Prevalence of Goiter and Its Association with Iodine Status among the Women of Reproductive Age Group in Coastal Villages of Udupi Taluk, Karnataka, India

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Abstract

Background: Iodine deficiency is one of the most prevalent micronutrient deficiencies globally. Women in reproductive age group are vulnerable to develop iodine deficiency as there is an increase in demand for iodine, especially during pregnancy. **Objectives:** The objective is to assess the prevalence of goiter and its association with iodine status and salt usage practices among the women of reproductive age group. **Methods:** A community-based cross-sectional study was conducted from August 2015 to July 2017 among 1500 women of reproductive age group in five villages of Udupi Taluk. Stratified sampling design and proportion to population size of the reproductive age women in the study area was used to select the study participants. A pretested semi-structured questionnaire was used for data collection. Goiter was assessed clinically and graded as per the recommended criteria of the WHO. Salt samples from every household were collected for iodine estimation. Blood and urine samples were collected from subsample to estimate thyroid-stimulating hormone levels and urinary iodine excretion levels, respectively. **Results:** The overall prevalence of goiter was 13% with 11.5% being Grade 1 and 1.5% being Grade 2. No significant association of goiter with urinary iodine, salt iodine levels, and salt usage practices was found. **Conclusions:** Median urinary iodine among the women with goiter indicates iodine sufficiency and no significant difference observed in urinary iodine levels between women with and without goiter.

Key words: Goiter, iodine, reproductive age, salt iodine, urinary iodine, women

Introduction

Iodine is an important component of the hormones produced by the thyroid gland. A healthy adult human body contains 15–20 mg of iodine, of which 70%–80% is present in the thyroid gland. Recommended daily intake of iodine for an adult is 150 μg. Nearly 90% of the ingested iodine is absorbed in stomach and duodenum. More than 90% of consumed iodine is ultimately excreted in the urine.[1]

Iodine deficiency is one of the most prevalent micronutrient deficiencies globally. Iodine deficiency disorder (IDD) includes a spectrum of diseases which include endemic goiter, hypothyroidism, cretinism, decreased fertility rate, increased infant mortality and mental retardation.[2] Among all these disorders the most common manifestation of iodine deficiency, both in children and adults is goiter which makes goiter as the most common presentation and indicator of iodine deficiency.[1] Hence, the goiter prevalence survey is used as a diagnostic tool for identifying areas of IDD. Globally, the total goiter prevalence is estimated to be 15.8%. Africa has the highest prevalence of 28.3% whereas America has lowest prevalence of 4.7%. The prevalence in South East Asia is 15.4%.[3] Goiter due to iodine deficiency contributes to 2.72% of all sequel of disease worldwide. This statistic makes goiter the 32nd most

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prevalent disease sequel in human beings.[4] In India, it is estimated that 54 million people are suffering from goiter, 2.2 million suffering from cretinism, and 90,000 stillbirths and neonatal deaths.[4]

Women in the reproductive age group are vulnerable to develop iodine deficiency as there is an increase in demand for iodine, especially during pregnancy. Deficiency of iodine in prepregnant state ultimately leads to hypothyroidism in pregnancy which is associated with adverse maternal and fetal effects.

Considering the IDD in India as a public health problem, Government of India had launched National Goiter Control Programme in 1962 which was renamed as National IDD Control Programme which adapted that the simplest, inexpensive, and most effective method to prevent iodine deficiency is to consume iodized salt daily and mandated the universal salt iodization.[5] Although the burden of IDD declined after the universal salt iodization the problem still continues. As earlier thought, IDD is not confined to the sub-Himalayan regions.[6] This might be due to the fact that nearly 22% of the households in the country end up consuming salt with inadequate iodine.[7] Poor salt storage practices affect the iodine content of salt which may lead to iodine deficiency and goiter. This study was conducted with the objectives to find out the prevalence of goiter and its association with iodine status and salt usage practices among the women of reproductive age group in the coastal belt of Udupi Taluk' Karnataka.

Materials and Methods

This was a community-based cross-sectional study carried out for a total period of 2 years from August 2015 to July 2017 among women in the reproductive age group in the five coastal villages of Udupi Taluk. These villages are homogeneous in terms of occupation, socioeconomic status, and food habits.

All women aged 18–49 years and residing at least for the past 1 year in the study area were the study population. Women who have undergone thyroidectomy and known cases of thyroid malignancy were excluded. Anticipating the prevalence of goiter as 11%[8] with a relative precision of 15% and nonresponse rate of 10%, the sample size was calculated to be 1600. Stratified sampling was done with village as a stratum and number of women to be included in the study from each stratum was calculated based on the proportion to population size of the reproductive age women in the study area. Within each stratum convenient sampling technique was used to select the required number of women.

Ethical approval was obtained from the institutional ethics committee before the initiation of the study. The data were collected by making house visits. At the household, all women in the childbearing age were enumerated, and the purpose of the visit was explained to them. After obtaining the consent, the pretested semi-structured questionnaire was administered by the investigator followed by clinical examination of thyroid gland. Socioeconomic status was assessed using updated BG Prasad scale.[9]

The goiter was graded as per the WHO guidelines:[10] Grade 0 – no palpable or visible goiter; Grade 1 – a mass in the neck that is consistent with enlarged thyroid that is palpable but not visible when neck is in normal position; and Grade 2 – swelling in the neck, which is visible in normal position and is consistent with enlarged thyroid when neck is palpated.

A teaspoonful of cooking salt sample was collected from each family to test the salt iodine content on the spot using spot iodine testing kits (MBI KITS). Salt iodine level was classified as 0 ppm, 15 ppm, and 30 ppm. Salt iodine level of 15 ppm and above was considered adequate. All women with goiter were requested to provide urine samples (15 mL) for the estimation of iodine levels by Sandell–Kolthoff method. Cutoff values of urinary iodine were taken as per the WHO criteria.[3] Blood samples were collected from a subsample of 50 women with goiter (randomly selected) for the estimation of thyroid-stimulating hormone (TSH) levels. Both blood and urine samples were also collected from 50 age-matched (5-year age interval) controls for the estimation of TSH levels and urinary iodine levels, respectively. The normal level of TSH was taken as 0.3–4.5 μIU/ml.

Results

A total of 1500 women were enrolled in the study of which 22 women refused to participate giving a nonresponse rate of 1.5%.

The mean (standard deviation) age of the study participants was 34.1 (7.9) years with almost half of the population (42.2%) in the age group of 31–40 years, followed by one-third aged 21–30. Only 2.2% were illiterate with more than a third (40.6%) having a secondary level education. Majority (80.4%) of the participants were homemakers, and a small proportion (2.4%) was unemployed. Most (87.2%) of the study participants were ever married (which include married, widowed, and divorced women). Nearly half of the population (47.7%) belonged to middle class with 5% belonging to lower class.

Goiter was diagnosed among 192 study participants providing an overall prevalence of 13% (11.5% being Grade 1 and 1.5% being Grade 2).

Median urinary iodine level for the 170 urine samples collected was 125 μg/L (IQ 75,200), which indicates there is no iodine deficiency.

As observed in Table 1, there was no significant association of salt iodine levels with goiter. However, we can see that likelihood of having goiter among women consuming salt with no iodine was 2.2 times (odds ratio [OR] 2.24; 95% confidence interval [CI] 0.44–11.0) more as compared to women consuming salt with 30 ppm of iodine.

A subsample of 104 participants, 52 women with goiter and 52 women without goiter matched for age was studied for Comparison of biochemical and clinical parameters [Table 2]. There was a statistically significant difference in the proportion of goitre and non goitre women consuming salt with adequate iodine content. Median TSH was found to be more in the goiter group (2.51 µg/L) as compared to control (2.08 µg/L), but this difference was not statistically significant. A multilevel binary logistic regression analysis identified the intraclass correlation coefficient for all the household characteristics were lower than 0.001 and insignificant.

None of the salt storage and usage practices were found to be significantly associated with goiter. However, the prevalence of goiter was found to be more among the women using table salt, storing the salt in ceramic container, using storage container without lid, salt exposed to heat and sunlight.

Discussion

The prevalence of goiter in the present study was found to be 13%. Comparable results were found by a study done by Kousar *et al*.[11] during 2012–2013 in Srinagar where the prevalence was 12.7% with entirely Grade 1 goiter while studies from other areas of India such as Ernakulam,[12] Delhi[8] (2007–2010), and Belgaum[13] (2005) has shown a higher prevalence of 16.1%, 17.4%, and 21.8%, respectively.

Prevalence in another study done by Cuthbertson *et al*.[14] among Malay community which is an iodine deficient area as evident by the low median urinary iodine levels (14.5 µg/L) was 32.4% which is more when compared to the present study. Asibey-Berko *et al*.[15] conducted a study in Ghana which revealed the prevalence of goiter of 70.8% which is much higher than the present study. A study conducted by Belay *et al*.[16] in Ethiopia revealed that the prevalence of goiter among reproductive-age women was 10.8% which is less than the present study and the median urinary iodine level of 98 µg/L was observed.

There was no significant association of salt and urinary iodine levels with goiter in the present study. In a study by Kousar *et al*.[11] it was observed that women consuming inadequately iodized salt had a higher prevalence of goiter (26.7%) as compared to women consuming adequately iodized salt (6.6%) and this was found to be statistically significant ($P < 0.001$) A study by Farahati *et al*.[17] found that the odds of having goiter was 50% (Adjusted OR 0.50; 95% CI 0.29; 0.85) less among women who consume iodized salt as compared to women who do not consume iodized salt. A study conducted by Menon *et al*.[12] revealed that the prevalence of goiter was more in the iodine-deficient group than iodine sufficient group.

A case–control study by Gaengler *et al*.,[18] has shown no significant difference in the median urinary iodine levels ($P = 0.1$) and median TSH levels ($P = 0.06$) between cases and controls which is similar to the present study. In contrast, they found a significant difference in the mean age ($P = 0.01$) while there is no such difference ($P = 0.3$) in this study. There was a significant difference ($P < 0.002$) in TSH levels among cases (11.4 ± 3.8) as compared to controls (1.27 ± 0.42) and significantly ($P < 0.001$) lower urinary iodine levels were found among cases in a case–control study done by Kandhro and Khand.[19] A significant difference ($P = 0.01$) in the mean urinary iodine levels was observed between cases and controls in a study done by Washington *et al*.,[20] which contrast the results of the present study.

There is a paucity of literature available on the association of salt storage practices and goiter. However, a study Abebe *et al*.[21] revealed no significant association of goiter to exposure of salt to sunlight or heat which agrees with the

Table 1: Association between salt iodine levels and goiter in the study population (*n*=1478)

Salt iodine content (ppm)	Total	Goiter		COR (95% CI)
		Yes, *n* (%)	No, *n* (%)	
0	8	2 (25.0)	6 (75.0)	2.20 (0.44-11.03)
7	49	5 (10.2)	44 (89.8)	0.75 (0.29-1.92)
15	378	48 (12.7)	330 (87.3)	0.96 (0.67-1.36)
30	1043	137 (13.1)	906 (86.9)	1

COR: Crude odds ratios, CI: Confidence interval

Table 2: Comparison of clinical and biochemical parameters between goiter and control group (*n*=104)

Variable	Goiter group (*n*=52)	Control group (*n*=52)	*P*
Age (years), mean±SD	31.28±7.4	32.6±7.5	0.3
Salt iodine levels, *n* (%)			
Inadequate (<15 ppm)	5 (9.6)	0	0.02
Adequate (≥15 ppm)	47 (90.4)	52 (100)	
Median urinary iodine (µg/L), median (IQR)	125 (75, 237)	125 (75, 200)	0.7
TSH levels (µIU/ml), median (IQR)	2.51 (1.48, 5.03)	2.08 (1.17, 3.61)	0.2

SD: Standard deviation, IQR: Interquartile range, TSH: Thyroid stimulating hormone

present study. A study conducted by Matthys *et al*.[22] among school children found an increase in odds of having goiter among those who consumed salt stored in containers without lid (OR 1.24; 95% CI 0.85–1.79) as seen in the present study.

However, we were not able to get sufficient information regarding compliance to iodized salt in the past, and this could have possibly led us with study observation that women with goiter consumed adequately iodized salt.

Conclusions

We found the prevalence of goiter to be 13%. Median urinary iodine among the women with goiter indicates iodine sufficiency with no significant difference when compared to women without goiter.

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Conflicts of interest

There are no conflicts of interest.

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