Children's Iodine Intake in the Aseer Region, Southwest Saudi Arabia

Mohammed Abadi Alsaleem, MBBS, SBFM, ABFM*

ABSTRACT

Study Design: Descriptive cross-sectional study.

Objectives: To figure out if children in the Aseer region of southwestern Saudi Arabia are getting enough iodine by looking at what they eat and how many of their families use iodized salt.

Methods: This cross-sectional research implemented a stratified proportional allocation sample. A questionnaire was used to study dietary habits. The families of each child were requested to supply one teaspoon of table salt. Spectrophotometric analysis was used to determine the iodine content of salt.

Results: The investigation included school-aged participants. Insufficient iodized table salt samples were observed in 22.3% (95% CI: 20.8%–23.8%) of the samples. Based on the results of this study, rural areas had significantly more insufficient table salt samples than urban areas. Milk (2,451; 80.7%), chicken (1,835, 60.4%), and eggs (1290; 42.0%) were the items consumed most frequently on a daily basis during the preceding week. The daily intake of milk and chicken is more frequent among those consuming insufficient iodine table salts. Unfortunately, children who ate table salts with too little iodine ate less fish than other kids.

Conclusions: The study revealed that the region still frequently uses insufficient iodized salt. There should be increased emphasis on health education regarding the need of frequently consuming dairy products, chicken, and fish. Through sales and marketing, iodized salt can be made more widely available. The Aseer region's authorities should take all reasonable measures to prevent the sale of non-iodized salt in the area's markets.

Keywords: Iodine, Dietary pattern, Table salt, Saudi Arabia

INTRODUCTION

The quality and quantity of a child's diet has a significant impact on their physical and mental development throughout childhood. The food and water we ingest provide the vast majority of the iodine we consume. Since the ocean is a rich supply of iodine, seafood is often a reliable source. The amount of iodine in other foods varies widely depending on where they came from and whether or not they were fortified. Meats and other products from animals fed on plants produced in iodine-deficient soil also lack sufficient iodine levels. Dairy products are typically rich in iodine because the breast concentrates it, but only if the cows get adequate iodine[1].

Critical is the amount of iodine consumed in the form of table salt. Universal Salt Iodization (USI) is suggested for the treatment of a wide range of iodine deficient illnesses (IDDs), including goiter, cretinism, dwarfism, stillbirths, abortions, and mental retardation[2]. Iodine is necessary for the creation of thyroid hormone, which is necessary for the metabolism of fat, utilization of glucose, and manufacture of protein[3]. A sufficient amount of it in the body has a positive effect on a developing child's bone and muscle growth[4]. Generally, 100-150 µg per day is necessary for thyroid function to manipulate the spectrum of IDDs. The USI strategy recommends 30 ppm of iodine in cooking salt at the production level and 15 ppm at the consumption level[5]. Appropriateness of nutrients is confirmed by dietary quality in terms of quantity and diversity.

Since 1994, the WHO and UNICEF Joint Committee on Health Policy has supported Universal Salt Iodization (USI) to ensure adequate iodine intake by all adults. It reveals that all household and food-handling salt should be enriched with iodine as a safe and effective technique for preventing and managing iodine deficiency illnesses in stable and emergency situations[6].

This approach has been implemented in over 120 nations worldwide, many of which have nearly eradicated iodine deficiency illnesses or made significant strides in their management. In 1994 and 1995, Saudi Arabia conducted the first national assessment of iodine deficient illnesses in the Saudi population using this concept[7]. Salt iodization starts first at a level of 70–100 ppm[8], then is subsequently adjusted to a level of 15-40 ppm in response to the WHO recommendation[8].

Information on the iodine content of foods is crucial for monitoring their intake, since it is critical for nutritional research, dietary counseling, and public health programs. The iodine nutritional status of a community is determined by differences in the iodine content of foods and differences in eating patterns. A recent publication analyzed the iodine content of foods using international databases. The foods utilized were those reported in the Household Budget Survey for 2008-2009. There was a substantial difference in the iodine content of foods between countries and within and between dietary groups. The study

* Bachelor of Medicine, Bachelor of Surgery
Saudi Board of Family Medicine
Arab Board of Family Medicine
Department of Family and Community Medicine
College of Medicine
King Khalid University, Abha, Saudi Arabia.
E-mail: mabade@kku.edu.sa

indicated that fish and seafood had the highest levels of iodine. In terms of the highest iodine concentration among food groups, the dairy and tuberous vegetable groups stood out. Glaciation, flooding, and erosion remove iodine from the soil, therefore it is mostly found in the seas and oceans, which explains why marine foods have a higher concentration[9].

The Aseer Region in Southwestern Saudi Arabia encompasses more than 80,000 km2 and has a population of 1,200,000. The region shares a border with Yemen and stretches from the over 3,200-meter-high Aseer Mountains to the Red Sea. Despite the lack of detailed public statistics on iodine deficiency in Saudi Arabia, two countrywide studies conducted nearly two decades apart revealed that the Saudi population has relatively adequate iodine nutrition at the public level; however, both studies and other regional reports indicated a status of mild to moderate iodine deficiency, especially in the southern regions of Saudi Arabia, based on the prevalence of goiter[7,10,11].

In the Aseer region in southwestern Saudi Arabia, there were insufficient data on children's dietary patterns, household coverage with iodized salt, and salt iodization sufficiency. By examining what they consume and how many of their families use iodized salt, researchers in the Aseer region of southwest Saudi Arabia hope to determine whether youngsters are receiving enough iodine.

METHODOLOLGY

Design: A cross-sectional study was conducted on a sample of schoolchildren in the Aseer region of southwestern Saudi Arabia.

Target Population: Due to their increased susceptibility to IDDs, 8 to 10-year-olds in the Aseer region were the target population for screening[12]. WHO proposes adding a community-based sample if less than fifty percent of children attend school[13]. In Saudi Arabia, admission to school surpasses 90%. Therefore, it was unnecessary to also include samples from non-school situations.

Sampling and Field Activities

With a 95% confidence interval[14], a conservative estimate of the projected population proportion of 45%[7], and an absolute precision of 2%, the required sample size for the study was calculated to be 2,377 children. To compensate for the potential loss of cases, it was planned to include a total sample of 3,000 youngsters. A proportional stratified sample of schools was selected. The parents were sent confidential letters describing the purpose of the study and requesting their written consent. In addition, the letters requested that parents bring a sample of the table salt used in their homes along with their children. In addition, the letter included a simple questionnaire for parents to complete addressing their children's sociodemographic characteristics and dietary habits. Two days later, field activities were conducted at the school.

Questionnaire Interview

Each child completed a questionnaire, and data were collected face-to-face or through the parents. The questionnaire includes biographical information, demographic information about the subject's family, dietary behaviors, and socioeconomic factors, including housing situation. The Arabic Version of the CDC Youth Health Survey was utilized for nutritional habits, food intake, and related dietary behaviors[15].

Iodine Content in Table Salt

Each child was asked to bring a teaspoon of table salt from their home. The salt samples were collected in small, conventional, self-sealing plastic bags. The method described by WHO[16] for salt was followed.

Determination of Iodine Content in Table Salt

Using the WHO-recommended titration method with sodium thiosulfate and starch as an external indicator, the iodine concentration in table salt was measured[17,18]. Each child's family contributed a teaspoon of table salt in a small, self-sealing plastic bag. The titration assay required liberating free iodine from the salt by treating it with sulfuric acid; the liberated free iodine was consumed by sodium thiosulphate during titration. The conclusion is believed to be the absence of blue colour. The amount of sodium thiosulphate utilized is then used to determine the iodine concentration in the salt. Sandel-Kolthoff spectrophotometry was used to determine the content of iodine[19,20]. This assay is conducted in two steps: a preliminary digestion step and a Sandell – Kolthoff reaction[21]. In the digesting step, chemicals that may inhibit the function of iodine are eliminated. It is accomplished by treating the sample at a high temperature with a strong acid or base[22]. In the Sandell-Kolthoff reaction, yellow ceric ions were reduced by arsenic ions in iodide to produce a colourless ion and elemental iodine. This time-dependent drop in yellow colour intensity was measured with a spectrophotometer (Novaspec II, Biochrom Ltd., UK) at 420 nm and plotted against a standard curve to calculate iodine concentration.

Data Analysis

Data were investigated using the SPSS Software, version 22 (IBM Corp., released 2013, IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA). The findings were presented using frequency, percentage, arithmetic mean, median standard deviation, and confidence intervals of 95%. Pearson chi-square was used as a test of significance at the 5% level.

RESULTS

This study includes 3038 school-aged participants (1501 boys and 1537 girls). The age of the study sample ranged from 8 to 10 years, with an average of 8.77±067 years and a median of 9 years.

There were 3038 samples of table salt in the present investigation. Observations revealed that some student-collected table salt samples included yellowish, coarse particles (similar to rock salt). The remaining specimens were white and fine. Overall, the iodine level of table salt samples ranged from 0 to 112 ppm, with a mean value of 47.8±27.9 ppm and a median value of 55.1 ppm.
Based on the WHO/UNICEF ICCIDD classification, Table 1 displays the distribution of table salt samples. The prevalence of insufficiently iodized table salt (less than 15 ppm) was 22.3% (95% CI: 20.8%–23.0%).

Table 1: Assessment of salt iodization in Aseer region, Saudi Arabia (based on WHO/UNICEF/ICCIDD Classification)

The iodine content of salt (ppm)	Number	Prevalence %	Interpretation	95% Confidence Interval
<15 ppm	677	22.3	Insufficient	20.8 - 23.8
15 + ppm	2361	77.7	Adequate	76.2 – 79.2
Total	3038	100		

WHO (World Health Organization), UNICEF (United Nations Children’s Fund), ICCIDDs (International Council for Control of Iodine Deficiency Disorders).

Table 2 depicts the distribution of the study sample of children (3038) by meal choices in the preceding week and the sufficiency of iodine in table salt. The analysis revealed that milk (2,451; 80.7%), chicken (1,835, 60.4%), and eggs (1290; 42.0%) were the items consumed most frequently on a daily basis during the preceding week. Similarly, the most often consumed weekly foods were fish (1719, 56.6%), beef (1663, 54.8%), and nuts (1563, 51.0%). Nuts (893, 29.4%) and fish (889, 29.4%) were the foods consumed the least frequently during the previous week, according to the research.

Table 2: Distribution of the study sample of children (3038) by food choices in the previous week and adequacy of iodine in table salt

Food Item	Adequacy of iodine in Table salt	Frequency of food intake						P
		Never		Weekly		Daily		
		No	%	No	%	No	%	
Milk	Insufficient	17	2.5	92	13.6	568	83.9	0.017*
	Adequate	109	4.6	369	15.6	1883	79.8	
	Total	126	4.1	461	15.2	2451	80.7	
Eggs	Insufficient	78	11.5	312	46.1	287	42.4	0.395
	Adequate	316	13.4	1042	44.1	1003	42.5	
	Total	394	13.0	1354	44.6	1290	42.4	
Meat	Insufficient	65	9.6	389	57.5	222	32.9	0.076
	Adequate	297	12.6	1274	54.0	790	33.4	
	Total	362	11.9	1663	54.8	1012	33.3	
Chicken	Insufficient	13	1.9	228	33.7	436	64.4	0.005*
	Adequate	97	4.1	865	36.6	1399	59.3	
	Total	110	3.6	1093	36.0	1835	60.4	
Fish	Insufficient	261	38.6	350	51.7	66	9.7	0.001*
	Adequate	688	29.1	1339	56.7	334	14.1	
	Total	889	29.3	1719	56.6	430	14.2	
Nuts	Insufficient	189	27.9	364	53.8	124	18.3	0.391
	Adequate	704	29.8	1199	50.8	458	19.4	
	Total	893	29.4	1563	51.4	582	19.2	
Fresh Vegetables	Insufficient	56	8.3	204	30.1	417	1355	0.147
	Adequate	219	9.3	787	33.3	61.6	57.4	
	Total	275	9.1	991	32.6	1772	58.3	
Cabbage	Insufficient	384	56.7	181	26.7	112	363	0.726
	Adequate	1344	56.9	654	27.7	16.5	15.4	
	Total	1728	56.9	835	27.5	475	15.6	
Cauliflower	Insufficient	527	77.8	110	16.2	40	5.9	0.174
	Adequate	1795	76.0	450	19.1	116	4.9	
	Total	2322	76.4	560	18.4	156	5.1	
Broccoli	Insufficient	614	90.7	44	6.5	19	2.8	0.626
	Adequate	2111	89.4	175	7.4	75	3.2	
	Total	2725	89.7	219	7.2	94	3.1	

*Significant (P<0.05)

In terms of goitrogenic foods, the survey revealed that the majority of youngsters had never eaten broccoli (2,725, or 89.7%), cauliflower (2,322, or 76.4%), or cabbage (1,728 or 56.9%) in the preceding week. Few youngsters regularly eaten cabbage (475, 15.6%), cauliflower (156, 5.1%), and broccoli (94, 3.1%).

The present study showed that the daily intake of milk is more among those consuming insufficient iodine table salts. Similarly, daily intake of chicken is more among those consuming insufficient iodine table salts. Unfortunately, the present study showed that the consumption of fish was less frequent among children consuming insufficient iodine table salts.

DISCUSSION

Insufficiently iodized table salt samples (less than 15 ppm in accordance with the WHO/UNICEF ICCIDD classification) were discovered in 22.3% (95% CI: 20.8% - 23.0%) of the present study samples. Similarly, 75.7% (95% CI: 74.1–77.2%) of the study samples contained insufficiently iodized table salt (less than 70 ppm based on Saudi Standards, Metrology and Quality Organization "SASO" classification). Several factors can account for the low iodine content of salt observed in the present study. It appears that locals continue to use table salt of rock origin available on the local market, which is very inexpensive but not at all iodized.

Globally it was proposed to iodize salt to combat iodine deficiency disorders. The choice of salt was based on its wide accessibility and low iodization cost, in addition to its convenience, and lack of adverse chemical reactions. In the Eastern Mediterranean Region, 64 percent of households consumed adequately iodized salt between 2000 and 2006, according to a systematic review[23]. In Egypt, Lebanon, Oman, and the Syrian Arab Republic, at least fifty percent of households consume sufficiently iodized salt. Regrettably, roughly 1% of the population of Sudan, 28% of Iraq, and 30% of Yemen remain confronted with challenges and barriers[23]. Based on the dataset of the Sudan Household Health Survey (SHHS), a survey of 24,507 families was studied, and 18,786 samples of food preparation salt were tested for iodine levels utilizing rapid salt-testing kits. The percentage of families using iodized salt increased from less than one percent in 2000 to 14.4 percent in 2012[24].

Rural areas in the present study had significantly more insufficient table salt samples according to ICCD classification (aOR = 4.834, 95% CI: 2.555–9.147) and SASO classification (aOR = 2.531, 95% CI: 1.231–5.319) than urban areas. The rural-urban difference in the present study can be attributed to the fact that people use rock salt as a source of table salt, which is significantly less expensive than other types of table salt on the market.

A study of 311 families in Jazan disclosed that 89.4% used insufficient table salt (as according SASO classifications), whereas the figure was 10% based on WHO/UNICEF ICCIDD classifications. The study showed no urban-rural distinctions[25].

A national study involving 4 242 salt samples was conducted in Saudi Arabia. Using the rapid test kit (RTK), iodine levels in specimens were analysed. The study revealed that 68.7% (95% CI: 67.3–70%) were iodized. The remainder, 31.3%, was found to be improperly iodized. The study revealed substantial regional disparities[8].

A study analysed twenty-five data sets from eighteen population surveys that evaluated household iodized salt using both the RTK and quantitative titration methods. Data were obtained from Asian (19 data sets), African[5], and European[1] countries. The conclusion of the study was that the RTK is unsuitable for measuring iodized salt coverage. To estimate adequate iodized salt coverage, quantitative evaluation is required[26].

The present study revealed that milk (2,451; 80.7%), chicken (1,835, 60.4%), and eggs (1290; 42.0%) were the items consumed most frequently on a daily basis during the preceding week. The present study showed that the daily intake of milk is more among those consuming insufficient iodine table salts. A study in Saudi Arabia examined liquid milk of high fat, low fat buffalo milk samples bought from local supermarkets for iodine content using mass spectrometric measurements. The study showed a reasonable levels of iodine content in different studied samples ranging from 0.17 – 0.24 mg/kg[27]. Based on these results we can say that the daily intake of milk among children in Aseer region may compensate for the insufficient iodine intake in table salts. A study in Ethiopia documented the low frequency of milk consumption among primary school children as a significant risk factor for the development of goitre[28]. A study in UK showed that milk and milk products are the main dietary sources iodine[29]. Iodine in milk naturally occurs in small levels, and most of the iodine in milk comes from indirect fortification through animal feeds. Processing can also affect iodine; ultra-high temperature milk has 30 % lower iodine compared with conventional milk, although the milk fat content has no effect[30].

Similarly, in the present study daily intake of chicken is more among those consuming insufficient iodine table salts. A study comparing food iodine contents compiled from international databases found that chicken has a reasonable iodine content (median of 4.1 µg 100g and a range of 0.4 – 8.0 µg 100g)[9]. Similarly, we can say that the daily intake of chicken among children in Aseer region may compensate for the insufficient iodine intake in table salts.

Unfortunately, the present study showed that the consumption of fish was less frequent among children consuming insufficient iodine table salts. Fish is a rich natural source of dietary iodine. The fish and sea food had the highest iodine levels among different food groups. The study comparing food iodine contents compiled from different international databases found that fish has the highest iodine content (median of 45.1 µg 100g and a range of 40.1 – 80.5 µg 100g)[9]. The diversity of fish and seafood products creates a variety of food choices with a spectrum of iodine contents. A study in UK showed that marine fish contains the highest amounts of iodine, ranging from 40 to 69 µg/100 g, which is also approximately 6-fold higher compared to freshwater fish[31]. Cooking can affect the iodine content of fish, with losses varying in average from 20 % in fried fish to 23 % in grilled fish and 58 % in boiled fish[32].

CONCLUSIONS AND RECOMMENDATIONS

The findings of the current investigation demonstrated that the usage of insufficient iodized salt is still widespread in the area. In order to address this issue, recommendations should include supporting advocacy and communication while also ensuring that salt is sufficiently iodized. The significance of consuming dairy products, chicken, and fish frequently should be covered in more health education. By persuading and informing people at all levels about the benefits of iodine and iodized salt, advocacy and communication play a crucial role in eradicating iodine deficiency. Reaching out to certain audiences, such as community leaders, the media, teachers, the general public, and the heads of schoolchildren, is necessary for effective communication campaigns. Iodized salt must be available to everyone in order to eradicate IDD. Through sales and marketing, iodized salt can be made more widely available. The Aseer region's authorities should take all reasonable measures to prevent the sale of non-iodized salt in the area's markets.

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