iodized salt was 95.7% [17]; however, the level of patronage dropped from 95.7% to 52% in 2010 [18]. In addition, only 58% of salt sold in markets in the region were iodized. However, they had a low iodine concentration of 20 ppm, as compared to the mandated iodization level of 25 to 45 ppm [17]. Subsequently, it was deduced that the United Nations' target of 90% plus of Worldwide Salt Iodization has not been achieved [18]. Also, in 1998, a further study conducted in the northern parts of Ghana revealed that 68.8% of the 1061 study subjects had goitre [19].

Accurate data on the level of iodine consumption, knowledge and practices among the people are very essential to help in the choice of interventions and the components of such interventions thereof, and thereafter in assessing the success or impact of any program that is implemented. However, there are no current national or regional data on household coverage of iodized salt; even the 2008 and 2014 Ghana Demographic and Health surveys could not capture this vital information [20-21]. This study will contribute to increasing the knowledge base of iodine issues concerning the people in Hohoe municipality by providing data, which can set the pace for more intensive research and subsequent interventions for people's health and nutrition.

2. Materials and Methods

2.1. Study Site

Hohoe municipality is one of the five (5) municipalities in the Volta region of Ghana, about 78 kilometres from Ho, the regional capital. It has a total land surface area of 1,172 km^2 making up 5.6% of the total land area of the region. It is located on longitude 0º 45'N and 7º 15' N and lies almost in the centre of the region with an estimated population of 188,963 inhabitants and a growth rate of 2.4 [22].

There are seven (7) sub-municipalities with ninety-two (92) communities and about 43,329 households with an average household size of 3.9 persons [23]. It has two main tribes (Ewes and Guans) with Christianity being the major form of religious expression of the people, followed by Islam and Traditional African Religion.

The Municipality has twenty (20) health institutions including a hospital with a research centre, a private clinic, fourteen (14) health centres, three (3) Community-based Health Planning and Service (CHPS) zones and one (1) Reproductive and Child Health (RCH) unit with an Adolescent Health Corner. It also has four (4) tertiary institutions: a Midwifery Training School, a Public University offering courses in public health, two colleges of education, and a number of first and second cycle schools.

More than half (57.4%) of the population in the municipality engage in agricultural activities such as cultivation of Cocoa, Cassava, Rice, and various vegetables notably '*Kontomire*', Pepper and Okro. Chicken is the dominant poultry reared in the municipality.

2.2. Study Population

The study was conducted among female adults between the ages of 18-60 years who were mostly in-charge of food preparation in households. Only those who were willing to be part of the study and to sign the consent forms were included in the study. However, those who have not stayed in the municipality for three or more months were excluded, as well as Non-Ghanaians and Health professionals, even if they have stayed in the municipality for three or more months.

2.3. Study Design

The study was descriptive cross-sectional in design, and it determined the level of Iodine concentration in household salt, as well as the knowledge level of the people towards iodized salt and the factors influencing its use in the municipality.

2.4. Sample Size

The sample size was 450 and it was determined using the formula: $n=z^2\times p(q)\div d^2$ [24], where n is the sample size to be determined, z is the z-score (reliability coefficient) of 1.96 at 95% confidence level, p is the national coverage (24.6%) [25] of household iodized salt, d is the margin of error at 5% (0.05), and q is 1-p. Because of the involvement of cluster sample in the sampling method, 'design effect' was considered in the sample size calculation. Therefore, the sample size became n (285.022) multiplied by the 'design effect' (which was 1.5 in this case). For a 5% non-response rate of 427.533, the sample size was upwardly adjusted to 448.5; this was rounded up to 450 participants for the study. This sample size ensured, with probability of 95% that the estimated prevalence fell within ±5% of the true population coverage.

2.5. Sampling Method

This study employed a multi-stage sampling technique. The municipality was stratified into seven (7) strata. A sample size was proportionately allocated to each stratum based on the population size of the sub-municipalities. For each stratum, a list of all the communities was obtained and unique numbers were assigned to them. Two communities were randomly selected to represent each stratum. Based on the sample size calculated for each stratum and the total population of the communities selected, proportionate allocation was again used to allocate sample size to each community. The list of all houses in the selected communities were obtained and the number of houses needed based on the allocated sample size was randomly selected. In each selected house, female adults between the ages of 18-60 years were identified and interviewed. In houses where there were more than one household, a balloting (YES or NO) was used to select one household to represent the house. Also, in households where there were more than one female adult between the ages of 18-60 years involved in food preparation, a balloting (YES or NO) was used to select one of them to represent the household. Those who picked YES were interviewed.

Rapid field iodine test kits manufactured by MIN KITS INTERNATIONAL, India was used to test the iodine content of household salt, and a structured questionnaire was administered to collect data from the study participants.

2.6. Data Collection

The Rapid field iodine test kits and the structured questionnaire were the tools and methods used to collect data on salt iodine concentration, knowledge as well as other background information of the respondents using face-to-face interview technique. A small amount of household salt was obtained from each respondent and Rapid Field Iodine Test Kits was used to test the iodine content. The test was done by adding two drops of the test solution to each salt sample and this was expected to produce a light or deep violet colour within one minute depending on the iodine content of the salt. The colour of the salt was compared to the colour chat provided to determine the iodine content. On samples where no colour appeared after one minute, fresh salt samples were obtained and about five drops of the test solution was added. The colour was then compared to the colour chart to determine the iodine content.

Participants' ages were assessed using their Birth Certificates. Where certificates were not available, events calendar were used to determine their age. Also, knowledge was determined by providing a list of responses regarding the benefits and deficiencies of iodine for participants to choose. Those who were able to pick at least five correct options were categorized as having good knowledge while those who picked less than five correct responses were categorized as having poor knowledge.

2.7. 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 women.

2.8. Data Analysis

Data was entered using EPI DATA 3.1 software and then exported to STATA 11.0 for analysis. After data was entered, cleaning and validation was done to ensure data quality before analysis was carried out. Descriptive statistics such as determination of proportions, frequencies, mean and standard deviation were used in describing the population. Chi-square test and logistic regression were used to assess the associations between the dependent and independent variables. A *P*-value <0.05 was considered as statistically significant.

3. Results

3.1. Background Characteristics of the Respondents

A total of 450 women were interviewed and 48% of them were aged 18-35 years. The mean age was 40.4 years with ± 2.3 standard deviation. Nearly half (48.9%) of the households had an average of 1-4 persons, while 3.3% had more than 10 persons. About 61% had up to basic school education while only 6% reached or completed tertiary level education. Almost half (49%) and 12.8% were traders and unemployed respectively. About 62% of the participants belonged to the Ewe tribe while only 3.2% were Akans. Christianity was the

main (89.1%) form of religious expression in the municipality. Majority, (69.1%) of the respondents lived in the urban areas, while 30.9% resided in the rural areas (Table 1).

Table 1. *Demographic characteristics of respondents.*

Attribute	Number (450)	Percentage (%)
Age of respondent (years)		
18-34	216	48.0
35-49	144	32.0
50-60	90	20.0
Household size		
1-4	220	48.9
5-7	183	40.7
8-10	32	7.1
Above 10	15	3.3
Educational level		
No education	59	13.1
Basic education (Primary/ JHS/Middle school)	276	61.3
SHS/Technical/Vocational/Commercial education	88	19.6
Tertiary	27	6
Occupation of respondent		
Farmer	119	26.4
Trader	205	45.6
Civil servant	22	4.9
Student	32	7.1
Unemployed	54	12.0
Others	18	4.0
Ethnicity		
Ewe	281	62.5
Guan	118	26.2
Akan	14	3.1
Others	37	8.2
Religion		
Christianity	401	89.1
Islam	45	10.0
African traditional religion	4	0.9
Area of residence		
Rural	139	30.9
Urban	311	69.1

3.2. Reasons for Non-use of Iodized Salt in Household

Out of the 450 respondents, 165 (36.7%) claimed they have heard about iodized salt but were not using it (Table 2). Out of this, 53 (32.1%) indicated they were not using it because it was expensive to buy. Also, 38 (23.0%) stated they were not using it because of their addiction to the local salt and 5 (3.0%) were not using because they thought it contained chemicals that are harmful to the human body (Figure 1).

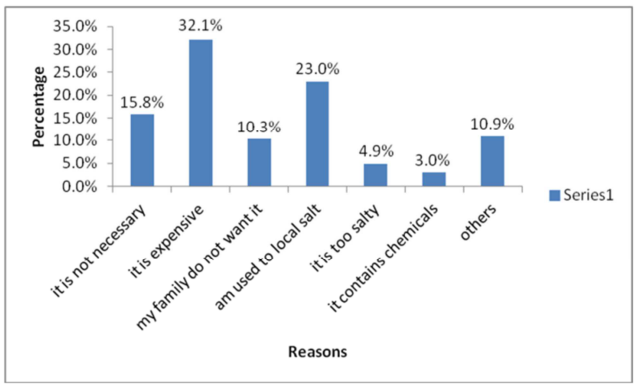

Figure 1. *Reasons why households do not use iodized salt.*

3.3. Knowledge on the Benefits of Using Iodized Salt

More than half, 267 (59.3%) had good knowledge on the benefits of iodized salt. Out of this, 73.8% claimed they were using iodized salt while 26.2% were not using. Also, out of the 183 respondents who did not have adequate knowledge on the benefits of iodized salt, 48.1% were using iodized salt while the remaining 51.9% were not using (Table 2).

Table 2. *Respondents' knowledge on benefits of iodized salt.*

Iodized salt use	Good knowledge	Poor knowledge	Total
Yes	197 (73.8%)	88 (48.1%)	285 (63.3%)
No	70 (26.2%)	95 (51.9%)	165 (36.7%)
Total	267 (59.3%)	183 (40.7%)	450

3.4. Benefits of Iodized Salt Over Non-iodized Salt

More than half 139 (52.1%) of the 267 households who had good knowledge on benefits of iodized salt knew that the intake of iodized salt prevents IDDs. About 50 (18.7%) knew that iodized salt is healthier than the non-iodized salt. A small number 6 (2.2%) mentioned the benefits of iodized salt as preventing hypertension (Figure 2).

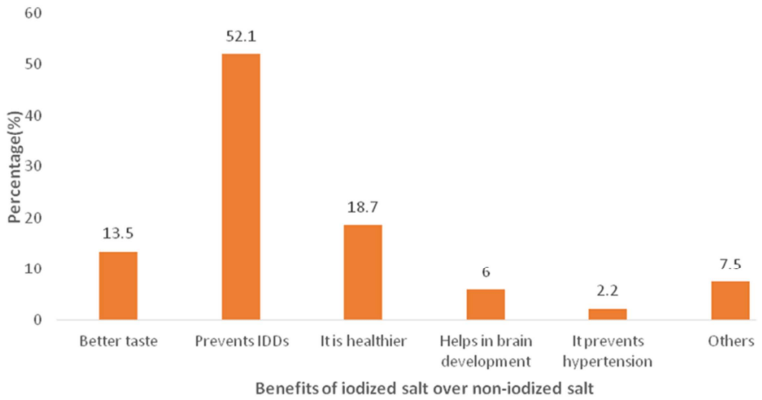

Figure 2. *Distribution of benefits of iodized salt over non-iodized salt.*

3.5. Knowledge on Effects of Iodine Deficiencies

About 185 (41.1%) of the respondents had good knowledge on the effects of iodine deficiencies. Out of this, 122 (65.9%) claimed they were using iodized salt while 63 (34.1%) were not. Also, out of the 265 (58.9%) respondents who had inadequate knowledge about the effects of iodine deficiencies, 163 (61.5%) were using iodized salt while the remaining 102 (38.5%) were not (Table 3).

Table 3. *Respondents' knowledge on effects of iodine deficiencies.*

Iodized salt use	Good Knowledge	Poor knowledge	Total
Yes	122 (65.9%)	163 (61.5%)	285 (63.3%)
No	63 (34.1)	102 (38.5%)	165 (36.7%)
Total	185 (41.1%)	265 (58.9 %)	450 (100%)

3.6. Respondents' Source of Information on Iodized Salt

Respondents' main sources of information on iodized salt were the media (mainly radio and television), 174 (38.7%), followed by health workers, 91 (20.2%). However, 62 (13.8%) of the respondents could not mention the source of information on iodized salt (Figure 3).

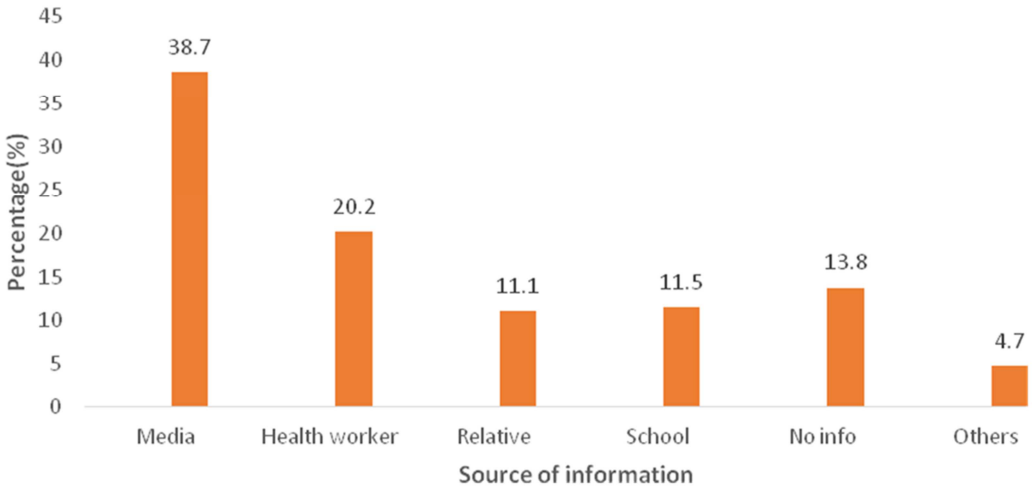

Figure 3. *Source of information on iodized salt.*

Others* include: church, educational team, salt seller and salt producer

3.7. Household Salt Storage Practices

Majority 314 (69.8%) of the participants stored their salt in covered containers, while 95 (21.1%) and 40 (8.9%) stored it in the opened original packs and uncovered containers respectively (Figure 4).

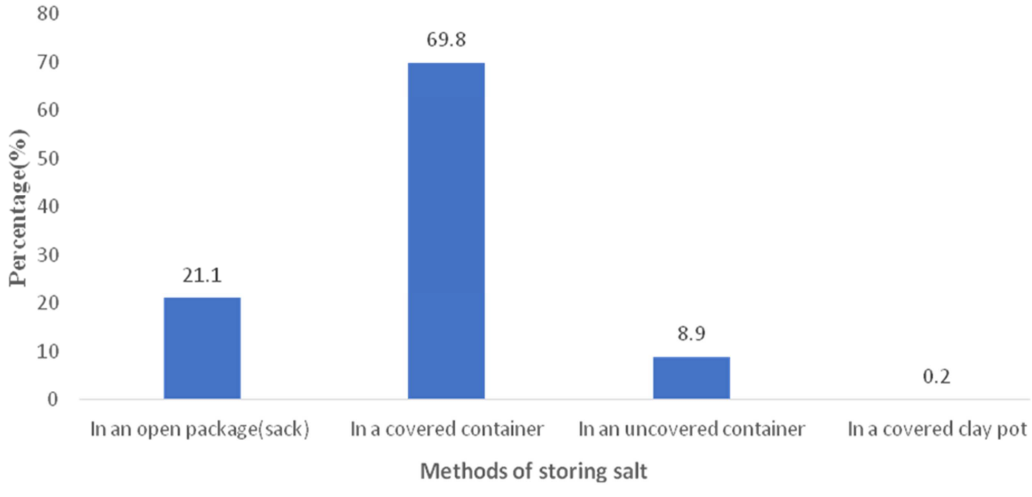

Figure 4. *Household salt storage practices.*

3.8. Types of Salt Used by Households

Out of the 450 households surveyed, 116 (25.8%) were using fine salt for cooking while more than half, 233 (51.8%) preferred coarse local salt (Table 4).

Table 4. *Types of salt mainly used by households.*

Type of salt	Frequency	Percentage (%)
Fine	116	25.8
Coarse	233	51.8
Granular	101	22.4
Total	450	100.00

3.9. Iodine Content of Household SALT

Only 109 (24.2%) of the household salts tested contained adequate iodine of ≥15ppm, 128 (28.4%) was not having any iodine in the salt and 213 (47.4%) having little iodine below 15ppm (Figure 5).

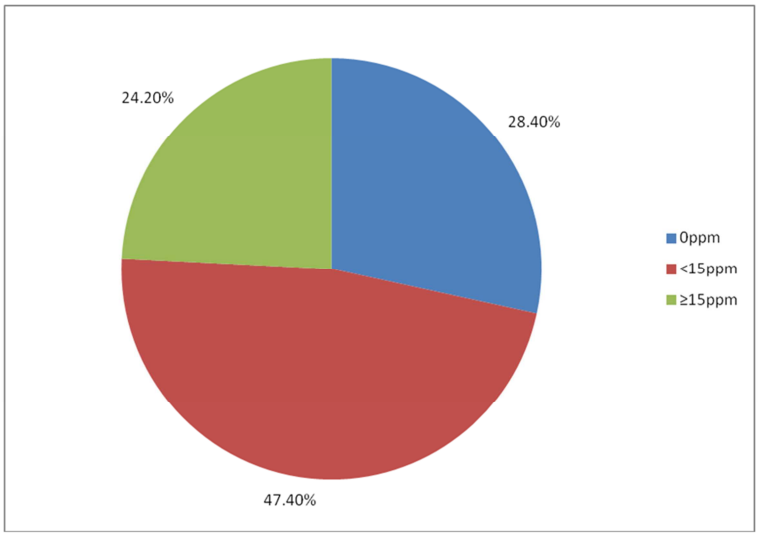

Figure 4. *Iodine content of Household Salt.*

3.10. Iodine Content in Household Salt Types

Adequate iodine of more than 15ppm was found in 92.3% of all the fine salt (packed iodized salt) tested, while only 1.7% and 7.9% of coarse and granular salt contained adequate iodine respectively (Figure 6).

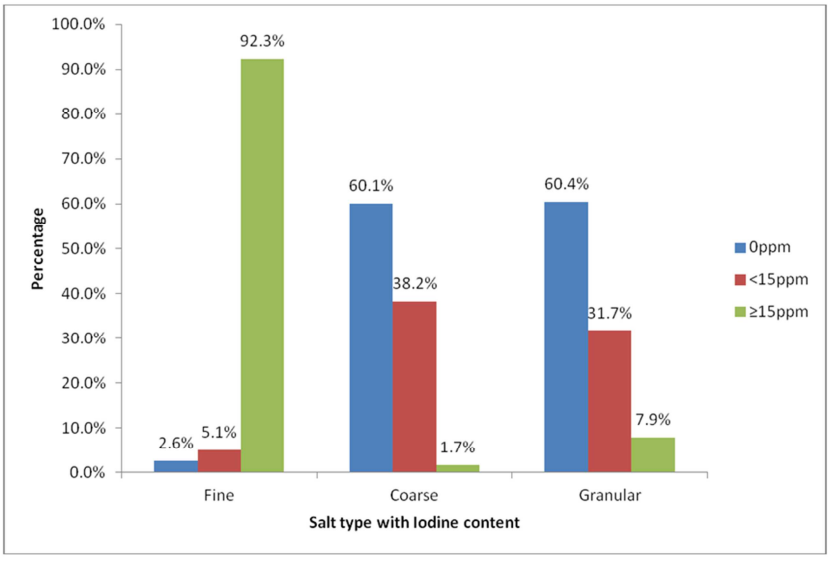

Figure 6. *Distribution of iodine content in household salt types.*

3.11. Associations Between Iodized Salt Use and Background Characteristics

The results showed a significant association between iodized salt use and area of residence (*P*=.002), and level of education (*P*<.001). To further explore the strength of the associations, multiple logistic regression analyses were done and these confirmed the associations between iodized salt use and area of residence [OR (0.184); CI (0.091-0.373), *P*=.006] and educational level [OR (34.905); CI (2.955-41.236); *P*=.004]. The multiple logistic regressions also showed associations between iodized salt use and households with more than 10 people [OR (0.243); CI (0.062-0.956); *P*=.026] and occupation of respondents [OR (6.468); CI (1.722 – 24.304); *P=.042*]. The associations showed that, traders were 2.193 times more likely to use iodized salt than farmers and those with other occupations were 6.468 times more likely to use iodized salt than farmers. The associations further indicated that households in the urban areas were 81.6% less likely to use iodized salt than households in the rural areas. Moreover, when variables that were having associations with iodized salt use from bivariate analysis were alone explored for strength of associations, it was revealed that, there was no association between those with basic education and iodized salt use [AOR (0.692); CI (0.382-1.254); *P*=.081]. However, there were associations between those with secondary [AOR (2.124); CI (1.038-4.344); *P*=.042] and tertiary [AOR (17.206); CI (2.174-136.181); *P*=.037] education and area of residence [AOR (0.360); CI (2.174-136.181); *P*=.029], and iodized salt use. Those with secondary and tertiary education were 2.12 and 17.21 times respectively more likely to use iodized salt than those with no formal education. Also, those in the urban areas were 64% less likely to use iodized salt than those in the rural areas (Table 5).

Table 5. *Associations between iodized salt use and background characteristics.*

Attribute	Not using	Using	Pearson Chi Square		OR (95% CI); *P*-value	AOR (95% CI); *P*-value
	(N=165)%	(N=285)%	Chi-square	P-value		
Area of residence						
Rural	21.8	36.1	10.041	0.002	1	1
Urban	78.2	63.9			0.184 (0.091-0.373); 0.006	0.360 (2.174-136.181); 0.029
Age						
18-34	50.3	46.7	0.738	0.692	1	
35-49	31.5	32.3			1.199 (0.710-2.025)	
40-60	18.2	21.0			1.520 (0.808-2.861)	
People per household						
1-4	46.1	50.5	1.783	0.619	1	
5-7	41.2	40.4			1.086 (0.674-1.748)	
8-10	8.5	6.3			0.737 (0.288-1.900)	
Above 10	4.2	2.8			0.243 (0.062-0.956); 0.026	
Education						
No education	14.6	12.3	22.604	0.000	1	1
Basic	71.5	55.4			0.786 (0.375-1.647)	0.692(0.382-1.254); 0.081
Secondary	13.3	23.2			2.691 (1.072-6.759); 0.004	2.124 (1.038-4.344); 0.042
Tertiary	0.6	9.1			34.905 (2.955-41.236)	17.206 (2.174-136.181); 0.037
Occupation						
Farmer	25.5	19.2	10.288	0.067	1	
Trader	50.9	47.1			2.193 (1.125 - 4.277)	
Civil servant	2.5	6.9			0.972 (0.193 - 4.895)	
Student	4.9	9.2			2.626 (0.820 - 8.402); 0.042	
Unemployed	13.7	12.3			1.777 (0.785 - 4.024)	
Others	2.5	5.3			6.468 (1.722 – 24.304)	
Tribe						
Ewe	64.4	60.3	2.540	0.468	1	
Guan	26.9	26.6			0.599 (0.3185- 1.126)	
Akan	3.1	3.2			0.775 (0.208 - 2.894)	
Others	5.6	9.9			6.075 (0.857 – 43.063)	
Religion						
Christianity	89.1	89.1	0.330	0.848	1	
Islam	9.7	10.2			0.620 (0.102 - 3.754)	
Traditional	1.2	0.7			0.391 (0.018- 8.272)	

4. Discussion

The mandatory Universal Salt Iodization was recommended by WHO/UNICEF/ICCIDD for eradication of iodine deficiency disorders with a 90% recommended coverage for countries with high Iodine deficiency including Ghana [26]. The present study collected information on the types of salt consumed, iodine content of household salt, knowledge and practices regarding storage of iodized salt as well as the factors influencing iodized salt use.

This survey revealed that 59.3% and 41.1% of the

respondents had good knowledge on the benefits and deficiencies of iodine respectively, but low level (24.4%) of iodized salt use due to its high cost (32.1%), addiction to local salt (22.8%) and non-preference (16%). These findings are in agreement with other findings, where respondents had a high (85%) knowledge on iodized salt but did not use it due to its high price (31%), unavailability (25%) and misconceptions (7%) [27]. Also, majority (79.3%) of the participants in the present study identified goitre as a sign of iodine deficiency which agrees with findings from other studies, where 69.3% of respondents identified goitre to be associated with iodine deficiency [18]. Findings concerning the consumption of iodized salt in the present study suggest an incredible progress in knowledge about iodized salt as compared to the findings of a study conducted between 1991-1993 by the University of Ghana and Ministry of Health, Ghana, on IDDs in Ghana where 98% of the respondents had no knowledge on iodized salt [15]. The increase in knowledge may be as a result of the health education campaigns to create awareness on the importance of iodized salt in the country through the print and electronic media, schools and communities. This means that, if awareness and educational campaigns programs continue mainly in the local dialects, all Ghanaians could be aware of iodized salt and its importance to human health and wellbeing, hence its usage will increase.

The present study results showed that only 24.2% of households in the municipality consumed adequately iodized salt of ≥15ppm. This percentage is however lower than the 35.0% reported by Agbozo *et al.,* 2014 [25] which was conducted in the same municipality two years before the present study. The possible reason for the reduction in the usage of adequately iodized salt in household in Hohoe municipality might be due the difference in the study methods used. This present study used stratified sampling while that of Agbozo *et al.,* 2014 [25] employed a cluster-randomized method. The low coverage of iodized salt consumption in the municipality indicates that the municipality is at high risk of iodine deficiency.

Respondents' main sources of information on iodized salt were the media (38.7%), particularly local radio stations and Television, health workers (20.2%) and school (11.5%). Similarly, Khan et al., 2013 report that respondents' main source of information was Television (about 75%) [27]. However, from a similar study conducted in the Bia district of Ghana, health workers (16.6%) and television (16.6%) were the least quoted sources of information about iodized salt [18]. 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. They therefore visit the hospitals or listen to radio less frequently hence did not get access to information about iodized salt from these sources. Findings in the present study suggest that the use of electronic media and health workers are the most effective ways to improve and sustain peoples' use of iodized salt in the municipality. This information is also important for developing better awareness campaigns to increase iodized salt intake.

Iodized salt depreciates its iodine contents when not stored in closed plastic bags, sealed waterproof materials or closed containers [28]. The present study revealed that majority (69.8%) 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. From a similar study conducted in the Bia district, Western Region of Ghana, a good proportion (62.6%) of the respondents stored their salt in enclosed containers [18]. However, 64.6% of households used packed iodized salt exclusively and this might have contributed to the high (75.6%) coverage of adequately iodized salt in the district [18].

The present study revealed that there was an association between iodized salt use and level of education (P<.001), and area of residence (P=.002). Results from this study show that households in the urban areas are 64% less likely to use iodized salt than those in the rural areas. However, a similar study conducted in Pakistan revealed that rural households were more likely not to use iodized salt [27]. The difference in the findings might be that, the rural areas of Hohoe municipality may have more access to iodized salt than that of Pakistan. Also in urban areas of Hohoe, the media is chosen over community durbars, meetings and home visits for health educational campaigns, and since women spend most hours of the daytime at market and other work places, they may not get enough messages, hence low information and use of iodized salt use in the municipality.

Also, education increases knowledge and decision making levels of individuals. Therefore, education should be one of the main ways of communicating information on IDDs. The present study deduced that, those with secondary and tertiary education are 2.12 and 17.21 times respectively more likely to use iodized salt as compared to those with no formal education. Similarly, in the work of Gidey *et al.,* (2015) there was a positive association (AOR=2.207, CI: 1.27-3.39) 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 [29]. Again, illiteracy was associated (AOR=1.61, CI 1.28-2.04) with non-use of iodized salt in Pakistan [27]. Since literacy influences the use of iodized salt, health education programs, especially on IDDs, should be integrated into the school curricula to help increase awareness at childhood level to help alleviate IDDs and its effects.

Study Limitation(s)

Salts in the markets were not tested to determining the iodine content; therefore, it is difficult to conclude that iodine content of salts were lost at the household level or at the market level.

5. Conclusion

Only about 1in 4 households were consuming salt with adequate iodine, and this was very low compared to the 90% recommended coverage by WHO/UNICEF/ICCIDD [11].

There was a high preference of common (coarse and granular) salt despite their low iodine content, and a good proportion stored their salt in covered containers. Majority of the respondents had adequate knowledge on both the benefits and consequences of the deficiencies of iodine. Those with secondary and tertiary education and rural households were more likely to use iodized salt.

Recommendations

- Children are known to be agents of change; therefore, the Ghana Education Service should intensify health education activities in the school curricula so as to increase early awareness among children on the benefits and effects of iodine.
- The Ghana Health Service should empower and motivate health workers to intensify iodized salt education and awareness in the communities, hospitals, clinics and market centres to increase the use of iodized salt.
- Due to the high preference of coarse and granular salt, policy makers should ensure that, just as the packed fine iodized salt, common salt is adequately iodized, sealed, labelled and distributed into the markets so that the population can have access to.
- Frequent market surveys should be conducted to identify and remove salt that are not iodized in the market.
- Regulatory bodies and security agencies should intensify their monitoring activities to ensure that all salt produced in the country are fortified with iodine
- Regulatory bodies and security agencies should enforce laws and regulations to punish offenders to serve as deterrent to others.

Competing Interest

The authors have no competing or conflicts of interest.

Authors' Contributions

NAS conceived the study and partially financed the data collection; AKP and KM financed the remainder of the cost for data collection and also participated with data input, design of tables and analysis; NAS, AKP, ASY and AAG designed the study, collected and inputted the data; TKW and AKP did the preliminary analysis of the data; NAS and AKP did the zero draft of the paper; ASY and AKP also finalized the revision of the paper for submission and subsequent follow-up to get the paper published. All authors approved the revised manuscript.

Acknowledgement

The authors wish to acknowledge the Volta Regional Health Directorate and the Hohoe Municipal Health Directorate for the donation of Rapid Field Iodine Test Kits used to test the iodine content of household salt

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