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ENDEMIC GOITER AND HYPOTHYROIDISM IN ORANG ASLI AND MALAYS IN PENINSULAR MALAYSIA

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ABSTRACT

The study was conducted to determine the prevalence of goiter and hypothyroidism in two groups of the population at various stages of social development and to determine its association with malnutrition and dietary intake. Aboriginal inhabitants (Orang Asli), a resettlement rural village (Betau Post), a traditional village in the jungle (Lanai Post) and a modern village settlement near Kuala Lumpur City (Bukit Lanjan) were selected. Three Malay villages with almost similar environments were selected for comparison. The study included house to house interviews, anthropometric, clinical and biochemical assessment of 1419 samples and estimation of iodine concentration in the drinking water of the areas studied. The World Health Organization criteria for classification of goiter were used. It was found that all Orang Asli settlements in rural areas were iodine deficient. The prevalence of goiter and hypothyroidism were higher among Orang Asli at all ages compared to Malays, and increased with remoteness of the areas (20-70% and 20-30% respectively). Apart from iodine deficiency, a high intake of cassava and deficient intake of sea foods and protein diets were also significantly related with high prevalence of goiter. Among children, goiter was associated with the level of thyroid stimulating hormone (TSH) whereas among adults, body mass index (BMI), triiodothyronine and thyroxine levels were predictors for the presence of goiter. In conclusion, goiter and hypothyroidism were more common among Orang Asli compared to Malays, and were associated with rural location and poverty.

Key Words: Goiter, Hypothyroidism, Malay, Orang Asli, Malaysia.

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INTRODUCTION

The World Health Assembly in 1990 passed a resolution to prevent and eliminate iodine deficiency disorders (IDD), especially endemic cretinism.[1] Iodine deficiency retards growth and mental development.[2] Because iodine deficiency occurs mostly in developing countries, it is a major problem

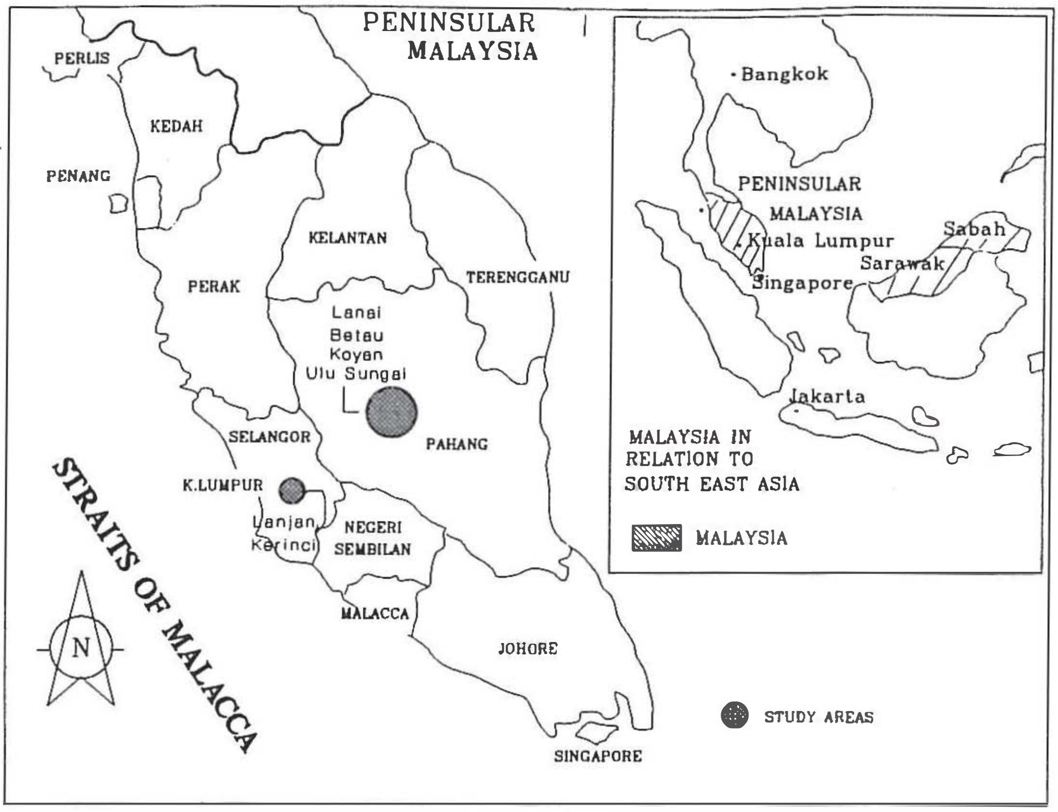

Fig. 1. Study areas

for their manpower development.

The prevalence of goiter and hypothyroidism varies with geographical, socioeconomic and environmental factors. The prevalence is highest in isolated communities, especially those living in mountainous areas.[3,4,5,6] Approximately 400 million people in Asia are afflicted by iodine deficiency disorders.[7] Dietary intake, age, and racial type were the factors found to be important in predicting the occurrence of endemic goiter in the tropics.[2] Because endemic goiter is not considered a public health problem in Peninsular Malaysia, little attention has been given to it. However, published epidemiological data on the prevalence of goiter and hypothyroidism in Peninsular Malaysia is very limited. Most of the studies were performed in East Malaysia.[3,8,9] A community-based study in a rural population in Sarawak found a goiter prevalence of 4.5-21.4% and 3.1-55.3% in 10-14 year olds.[9] It was also found that the prevalence among the population living in other parts of the country was twice that living in urban areas. However, none of the studies done so far have investigated the prevalence among the aborigines (Orang Asli) of Peninsular Malaysia, nor the Malay people living in various locations ranging from jungle fringes to urban towns.

Thus, the aims of this study were to determine the prevalence of goiter and hypothyroidism among the Orang Asli and Malays from different locations and environmental conditions with varying stages of modernization and development, in order to examine the factors associated with the occurrence of the disease.

MATERIAL AND METHODS

Sampling

A total of 1419 subjects aged 2 years and above were chosen using cluster sampling from different locations in Peninsular Malaysia (Fig. 1). The areas were selected based on degrees of social development and lifestyles. Different sampling strategies were chosen depending on the homogeneity of the population. For Orang Asli subjects, the areas chosen were Lanai Post, Betau Post and Bukit Lanjan. In Lanai Post, almost all eligible subjects from three randomly selected villages were invited to participate in the study. In Betau Post, three clusters comprising 6 villages were randomly selected with a participation rate of more than 85%. In Bukit Lanjan, all eligible subjects were invited, with a participation rate of more than 80%. For Malays, the areas selected were Ulu Sungai, Sungai Koyan and Kg. Kerinci. In Ulu Sungai traditional village, the response rate was more than 95%. In the Sungai Koyan resettlement scheme and Kampong Kerinci urban village, random

Table I: Prevalence of goiter according to age and stage of development.

Stage of development	Age group (years)	Number of subjects	prevalence	Standard error	95% confidence interval
Remote rural:					
Lanai Post	2 - 6	39	20.3	4.1×10^{-3}	19.5 - 21.1
	7 - 17	61	55.7	4.0×10^{-3}	54.9 - 56.5
	> 17	112	67.3	2.0×10^{-3}	66.9 - 67.7
Hulu Sungai	2 - 6	34	2.9	8.3×10^{-4}	2.74 - 3.06
	7 - 17	56	17.2	2.4×10^{-3}	16.7 - 17.7
	>17	154	25.0	1.2×10^{-3}	24.8 - 25.2
Rural:					
Betau Post	2 - 6	55	21.2	3.0×10^{-3}	20.6 - 21.8
	7 - 17	68	55.2	8.6×10^{-3}	53.5 - 56.9
	>17	137	48.2	1.8×10^{-3}	47.8 - 48.6
FELDA Koyan	2 - 6	55	0	0	0
	7 - 17	119	1.7	1.4×10^{-4}	1.67 - 1.73
	>17	133	8.1	5.6×10^{-4}	7.99 - 8.21
Urban:					
Lanjan	2 - 6	57	0	0	0
	7 - 17	68	4.4	3.6×10^{-4}	4.33 - 4.47
	>17	78	24.4	2.3×10^{-3}	23.9 - 24.9
Kg. Kerinci	2 - 6	39	0	0	0
	7 - 17	59	1.7	2.8×10^{-4}	1.64 - 1.76
	>17	92	6.6	6.7×10^{-4}	6.47 - 6.73

samplings of the households were applied and more than 80% participated. Description of study areas and their sociodemographic profiles has been published elsewhere.[10]

Survey procedures

The survey was conducted between March and April 1991. All the subjects selected were invited to attend the clinic. Neck examination for goiter detection and grading was performed by an experienced endocrinologist in our team. Twenty ml of blood was drawn from subjects aged 7 and above (school children and adults), centrifuged and serum kept frozen at-40°C for biochemical testing. Anthropometric assessment and blood pressure were measured and recorded. Dietary information was gathered using a 24-hour dietary recall and food frequency questionnaire.

Thyroid gland size was classified according to criteria recommended by WHO.[11] Thyroid stimulating hormone (TSH) levels of more than 5 mIU/L were taken as indicative of hypothyroidism.

Thyroxine (T_4) and triiodothyronine (T_3) were measured by radioimmunoassay and TSH by an immunoradiometric assay using reagents from NETRIA (North East Thames Regional Immuno Assays).

Random urine samples were collected from 30 subjects in different locations. Samples of drinking water from various sources such as pipe water, river, gravity feed systems and spring water were also collected. The level of iodine was determined using an ashing method based on the Sandell-Kolthoff reaction.[12]

Statistical Analysis

Statistical analyses were performed using the SAS statistical software release 6.3 (SAS Institute Inc.). In order to compare groups, Chi-square tests and Student's t-tests were used. In both age categories (children and adults), the common factors tested were racial group (Orang Asli), rural location, sex (female), body mass index (BMI) of less than 15 kg/m^2, serum albumin level of more than 4.5 g/L, serum cholesterol level of less than 5 mmol/L and presence of splenomegaly. Specifically for children, the factors tested were age of more than 13 years, energy intake of 1200 calories, protein intake of more than 45 g, carbohydrate intake of more than 200 g and fat intake of more than 25 g per day. For adults, age of less than 40 years, energy intake of 1500 calories, protein intake of more than 50 g,

Table II: Association between goiter and socio-demographic and nutrition factors among children and adults.

	Children		Adults	
	Chi-sq	P	Chi-sq	P
Ethnic	62.6	<0.0001	102.9	<0.0001
Urbanity	40.2	<0.0001	31.5	<0.0001
Age (years)	22.6	<0.0001	7.4	<0.025
Sex	8.3	0.016	34.6	<0.0001
BMI(kg/m²)	3.3	0.19	23.1	<0.0001
Albumin (g/l)	7.2	0.028	2.1	0.354
Cholesterol(mmol/l)	17.8	<0.0001	32.9	<0.0001
Splenomegaly	17.4	<0.0001	21.6	<0.0001
Energy intake (Cal)	1.0	0.59	7.2	0.027
Protein intake (gm)	0.6	0.76	27.3	<0.0001
CHO intake (gm)	1.7	0.43	0.01	0.99
Fat intake (gm)	1.9	0.38	31.8	<0.0001

Chi-sq = chi square, P is significant at 0.05
CHO = Carbohydrate

carbohydrate in take of more than 250 g and fat intake of more than 25 g per day. Criterion of significance was at $P<0.05$.

RESULTS

The prevalence of goiter was higher among the Orang Asli compared to Malays in all types of environment or lifestyles (Table I). In remote rural areas, the difference in prevalence of goiter was 3 times in preschool and school-age children, and twice in adults. No difference was observed between remote rural (Lanai Post) and rural (Betau Post) Orang Asli settlements. However, the prevalence was low among Orang Asli children in an urban settlement (Bukit Lanjan) and Malays in FELDA (Sungai Koyan) and urban village (Kg. Kerinci).

Hypothyroidism (TSH levels of more than 5 mIU/L) was found in 28.4% of Orang Asli compared to 5.3% among Malays. The highest prevalence was observed in Lanai Post of which 40.4% (23/57) of school-age children and 20.5% of adults were suffering from the illness (Fig. 1). Hypothyroidism was found among 28% (21/75) of all children with goiter and 75% of children with visible goiter. In adults, only 16.4% (36/219) of goitrous patients had hypothyroidism and the proportion was also higher in patients with visible goiters (19.7%). Hypothyroidism among non-goitrous subjects was 11.8% (34/287) and 8.8% (43/488).

There was little variability in the levels of T_3 between Orang Asli and Malays. However, there was a significant difference in the median level of thyroxine in children, young adults and elderly between the two ethnic groups. For TSH, a marked significant difference was observed between Orang Asli and Malays at all age groups. Orang Asli had higher TSH levels compared to Malays.

Goiter and hypothyroidism were significantly associated with ethnic type, being more common in Orang Asli (Table II and III). It was also associated with remoteness (rural) of the area. The overall prevalence of goiter in rural areas was 25.4% in children and 35.8% in adults compared to 1.9% and 15.5% respectively in urban areas. Low education, income of less than RM250 per month and light daily activities were also risk factors associated with the occurrence of goiter.

Goiter and hypothyroidism were not associated with BMI in children but were strongly related in adults (Table II and III). Goiter was found in 48.8% of malnourished adults compared to 29.3% in well nourished ones. The prevalence was 22.5% and 10.6% respectively for hypothyroidism.

Nutrient intakes were not associated with goiter in children. However, energy, protein and fat intake were significantly related with occurrence of goiter in adults. Low intake of these nutrients were associated with a high risk of developing goiter (Table II). A high serum albumin was significantly associated with the occurrence of goiter in children but a low serum cholesterol showed a significant relationship with the occurrence of goiter in children as well as in adults (Table II). In terms of food frequency, the study found that frequent consumption of cassava and deficient intake of sea foods and proteins in the diet were significantly associated with goiter (Table IV).

Goiter and hypothyroidism were significantly associated with age and gender. The study found that the prevalence was higher in females compared to males in both children and adults. For goiter, the prevalence was 19.4% vs 14.3% in children and 41.7% vs 20.7% in adults.

Using multiple regression, goiter in children was asso-

Table III: Association between hypothyroidism and socio-demographic and nutrition factors among children and adults.

	Children		Adults	
	Chi-sq	P	Chi-sq	P
Ethnic	62.6	<0.0001	102.9	<0.0001
Age (years)	22.6	<0.0001	7.4	<0.025
Sex	8.3	0.016	34.6	<0.0001
BMI(kg/m²)	3.3	0.19	23.1	<0.0001

Table IV: Association between goiter and frequency of food intake among children and adults.

Food items	Children		Adults	
	Chi-sq	P	Chi-sq	P
cassava	54.8	<0.0001	83.0	<0.0001
squid	23.4	<0.0001	24.7	<0.0001
cockles	22.6	<0.0001	30.6	<0.0001
chicken	14.3	<0.0002	25.5	<0.0001
eggs	37.3	<0.0001	56.8	<0.0001

*for cassava the tested categories were from the most frequent to the least frequent intake.

ciated with the level of thyroid stimulating hormone (TSH) whereas body mass index (BMI), T_3 and T_4 levels were predictors for the presence of goiter among adults. The regression model for predicting the occurrence of goiter in children was GOITER= 0.06 AGE + 0.19 GENDER - 0.45 ETHNIC - 0.11 LOG TSH - 0.02 (F= 31.4, P= 0.0001, r^2= 0.28), whereas in adults GOITER= 4.47 + 0.37 GENDER 0.48 ETHNIC - 0.03 BMI - 0.51 LOG T_3 - 0.76 LOG T_4 (F= 43.1, P= 0.0001, r^2= 0.25).

There were significant differences in the levels of urinary iodine excretion in different areas. The levels of urinary iodine in the remote areas of Lanai Post was 2.9 ± 7.6 µg/dl and Betau Post was 1.9 ± 1.2 µg/dl compared to 5.4 ± 1.7 µg/dl in Hulu Sungai village, 2.9 ± 2.0 µg/dl in FELDA Sungai Koyan and 7.3 ± 3.4 µg/dl in urban areas. The iodine level of drinking water in remote areas was 2.3 µg/dl compared to 2.8 µg/dl in Hulu Sungai village, 4.2 µg/dl in FELDA and 1.5 µg/dl in urban areas.

DISCUSSION

This study found the prevalence of goiter to be higher among Orang Asli aborigines compared to Malays. The prevalence among aborigines increased with age and was highest among females. The findings were similar to that found by Ogihara in Sarawak.[13] The prevalence was maximal between the age groups 7-12 and 13-17 years old. This corresponded to maximum secretion of TSH and thyroid gland growth.[14] The highest prevalence rates were in the interior aborigine settlements and Malay traditional village; the prevalence decreased as the level of social development increased. Similar findings were observed in other studies.[15,16] This also correlated well with the urinary iodine levels. In most areas endemic goiter, insufficient intake of iodine through food and drinking water has been shown to play a part and most of these areas were iodine deficient areas.[2,7] In the present study, the aboriginal settlements of Lanai Post and Betau Post had moderate endemic goiter (prevalence of goiter 20-50% with urinary iodine levels of 2.0-5.0 µg/dl) whereas the traditional Malay village had mild endemic goiter (prevalence of goiter 10-30% and urinary iodine levels of 5.0-10.0 µg/dl). Thus, the prevalence of goiter is in inverse ratio to the urinary iodine. Changes in prevalence had been shown in some communities to be due to an increase in the dietary iodine intake through improved social and economic conditions even before any iodine prophylaxis had been started.[2] This was supported in the present study. Even though the iodine level in drinking water was low in the city, there was no endemic goiter (even among aborigines living near the city), probably because town dwellers have access to manufactured and processed foods and an iodine rich diet such as sea foods whereas the rural people depend entirely on local products.

There was no association between malnutrition and goiter among preschool children and children 7-17 years old. Among school children, age, gender, ethnic type and TSH levels were predictors for the occurrence of goiter after controlling the other factors. Goiter is a consequence of excessive TSH secretion and the effect of TSH being reinforced at the level of thyroid cells by the depletion of thyroidal iodine stores.[11,17,18] However, among adults, apart from gender, ethnic type, and BMI, levels of T_3 and T_4 were significantly associated with goiter. Intake of energy, protein and fat was also associated with goiter in adults. TSH levels were not associated with goiter prevalence in adults. In adults, the chronic state of iodine deficiency leads to functional alterations due to thyroid hyperplasia.[19] The level of circulating TSH is enhanced and the thyroidal iodine stores are progressively depleted. The body maintains homeostasis by adaptive mechanisms, synthesizing and secreting T_3 at the expense of T_4.[20,21,22] Serum T_3 and T_4 levels were also influenced by malnutrition. In chronic malnutrition, the thyroid gland is not responsive to TSH stimulation.[23] In this study, chronic iodine deficiency and malnutrition were both affecting the size of the thyroid gland and the synthesis of thyroid hormones.

The prevalence of hypothyroidism (TSH of more than 5 mIU/L) was higher among aborigines and corresponded with the prevalence of goiter and urinary iodine levels. However, no cretin patients were found. This finding was also similar to that found by Ogihara in Sarawak.[13] The question is whether aborigines and other indigenous peoples in Malaysia are resistant to cretinism. The distribution patterns of hypothyroidism were similar to that of goiter. Among children, the prevalence was not associated with age, sex, or nutritional status. Among adults, the prevalence of hypothyroidism was higher among males and malnourished subjects. This probably indicated the relative unresponsiveness of the male thyroid gland to TSH stimulation.

This study also found that other important factors may have contributed to endemic goiter. Apart from lack of iodine in drinking water, frequent intake of cassavaroot leaves (a main staple food in rural communities, especially aborigines), less intake of iodine-rich foods such as sea foods, and a low protein diet were various factors significantly contributing to the occurrence of goiter especially in rural areas. Malnutrition and malabsorption may potentiate the deficiency. Iodine intervention may not be effective in this situation because of poor iodine absorption from the gut, inhibition by thiocyanates from cassava, poor thyroid hormone production due to malnutrition, etc. The use of thyroxine as supplement therapy as a short-term measure may be beneficial. The ultimate objective is still to eliminate the condition through integrated primary health care by proper nutrition and elevation of health status.

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