URINARY IODINE EXCRETION IN THE NORTHEAST OF PENINSULAR MALAYSIA

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Abstract. A total of 2,034 subjects aged 15 years and above from different parts of the State of Kelantan were studied to determine goiter size and urinary iodine excretion. The State was divided into 2 areas - area 1 consisting of localities in the districts near the coast and area 2 consisting of localities in the inland districts. There were 1,050 subjects in area 1 and 984 subjects in area 2. The mean age (± SE) of subjects in areas 1 and 2 were 38.2 + 0.5 and 37.1 ± 0.5 years, respectively. The prevalence of goiter was 31.4% in area 1 and 45.0% in area 2; the difference was statistically significant ($p < 0.05$). However, the prevalence of large and visible goiters (grades II and III) was only 2.0% in area 1 and 3.3% in area 2; the difference was not statistically significant. The mean (± SE) urinary iodine excretion in areas 1 and 2 was 57.1 ±2.1 and 56.8 ± 2.1 µg I/g Cr, respectively. The values were below those recommended by WHO. There was no significant difference in urinary iodine excretion between those with and without goiters in both areas and also between the grades of goiters. There were significantly more females with goiters than males in both areas but there was no significant difference in the urinary iodine excretion between the 2 sexes. Thus based on urinary iodine excretion, the iodine intake of the population in this area, was suboptimal and this was associated with a high prevalence of goiter.

INTRODUCTION

Iodine deficiency and goiter is a major health problem in many parts of the world (Stanbury and Hetzel, 1980). Areas well-known to be effected include the mountainous regions of the Andes, Himalayas and the Alps. However, in remote regions of Africa, Asia and South America, where living standards are very low, goiter is also endemic (Ermans, 1986). Iodine supplementation has been implemented in goiter endemic areas in many parts of the world and this has been successful in decreasing the goiter prevalence. Supplementary iodine has been given by adding it to bread, salt, drinking water or by iodized oil injections (Stanbury *et al,* 1974). In Malaysia, there have been a few reported studies on the prevalence of goiter (Polunin, 1951; Maberly and Eastman, 1976; Chen and Lim, 1982; Rozia Hanis *et al,* 1987). Nearly all of the studies have been done in the State of Sarawak, in the island of Borneo where the goiter prevalence was reportedly high - up to 99.5% in one area (Chen and Lim, 1982). Data on urinary iodine excretion was sparse however and hence iodine deficiency remained conjectural as the causative factor. Except for certain parts of Sarawak where iodized salt is made available though not compulsory, there is no organized iodine supplementation program in this country. The present study was undertaken to determine the prevalence of goiter and dietary iodine consumption, as measured by urinary iodine excretion in the State of Kelantan, in the Northeast of Peninsular Malaysia.

MATERIALS AND METHODS

A total of 2,034 subjects aged 15 years and above were selected from different parts of the state of Kelantan. The subjects were from localities randomly selected by the method of cluster sampling from the 10 districts of the State (Fig 1, 2). The localities were grouped into 2 areas - area 1

consisting of localities in the districts near the coast (Tumpat, Kota Bharu, Bachok, Pasir Mas, Tanah Merah, Machang and Pasir Puteh) and area 2 consisting of localities in inland districts (Jeli, Kuala Krai and Gua Musang). Examination of the neck for goiter was done by 1 person only throughout the study using the technique of Perez *et al* (1960). The goiter size was graded as follows : Grade 0 - thyroid gland not palpable; Grade I - thyroid gland not visible but palpable; Grade II - thyroid gland visible and Grade III - thyroid very enlarged, of at least the size of the subject's clenched fist. Spot urine was also collected for determination of urinary iodine excretion.

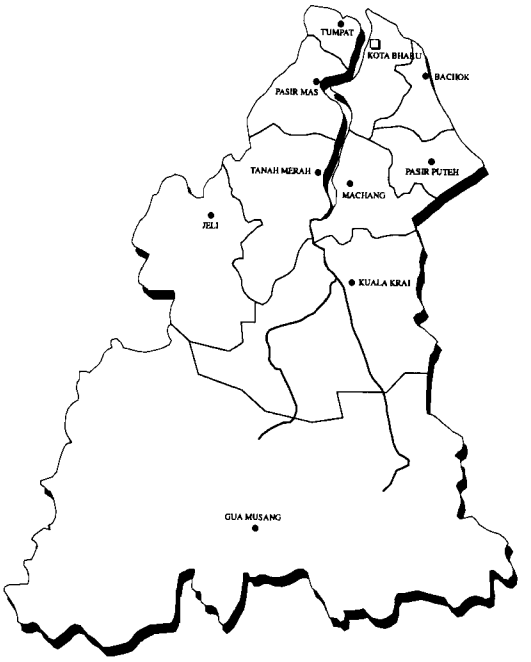

Fig 1–Map of Kelantan showing the 10 districts.

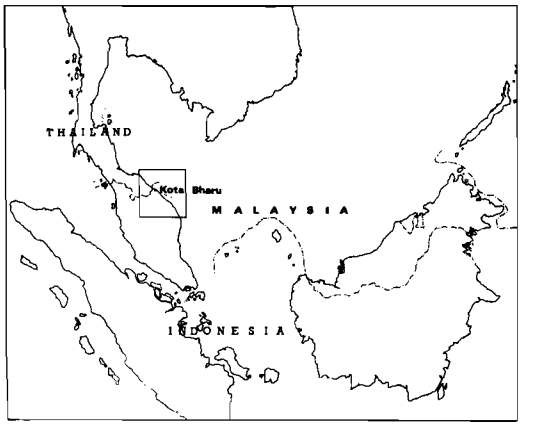

Fig 2–Map of Southeast Asia and Malaysia.

Urinary iodine excretion

Urinary iodine was measured by the ceric-arsenite reaction (Sandell-Kolthoff reaction) using a calorimeter as described by Dunn *et al* (1993) and urine creatinine was measured by picrate reaction using a spectrophotometer by the method of Jaffe with reagents from Boehringer Mannheim, Germany. Urine iodine excretion is expressed as µg I/g Cr.

Statistical analysis

Student's *t*-test and chi-square test were used in the statistical analysis using the SPSS-PC statistical program.

RESULTS

Of the 2,034 subjects, 1,050 were from area 1 and 984 were from area 2 (Table 1). In area 1, there were 330 (31.4%) subjects with goiters and in area 2, the number was 443 (45.0%); the difference was statistically significant ($p < 0.05$). However in both areas, the number of large goiters (grades II and III) was small - 21 (2.0%) in area 1 and 32 (3.2%) in area 2 and the difference was not statistically significant (Table 2). There were more females with goiters than males in both areas. The majority of goiters were small and only 1 male from each of areas 1 and 2 had large goiters (grades II or III) (Table 3, 4). There was no significant difference in the mean urinary iodine excretion between area 1 and area 2 (Table 2). In both areas, there were no significant differences in urinary iodine excretion between those without goiters and those with goiters (Table 2). There were also no significant differences in the urinary iodine excretion between females and males in both areas and also within each area (Table 5).

DISCUSSION

The present study showed that even though the overall prevalence of goiter was high in both the coastal and inland areas, the majority of goiters were small (grade I), and that the prevalence of large goiters (grade II and III) was small. This is in contrast with other reported studies from this country which showed that, in the State of Sarawak, the prevalence

Table 1

Mean (± SE) age and number of males and females in both areas.

Area	Mean age (years)	No. of males	No. of females
1 (n = 1,050)	38.2 ± 0.5	397	653
2 (n = 984)	27.1 ± 0.5	388	596

Table 2

Mean (± SE) urinary iodine excretion (in mg I/g Cr) and goiter prevalence in both areas.

Goiter grade area	O	I	II + III	overall
1	58.1 ± 0.5	52.5 ± 3.5	89.4 ± 20.0	57.1 ± 2.1
	(n = 720)	(n = 309)	(n = 21)	(n = 1,050)
	(68.6%)	(29.4%)	(2.0%)	(100%)
2	56.0 ± 2.9	58.0 ± 3.3	55.4 ± 10.1	56.8 ± 2.1
	(n = 541)	(n = 411)	(n = 32)	(n = 984)
	(55.0%)	(41.8%)	(3.2%)	(100%)

Table 3

Mean (± SE) age and goiter prevalence in females in both areas.

Area	Mean age (years)	Goiter grade				Total
		O	I	II	III	
1	37.8 ± 0.7	407	226	13	7	653
		(62.3%)	(34.6%)	(2.0%)	(1.1%)	(100%)
2	36.0 ± 0.6	268	297	21.0	10	596
		(45.0%)	(49.8%)	(3.5%)	(1.7%)	(100%)

Table 4

Mean (± SE) age and goiter prevalence in males in both areas.

Area	Mean age (years)	Goiter grade				Total
		O	I	II	III	
1	39.0 ± 0.9	313	83	1	0	397
		(78.8%)	(20.9%)	(0.3%)	(0%)	(100%)
2	38.6 ± 0.8	273	114	1	0	388
		(70.4%)	(29.4%)	(0.2%)	(0%)	(100%)

of goiter was up to 99.5% in one area (Maberly and Eastman, 1976) and in another study, it was 75.6% (Chen and Lim, 1982). However this State is in the island of Borneo where it is less well developed socio-economically and the areas surveyed in the above 2 studies were not easily assessible by land. Furthermore, the studies were done more than 10 years ago. In another State, Kedah, which is in Peninsular Malaysia and adjacent to the state of Kelantan, a study conducted in the early 1980s showed that the overall prevalence of goiter was 35.1% (Rozia Hanis *et al,* 1987) and the prevalence was higher in the inland villages. This is comparable to our overall figure of 38.0%. However,

Table 5

Mean (± SE) urinary iodine excretion (in mg I/g Cr) in females and males in both areas.

Area	Females	Males
1	60.0 ± 2.8 (n = 653)	52.3 ± 2.8 (n = 397)
2	54.5 ± 2.3 (n = 596)	60.5 ± 4.2 (n = 388)

their large and visible goiter prevalence was 22.0% whilst in this study it was 2.6%. In none of these studies were urinary iodine measurements made. However, the most likely cause of goiter put forward in these studies was lack of dietary iodine, because the prevalence was highest in inland areas where accessibility was poor and availability of iodine-rich seafoods was poor. Also suggested was the leaching of iodine from soil because of heavy rainfall (Maberly and Eastman, 1976). In this study, the urinary iodine excretion was comparable in both coastal and inland areas. This suggests that the dietary iodine intake is also comparable between the 2 different areas.

The infrastructure of the State of Kelantan is relatively well-developed with all the inland areas accessible by road or rail. The difference in the prevalence of large and visible goiters between the States of Kedah and Kelantan is more difficult to explain except perhaps the fact the study done in Kedah was conducted nearly 10 years ago, since then the basic infrastructure and socio-economic status of the overall population in this country has improved considerably. This could have led to greater accessibilty and easier availability of iodine-rich foods. Other causes of goiters, other than iodine lack, such as high cassava consumption, polluted drinking water and bacterial contamination of drinking water (Ermans, 1986) could play a part and need to be looked into.

There was no significant difference in the prevalence of large goiters (grades II and III) between the inland and coastal areas, but there were significantly more grade I goiters in the inland than in the coastal region. Distinction between grades O and I goiters is often difficult, but between grades I and II or III is easier. Gutekunst *et al* (1986) also found that thyroid volumes determined sonographically overlap widely with volume estimated by palpation, especially grades O and I.

The mean urinary iodine excretion rates of 56.8 and 57.1 μg I/g Cr in the inland and coastal areas, respectively, were comparable to those obtained in parts of other countries where goiter is still a problem such as Germany 83.7 μg I/g Cr (Gutekunst *et al*, 1988), Denmark 58.8 μg I/g Cr (Haas *et al*, 1988) and Italy 60.0 μg I/g Cr (Iodice *et al*, 1992). The values, though not severely low, were still below the iodine intake recommended by WHO, with an optimum of 150 - 300 μg iodine daily (Dunn and Medeiros-Neto, 1988).

There was no difference in the urinary iodine excretion between those with and those without goiters. Gutekunst *et al* (1986) in their study also found that there was no relationship between thyroid volume, as judged by sonography, and iodine excretion. They postulated that as the iodine excretion in their subjects was very close to the minimum daily excretion, as in our study, it would be difficult to distinguish those who were at risk of developing goiters from those that did not have goiters based on iodine excretion alone.

In conclusion, the dietary iodine intake seemed comparable between coastal and inland areas of Kelantan. The prevalence of goiter was still high, and the iodine intake, as assessed by urinary iodine excretion was still suboptimal.

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