

# Goitrogenic Food and Prevalence of Goitre in Sri Lanka

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**Abstract** The relationship of goitrogenic food to prevalence of goitre still remains a topic of debate. Roles of 6 goitrogens was assessed in an prevalence study. Objective was to assess the relationship of goitrogens on the prevalence of goitre in Sri Lanka. An islandwide descriptive cross-sectional study was conducted excluding north and Batticaloa district. A pre-tested interviewer administered questionnaire was used on all participants (n=5200). 426 were detected with goitre. Consumption of Cabbage, Lima beans, Millet, Turnips, Cassava and Peanuts was assessed. Significance of dietary goitrogens to the prevalence of goitre was analyzed with Pearson's chi-square test. Mean age for goitre was 36.3 ( $\pm$ 17.3) years. Consumption of goitrogens was low overall. Island wide adjusted prevalence of goitre was 6.8% (SD=6.0%-7.6%). Goitrogens assessed showed no significant association with the prevalence of goitre ( $p < 0.05$ ) concluding that the dietary goitrogens considered in this study showed no significant association with prevalence of goitre.

**Keywords** Dietary goitrogens/ Goitre prevalence/ Goitre/ Goitrogens

## 1. Introduction

Goitrogens are agents which cause an enlargement of the thyroid gland. They may act directly on the gland or indirectly by altering the regulatory mechanisms of the gland and peripheral metabolism and excretion of T3/T4[1].

TSH is the most potent stimulus in the growth and enlargement of the thyrocyte.

Food and water were regarded as the sources of these goitrogens and many possible agents were identified[1]. Association between goitrogens and goitre has been studied in detail in other countries. Data in Sri Lanka is incomplete. Cassava (*Manihot utilissima*)[2,3], Cabbage (*Brassica oleracea L.*)[4,5] and Pearl Millet (*Pennisetum americanum*) [6,7,8] are a few common examples of such goitrogens in food, which have been reviewed extensively. The available data contains cohorts which were mainly selected from the under-developed, malnourished populations in the African continent like the Idjwi island of Congo [9]. These goitrogens have been extensively studied in India as well[10]. In most of these studies the goitrogen reviewed was the staple food item of the investigated cohort.

There is no consensus regarding the association between food related goitrogens and goitres. Main drawback of the currently available data is the small scale of the studies.

## 2. Methodology

A cross-sectional descriptive study on epidemiology of goitre was conducted with an islandwide coverage except North & Batticaloa district (due to security reasons) from December 2006 to June 2007. The country was divided into 6 areas in 3 zones (Wet, Intermediate and Dry zones) based on rain fall patterns and geography.

### 2.1. Selection of Participants

Sample size of 865 participants for a zone was calculated using the equation  $n = (pq/d^2) \times 1.96^2$ . Grama Niladhari (GN) areas of each zone were categorized and 18 GN areas from each zone were selected using the Probability Proportionate to Size (PPS) technique. 108 GN areas were selected for the island wide study. Individuals were selected randomly from each GN area where 5 sub clusters of 10 were selected from a householders list maintained by Grama Niladhari or the midwife. Any person in a household under the age of 10 or failure to obtain informed consent was considered as the exclusion criteria. Majority of the participants were adults and was in the age range of 20-50years. A total of 5200 participants were recruited.

### 2.2. Data Collection

A detailed pre-tested interviewer administered questionnaire consisting of demographic data, details of family history, economic status and consumption of possible goitrogenic substances was used after obtaining verbal consent. The likely dietary goitrogens Cabbage, Lima beans (Kawpi),

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Millet (Kurakkan), Turnip (Raabu), Cassava (Manioc) and Peanuts were selected after thorough review of available literature and advice of a consultant nutritionist. Consumption of food items were considered to be significant, if consumed  $\geq 3$  times a week for more than 5 years duration. Examination of goitres was done at least by 2 investigators before confirmed by the principal investigator. All the investigators were medical graduates who were briefed and trained on administering the questionnaire and the standard examination goitre in the surgical clinics of Teaching hospital, Ragama. Response rate was 100% as all individuals were interviewed by trained personnel.

### 3. Results

Out of a total 5200 (n=5200) participants 3433 were females and 1767 were males. 426 participants were detected to have goitres. 283 were females and 143 were males with a mean age of 36.3 ( $\pm 17.3$ ) years. Calculated overall island wide adjusted prevalence of goitre was 6.8% (SD=6.0%-7.6%).

Consumption of all 6 goitrogens was low in the study population. Lima beans were consumed at the highest frequency (9.9%). [Table 1]

None of the goitrogens assessed in the cohort showed significant association with the prevalence of goitre ( $p < 0.05$ ). [Table 2]

### 4. Discussion

Goitre is one of the major health problems which affects people around the globe in both developing and developed countries. In neighbouring India, 54.4 million people have been detected to have goitre [10]. Goitre is endemic in Sri Lanka and deficiency of Iodine, an essential micronutrient is considered as the main causative factor. Previous studies have shown the prevalence of goitre in Sri Lanka to be 5-18% [11].

Apart from deficiency of Iodine the role of other goitrogens, specifically other dietary goitrogens have been a leading topic of interest in scientific circles around the world for centuries. Varying opinions on the influence of goitrogens on prevalence have been expressed.

**Table 1.** Frequency of consumption of goitrogens

“Goitrogen”	$f \geq 3$ times/week	%
Cabbage	149/5200	2.9
Turnips	147/5200	2.9
Peanuts	289/5200	5.5
Manioc (Cassava)	114/5200	2.2
Lima beans	515/5200	9.9
Kurakkan (Millet)	206/5200	4.0

**Table 2.** Relationship of ‘goitrogens’ in diet to goitre

Food item	Consumed $\geq 3$ times/week	Goitre				X <sup>2</sup>	P value
		Yes (N=425)		No (N=4775)			
		N	%	N	%		
Cabbage	Yes	14	9.4	135	90.6	0.31	0.58
	No	411	8.1	4640	91.9		
Turnips	Yes	18	12.2	129	87.8	3.34	0.06
	No	407	8.1	4646	91.9		
Peanuts	Yes	25	8.7	264	91.3	0.09	0.76
	No	400	8.1	4511	91.9		
Manioc	Yes	4	3.5	110	96.5	3.38	0.07
	No	421	8.3	4665	91.7		
Beans	Yes	37	7.2	478	92.8	0.74	0.39
	No	388	8.3	4297	91.7		
Millet	Yes	18	8.7	188	91.3	0.09	0.76
	No	407	8.1	4587	91.9		

Chesney et al first introduced the association between cabbage and goitre in 1928 by demonstrating thyroid hyperplasia in rabbits fed with fresh cabbage as the principal food[12]. Several studies done subsequently refuted this claim and it is clear that the association between cabbage and goitre is tenuous. The active goitrogen in Brassica spp.[Cabbage/Turnips (Brassica rapa)] is proposed to be a thiocarbamate called 'Goitrin'[13] which brings about its effect by blocking Thyroid Peroxidase (TPO) enzyme. Statistically there was no significance of cabbage on prevalence of goitre in this cohort.

Cassava contains the cyanogenic glucoside 'Linamarin' which releases thiocyanate[14]. Thiocyanate acts as a goitrogen by blocking iodide transport into the thyroid gland. The same mechanism explains the goitrogenic activity of Lima beans (Phaseolus lunatus)[15].

In Sri Lanka the commonly used variety of Millet is called 'Finger Millet' (Eleusine coracana). Goitrogenic effects of Millet were attributed to three types of 'C-glycosylflavones' (C-GF), 'Vitexin' being the main culprit[16]. The goitrogenic effect is said to be brought about by blockade of TPO enzyme.

'Arachidoside', the glycoside from Peanuts (Arachis hypogaea) is suggested to be goitrogenic due to preferential iodination of the phenolic metabolites in the thyroid tissue[17].

It is postulated that if a food item is consumed as the staple diet over a long period of time it may have a goitrogenic effect as showed in Idjwi island of Congo.

In Sri Lanka, the staple food item can generally be considered as rice. A typical main meal comprises of rice and several curries. Consumption of tubers like Cassava as the breakfast is also a popular practice. Millet is used to create various foods (Pittu, roti) whereas peanuts are usually consumed in between meals. Other selected goitrogens are usually consumed as side dishes.

The consumption of a goitrogenic food item  $\geq 3$  times a week was considered as significant in this study. Yet the consumption of all goitrogens was very low with Lima beans being the highest[ Table 1]. Individual preference determining the degree of consumption is one of the main limiting factors. A nation where food is more preferably eaten well cooked, the modes of cooking were not taken into account during the study. Thus the role of cooking (Heat, spices) in promoting or diminishing the goitrogenic activity was beyond the scope of our study.

According to our study it is unlikely these food items have a goitrogenic effect in our population. Myths associated with food and goitre needs to be reviewed and revised especially in medical text.

## 5. Conclusions

1. The 6 goitrogens assessed showed no significant association with the prevalence of goitre in this cohort.
2. The teachings regarding prevalence of goitre and

dietary goitrogens require re-evaluation.

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