FACTORS CONTRIBUTING TO IODIDE DEFICIENCY IN COAST PROVINCE OF KENYA

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ABSTRACT

Background: Iodide deficiency has serious effects on body growth and mental development. Iodide deficiency disorders are major public health problem in several areas of the world. At least 350 million Africans are at risk of iodide deficiency and are at risk of its complication. In Kenya, iodide deficiency was estimated at 36.8% and 50.7% in the Coast region. This study assessed factors contributing to iodide deficiency in coast region.
Methods: A cross-sectional study was carried out among 292 households in coast region using pretested and structured questionnaires. Multistage sampling technique was used; in the first stage clusters were selected using simple random sampling, and then households were selected using systematic random sampling technique. Data were entered, cleaned and analyzed using SPSS version 21 software. Bivariate analysis was performed to check on association at $p< 0.05$.
Results: About 26.2% of the respondents utilized adequately iodized salt, 80.1% of salt containers had a cover, and 82.2% stored in dry places. Around 22.6% of the respondents add salt at the end of cooking and 78.4% in the early beginning and end in the middle of cooking. Iodide deficiency was associated with lack of education (OR=3.22, 95%CI: 0.03-0.27, p=0.0436), salt container without cover (OR=2.19, 95%CI: p= 0.0103) and moist/wet storage place (OR=0.22, 95%CI: 0.12-0.41, p=0.000001).
Conclusion: Availability of adequate iodized salt at household level was very low when compared to the WHO recommended levels to prevent iodide deficiency
Keywords: Iodide levels, iodized salt, households.

INTRODUCTION

Iodide is necessary for the synthesis of thyroid hormones that regulate growth, development and metabolism. Inadequate intake can result in impaired intellectual development and physical growth [1]. Iodide deficiency is thought to be a public health problem in a community if goitre is detected in more than 5% of the school-age population. Prevalence of greater than 30% means that the deficiency is severe. According to iodide status data collected between 1993 to 2003 in 126 countries, World Health Organization (WHO) estimates that in 54 countries the population has insufficient iodide intake as indicated by a median urinary iodide (UI) below 100µg/l. These countries are classified as iodide deficient: one country is severely deficient, 13 are moderately deficient and 40 mildly deficient. In 43 countries, the population have adequate iodide intake with a median UI between 100 and 199µg/l. Iodide status of these countries is considered as optimal. In Kenya the prevalence of iodide deficiency was estimated to be about 36.8% and 50.7% in Coast region in sentinel surveys done by assessment of urinary iodide levels in 2006. Iodized salt programs are decreasing iodide deficiency in many regions in the world. However; this reduction is offset by apparent increases in other regions, where public health officials are now aware of the problem because of increased surveillance [1, 2]

Iodide deficiency, with endemic goitre as its main clinical manifestation and brain damage and irreversible mental retardation as major public health consequences, is part of the history of the world and Kenya in particular. All regions of Kenya have experienced this health and socioeconomic scourge to some degree. Endemic cretinism, the most severe consequence of iodide deficiency, has not been specifically studied and reported in Kenya as only limited attention has been paid to the public health consequences of iodide deficiency in Kenya until recently.

In 1960, the World Health Organization (WHO) published the first global review on the extent of endemic goitre [3]. This review, covering 115 countries, was instrumental in focusing attention on the scale of the public health problem of iodide deficiency disorders (IDD). It was only in the mid-1980s that the international community committed themselves to the elimination of IDD, through a number of declarations and resolutions [1,2]. WHO subsequently established a global database on iodide deficiency which now holds surveys dating back from the 1940s to date. Its objective is to assess the global magnitude of iodide deficiency, to evaluate the strategies for its control and to monitor each country's progress towards achieving the international community's goal of IDD elimination. In 1993, WHO published the first version of the WHO global database on iodide deficiency with global estimates on the prevalence of iodide deficiency based on total goitre prevalence (TGP), using data from 121 countries . Since then the international community and the authorities in most countries where iodide deficiency disorders was identified as a public health problem have taken measures to control iodide deficiency, in particular through salt iodization programmes – the WHO recommended strategy to prevent and control iodide deficiency. As a result, it is assumed that the iodide status of populations throughout the world has improved over the past two decades [3]

Iodide deficiency has been recognized in Kenya for many years now. At the beginning of the 19th century, it was suggested that the use of salt fortified with iodide would lead to good health in people living in iodide deficient areas [4]. After the pioneering work of Swiss doctors that demonstrated that iodide deficiency was indeed the cause of goitre, attempts began to locally iodize salt using a hand-and-shovel method. In Kenya iodized salt was introduced in the 1980s on a large scale in order to eliminate iodide deficiency. Due to various factors the availability of iodized salt progressed slowly. Today, over 90% of households consume iodized salt and about 70% of the salt used in industrial food production is iodized [5].

METHODS

The study was designed as a cross-sectional study to assess the factors that contribute to iodide deficiency in Coast region of Kenya. The study covered 30 clusters comprising 292 households within the region. Selection of the clusters involved multistage sampling technique; in the first stage clusters were selected using simple random sampling, and then households were selected using systematic random sampling technique. During the study, data was collected using structured interviewer administered questionnaires. The questionnaire included questions relating to the household socio-demographic characteristics, food consumption, knowledge, practices and behaviour of the respondents living in the selected household. A salt sample was collected from every sampled household for iodide level analysis using iodometric titration method as described by DeMaeyer [6].The salt was classified according to the iodide levels as; non-iodinated (5ppm), insufficiently iodinated (5 – 14ppm), adequately iodinated (15 – 45ppm) and over iodinated (>45ppm) [7]. Data were

analysed using bivariate analysis and significant differences were assessed with a given significance at $p<0.05$

RESULTS

Socio-demographic characteristics of the participants

A total of 292 participants were enrolled in the study with the mean age of 35 ± (10 SD) years ranging between 16-72 years. Of the 292 participants, 189 (64.7%) were Christians, 71(24.3%) were Muslims, 26 (8.9%) were traditionalist and 6 (2.1%) Hindu. About 65% were married, 61% were unemployed and 14.7% were not educated (**Table 1**)

Table 1: Socio-demographic characteristics of participants

Variable	n=292	%
Age		
16 – 19	52	17.8
20 – 29	76	26.0
30 – 39	81	27.7
40 -49	56	19.2
>50	27	9.3
Marital status		
Single	58	20.0
Married	190	65.0
Divorced	23	8.0
Widowed	20	7.0
Religion		
Christian	189	64.7
Muslim	71	24.3
Traditional	26	8.9
Hindu	6	2.1
Occupation		
Employed	61	21.0
Self-employed	53	18.0
Unemployed	178	61.0
Educational level		
Primary	132	45.2
Secondary	80	27.4
College	31	10.6
University	6	2.1
None	43	14.7

Availability of iodized salt at household level

Adequately iodized salt (≥15ppm) was 26.2% of the salt samples collected in the 292 households. Two hundred and ninety two of the respondents used iodized packed salt out of which 74.8% was inadequately iodized. About 80.1% of the salt containers had cover and

82.2% of the respondents store salt in dry places. Nearly 78.4% of the participants usually add salt in the early beginning and middle of cooking while 22.6% add salt late at the end of cooking and after cooking (**Table 2**)

Table 2: Availability of adequately iodized salt at household level

Variable	n=292	%
Iodide level		
< 5	96	33
5 – 14	119	40.8
15 – 45	54	18.4
>45	23	7.8
Types of salt used		
Iodized packed salt	292	100
Coarse salt (non-packed)	0	0
Salt storage		
Dry area	240	82.2
Moist area	52	17.8
Salt container		
With cover	234	80.1
Without cover	58	19.9
Time salt added during food cooking		
Early and at the middle of cooking	229	78.4
Late at the end of cooking & after cooking	63	22.6

All the respondents demonstrated complete lack of knowledge on food sources of iodide, knowledge on iodized salt, health benefits of iodide in humans and iodide deficiency despite most of the households visited having iodized salt. The salt was mainly used to add taste to food and not considered a source of iodide.. The respondents agreed that the processed iodized salt was universally available throughout the year in the places of purchase. The respondents acquire iodized salt from various sources including supermarkets, kiosks, retail shops, and markets.

Factors associated with availability of adequately iodized salt at household level

In the bivariate analysis, having formal education (OR=3.22, 95%CI: 0.03-0.27, p=0.0436), covering of salt containers (OR=2.19, 95%CI: p= 0.0103) and storing salt in dry places (OR=0.22, 95%CI: 0.12-0.41, p=0.000001).were associated with availability of adequately iodized salt at household level. There was no association between respondents age with availability of adequately iodized salt. (**Table 3**)

Table 3: Factors associated with availability of adequately iodized salt at household level

	Availability of iodized salt at household level				
	≥15ppm	**<15ppm**	**OR**	**95% CI**	**p-value**
Age (years)					
<19	12	40	0.86	0.37-1.98	0.7209
20-29	26	50	0.50	0.24-1.01	0.0516
30-39	22	59	0.69	0.33-1.42	0.3152
≥40	17	66	Ref		
Education level					
None	5	38	3.22	0.03-0.27	**0.0436**
Primary	31	101	1.38	0.61-3.10	0.4373
Secondary	27	73	0.83	0.36-1.93	0.6659
Tertiary	11	26	Ref		
Salt container					
With cover	54	180	2.19	1.19-4.02	**0.01032**
No cover	23	35	Ref		
Place of storage					
Dry places	49	191	0.22	0.12-0.41	**0.000001**
Moist/wet area	28	24	Ref		

DISCUSSION

Elimination of iodide deficiency is possible if more than 90% of the households consume adequately iodized salt and must be granted [8]. The study showed that 26.3% of the households had adequately iodized salt at household level. This concurs with a study carried out in Ethiopia by Hailay et al [9]. This is very low compared to a study in India where 51% of households had adequately iodized salt [10]. This can be attributed to availability and accessibility of iodized salt in the market, legislation and policies to fortify salt with iodine, regular follow ups and monitoring utilization of iodized salt. Among analyzed variable education level, place of storage and salt container was associated with iodide deficiency.

Education increases awareness and informed decision making of individuals. The study showed respondents with no education were significantly associated with consumption of inadequately iodized salt. This consistent with studies done in Pakistan [11] and Iraq [12] where household members with tertiary education used iodized then those illiterate. Fortification of salt with iodine is not enough to alleviate iodide deficiency hence education should play a role in communicating information about importance of consuming adequately iodized salt to the population.

Iodine stability is critical for the success of salt fortification. High humidity results in rapid loss of iodine from iodized salt ranging from 30-98% of the original iodine content. Storage of iodized salt in dry places and covering the salt containers was associated with availability of adequately iodized salt. This is in agreement with a study done in India where consumption of iodized salt was high in those storing salt in closed containers than those in the open containers [13].

Limitation: This study however did not interrogate the period of storage of the salt between purchase and consumption which is an important factor in salt iodide losses. Iodine level determination did not include titration level of iodine in salt and urinary iodine for body iodine level determination.

CONCLUSION

Availability of adequate iodized salt at household level was very low when compared to the WHO recommended levels to prevent iodide deficiency. Formal education, covering salt containers and storing salt in dry places were associated with availability of adequately iodized salts at households. Therefore there is need to sensitize people on importance of adequately iodized salt and how to handle it.

Conflict of interests

The authors declare no conflict of interests

Authors' contributions

KK: Primary author was responsible for formulation of the research concept, designing the study, collection of data and analysis, interpretation of results and writing up the draft manuscript. CM: Conception, design and coordination of the project, data analysis and interpretation and writing and review of the draft manuscript. AM: Conception, design and coordination of the project, data interpretation and writing and review of the draft manuscript

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