Original Article

Demographic, Dietary and Biochemical Risk Factors Associated with the Causation of Goiter in Plane Areas of Sindh Province

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Received: 13 December 2018
Revised: 18 February 2019
Accepted for publication: 8 March 2019

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This article may be sighted as:
Khand TU, Khand F, Kandhro AH, Memon MY. Demographic, Dietary and Biochemical Risk Factors Associated with the Causation of Goiter in Plane Areas of Sindh Province. LMRJ. 2019; 1(1): 5-8.
Doi: 10.38106/LMRJ.2019.1.1-02.

Abstract
Present study was conducted to find out the demographic, dietary and biochemical risk factors associated with the causation of goiter in plane areas of Sindh province. This case-control study was carried out at Liaquat University of Medical and Health Sciences, Jamshoro from July 2009 to December 2009. A total of 200 subjects (100 goiter patients and 100 normal control subjects matched for age and gender) were recruited for present study. The demographic characteristics and dietary history of both goiter patients and control subjects were studied with the help of a standard questionnaire developed for that purpose. Serum samples from goiter patients and control subjects were analyzed for iodine, TSH, FT3 and FT4 levels, while urine samples were analysed for iodine content. Of the 100 goiter patients 87 were females and 13 were males. Majority (53%) of the study patients were young adults (20-39 years age). Odds Ratio analysis of the dietary data showed that consumption of cabbage and pickle in mustard oil containing mustard seeds had a significant positive association with goiter. Similarly, consumption of fish, eggs, milk products, chicken, beef and peas had a significant inverse association with goiter. Blood and urine iodine levels were significantly ($P<0.001$) lower in goiter patients than in control subjects whereas, the reverse was true for serum TSH and FT4 levels. All the goiter patients were found to be iodine deficient with 33 percent having mild and 77 percent moderate iodine deficiency. It was concluded that consumption of underground water, cabbage, and pickle in mustard oil containing the mustard seeds and low intake of animal protein diet is associated with mild to moderate iodine deficiency found in the inhabitants of plane areas of Sindh province.

Keywords: Goiter, TSH, FT , FT , Iodine

Introduction

Goiter is a condition in which the thyroid gland is abnormally enlarged. It is a common disorder affecting around 200-300 million population around the world. Inadequate supply of iodine causes insufficient production of tri-iodothyronine (T3) and thyroxine (T4) which leads to an increased influx of thyroid stimulating hormone (TSH) by the pituitary gland. This in turn stimulates thyroid gland hyperplasia and hypertrophy which leads to goiter formation.

Goiter is found in all age groups. However, people above 40 years of age are significantly, more likely to have goiter than younger people. Goiters are more common in females than in males. In females it is associated with pregnancy and menopause. Most of the mountainous areas in the world particularly the arc of Himalayas from Pakistan across India and Nepal into northern Thailand and Vietnam are one of the most highly endemic goiter regions of the world[1]. Goiter is said to be endemic when its prevalence is more than 5% in children aged 6-12 years within a population[1, 2].

The prevalence of goiter in mountainous areas of Pakistan is reported to be 80-90%, whereas in plane areas it is reported to be as high as 55%[3]. In Pakistan, Gilgit and Chitral are recognized as highly endemic goiter regions, since food and drinking water consumed in these areas is deficient in iodine[4]. In the plane areas of southern part of Sindh province, especially in Hyderabad and its adjacent districts, the incidence of goiter is reported to be increasing[5,6]. The reason for this rise in the incidence of goiter cases is difficult to elucidate, as it is generally assumed that surface drinking water and agriculture products consumed by the inhabitants of these areas have sufficient iodine content. Besides this, several common food products used by local population, especially salt, are fortified with iodine. The possible demographic risk factors associated with the prevalence of goiter in these areas could be tobacco smoking, age, gender, parity, ingestion of large amounts of goiterogens in foods and drugs[1,7,10]. The

purpose of present study was to find out the demographic, dietary and biochemical risk factors associated with the causation of goiter in Hyderabad and its adjacent districts.

Material and Methods

During July 2009 to December 2009, one hundred diagnosed cases of goiter belonging to Hyderabad and its adjacent districts were randomly recruited from OPD of Nuclear Institute of Medicine and Radiotherapy (NIMRA) Jamshoro. Similarly, age and gender matched 100 non-goiter subjects from the same region, with similar socioeconomic status and with no family history of goiter were recruited as controls. Before obtaining written informed consent, the study participants were explained the nature and purpose of study and of possible harms and benefits from study. The ethical approval of the study was granted by the Ethical Committee of Liaquat University of Medical and Health Sciences, Jamshoro.

A questionnaire encompassing demographic and clinical parameters including age, gender, district of residence and dietary history was filled for each study participant. Serum and urine samples from patients and control subjects were analyzed for iodine content by spectrophotometric method using Hitachi-220 spectrophotometer. Serum samples were also analyzed for TSH, FT and FT levels by radioimmuno assays using Oak Field Health care Product Gamma Counter (UK) England.

Statistical Analysis

Dietary data of the goiter patients and control subjects were analyzed by Odds Ratio, while statistical comparisons for biochemical variables were done by using student's t-test. Results were considered statistically significant at $p \leq 0.05$ and highly significant at $p \leq 0.001$.

Results

Of the 100 goiter patients, 53% were of 20-39 years age; 87% were females; and 56% belonged to Hyderabad district. The association of various study parameters with goiter in current study have been presented in Table 1. Of the 10 smokers involved in present study 8 (80%) were goiter patients. Majority of the goiter patients (93%) and control subjects (84%) were non-iodized salt consumers. The Odds Ratio (OR) analysis of the data showed that the intake of underground water, cabbage and pickle in mustard oil containing the mustard seeds had a significant positive association with goiter. Similarly, consumption of fish, eggs, milk products, chicken, beef, and peas had a significant inverse association with goiter (Table 1). Table 2 gives the comparison of mean values for biochemical variables measured in serum and urine samples of goiter patients and control subjects. The mean iodine levels in serum and urine samples of goiter patients were found to be significantly lower ($P<0.001$) than the control subjects. Similarly, the mean serum TSH, FT3 and FT4 levels were significantly higher in goiter patients compared to control subjects. Thyroid profile of the goiter patients revealed euthyroidism in 60 cases, hyperthyroidism in 25 cases and hypothyroidism in 15 cases.

Iodine intakes calculated from urinary iodine levels according to UNICEF criteria are shown in Table 3. Only 3 categories namely optimal intake, mild iodine deficiency, and moderate iodine deficiency were seen on the basis of results obtained. Accordingly all the control subjects were found to have an optimal iodine intake (iodine in urine = 100-199 µg/l). However, 76% of the goiter patients were found to have mild (iodine in urine= 50-99µ g/l) and 24% moderate (iodine in urine= 20-49 µg/l) iodine deficiency. Blood iodine levels less than 6µg/l were noted in 51% goiter patients only

Table 1. Association of various study parameters with goiter

Variables		Cases (n=100)	Controls (n=100)	Odds ratio (95% confidence interval)	P-value
Smoking habits	Smokers	08	02	4.261 (0.991-18.144)	0.052
	Non-smokers	92	98		
Salt consumed	Iodized	07	16	0.3952 (0.1550-1.0075)	0.0518
	Non-Iodized	93	84		
Source of drinking water	Surface	62	94	0.1041 (0.0416-0.2610)	<0.0001
	Underground	38	06		
Cabbage	Users	70	28	6.0 (3.2564-11.0552)	<0.0001
	Non-users	30	72		
Turnips	Users	37	25	1.762 (0.962-3.224)	0.067
	Non-users	63	75		
Peas	Users	61	84	0.298 (0.154-0.578)	0.0004
	Non0users	39	16		
Spinach	Users	92	94	0.734 (0.256-2.111)	0.579
	Non-users	08	06		
Pickle with mustard seeds	Users	32	06	7.373 (2.986-18.120)	<0.001
	Non-users	68	94		
Soya oil	Users	09	17	0.483 (0.208-1.123)	0.093
	Non-users	91	83		
Mustard oil	Users	18	06	3.439	0.009
	Non-users	82	94	(1.338-8.804)	
Other oils	Branded	12	65	0.073 (0.035-0.152)	<0.000
	Non-branded	88	35		
Fish	Users	10	38	0.2029 (0.010-0.425)	<0.0001
	Non-users	90	62		
Eggs	Users	08	81	0.020 (0.009-0.049)	<0.0001
	Non-users	92	19		
Milk Products	Users	12	82	0.030 (0.014-0.066)	<0.0001
	Non-users	88	18		

Table 2. Comparison of mean values for continuous biochemical variables measured in cases and controls

Variables	Study group	Mean	S.D	P-Value
Iodine in urine (µg.L)	Cases	60.26	11.99	<0.0001
	Controls	128.9	9.95	
Iodine in blood (µg/L)	Cases	6.02	1.35	<0.0001
	Controls	9.88	0.64	
TSH (mµ/L)	Cases	23.01	17.46	<0.0001
	Controls	1.49	0.83	
FT_3 (pmol/L)	Cases	7.73	3.63	<0.0001
	Controls	3.72	0.76	
FT_4 (pmol/L)	Cases	26.74	20.92	0.01
	Controls	18.58	2.76	

Table 3. Descriptive statistics for biochemical variables measured in cases and controls

		Cases (n=100)	Controls (n=100)
Iodine in urine (µg/L) (UNICEF Criteria)	Moderate deficiency (20-49 µg/L)	24	00
	Mild deficiency (50-99 µg/L)	76	00
	Optimal intake (100-199 µg/L)	00	100

Discussion

The finding of the present study that goiter is about seven times more common in females than in males is in accordance with the findings from many other studies which reported 2-10 times higher prevalence of goiter in females as compared to males[2,7,11]. A greater proportion of females as against males had been reported to develop goiter when exposed to iodine deficiency[7].

In present study peak occurrence of goiter cases were seen in 20-39 years age group. Kundsen et al. (2002) had also noted greater prevalence of goiter in 30-40 years age group in areas of mild to moderate iodine deficiency. This association of goiter prevalence with age seems to be iodine intake dependent as in severe iodine deficiency areas the peak occurrence of goiter occurs around the middle age[7].

Of the ten smokers involved in the present study, eight were found to be goiter cases. Although, smoking was not positively associated with goiter in present study, the predisposition of smokers to goiter has been reported from iodine deficient areas[7,9,12]. Smoking undoubtedly is not the cause of goiter, but certainly could contribute in promoting iodine deficiency. This is suggested because thiocynate, which is abundant in cigarette smoke is known to produce goitrogenic effects through competitive inhibition of iodine uptake and organification[7,10,13,15]. Comparison of the dietary intakes between goiter patients and control subjects revealed that goiter patients as against the control subjects had significantly lower intake of fish and animal proteins in the diet. Contrary to this they had significantly higher consumption of underground water, cabbage and pickle in mustard oil with mustard seeds. Chemical compounds in underground drinking water samples might be interfering with the synthesis of thyroid hormones and hence contributing in the causation of goiter. Ingestion of the large amounts of goitrogenic foods (cabbage, turnips, soybeans, peanuts, peaches, peas, strawberries, spinach, onions, sweet potatoes, seeds of mustard and rape) and low amounts of animal and fish proteins might be involved in the causation of iodine deficiency in goiter patients. This is because both fish and animal proteins as compared to vegetable proteins are good dietary sources of iodine.

The finding of present study that iodine levels in both blood and urine samples were significantly ($P<0.001$) lower in goiter

patients than in control subjects suggests that iodine deficiency could be the major cause of goiter in Hyderabad and adjacent districts. This is further supported by the observation that all the goiter patients according to UNICEF criteria were iodine deficient; 24% had mild and 76% had moderate iodine deficiency.

Conflict of Interest
We hereby declare that we do not have any conflict of interest related to publication of this article.

Grant Support/ Financial Disclosures
None

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