Introduction

Iodine deficiency disorders (IDD) include a spectrum of disorders that occur due to insufficient intake of iodine. In 1994, the worldwide prevalence of IDD (defined as those people living in areas with iodine deficiency and a total goitre rate above 5%) indicated a problem in 118 countries, affecting 1572 million people. Of the world’s population, 655 million, or 12%, were affected by goitre, 11.2 million were affected by cretinism, and 43 million were affected by some degree of mental impairment.1

There are no national prevalence data for IDD in Malaysia. Various small studies have been conducted, indicating a high prevalence of goitre ranging from 45 to 93% in East Malaysia2 and a prevalence ranging from 19.6 to 45% in Peninsular Malaysia.3-7 A higher prevalence (Table 1) has been found in remote and rural areas and urinary iodine levels have also indicated that populations in inland areas are more iodine deficient. To date, IDD has been considered to be a public health problem in East Malaysia, but not in Peninsular Malaysia.

Women of childbearing age are particularly vulnerable to inadequate dietary intake. Iodine deficiency disorders may have severe consequences on the woman and/or child. In a woman of childbearing age iodine deficiency is commonly manifested as goitre. However, the most serious consequences may occur when a woman has insufficient intake in pregnancy, which may result in her child being born a cretin.1,8

The aim of this study was to determine the prevalence of IDD and associated factors in women of childbearing age. The study was conducted in a small Orang Asli (indigenous Malay) community, 46 km south-east of Kuala Lumpur, Malaysia. Women without children or who were not pregnant with their first child were excluded. Of the 45 women eligible, four women did not participate as they were absent from the village for the duration of the study. Thyroid palpation and urinary iodine level were used to determine the prevalence of IDD. The consumption of foods rich in iodine was determined using a food frequency questionnaire. The study population had a high prevalence (32.4%) of goitre and a very low median urinary iodine level (14.5 ± 11.5 µg/L, n = 34). This corresponds to ‘severe iodine deficiency’ according to World Health Organization classifications. Freshwater fish was the most frequently consumed iodine source. Cassava, which is considered goitrogenic due to its thiocyanate content, was a staple food and was consumed daily by 43% of the participants. Most staple foods were locally produced. Women with goitre had significantly lower protein and energy intakes than did those without. The IDD prevalence found in this study was similar to the prevalence reported in remote Malaysian communities. Possible factors contributing to IDD in various other studies were dependence on locally produced foods from potentially iodine deficient soils, frequent consumption of cassava, and low intake of seafood. Although this Orang Asli community was close to Kuala Lumpur and not remote, these factors were reflected in the current study. This implies that ‘pockets’ of IDD in Peninsular Malaysia may be more widespread than previously thought and highlights the need for further investigation of IDD in Peninsular Malaysia.

Key words: iodine deficiency disorders (IDD), Orang Asli, micronutrients, Malaysia, dietary intake.
Asli have traditionally led a lifestyle of hunting and gathering food from the jungle. Iodine deficiency disorder studies in Orang Asli communities (target groups have ranged from 7 years of age and over) in Peninsular Malaysia have indicated a high palpable goitre prevalence (26–45%), varying with location. The highest prevalence (Table 1) has been found in remote and rural villages.5,7

Methods
A cross-sectional study was conducted from December 1998 to January 1999 in an Orang Asli village, 46 km from Kuala Lumpur. The village is located on hilly land and backs onto the jungle; however, villagers have access to a town 20 km away via a sealed road. The community was relocated to its present site 18 years ago to make way for the construction of a dam.

Subjects
The village under study was included as part of a larger intervention study (sponsored by Intensification of Research in Priority Areas (IRPA) grants) that aimed to increase human iodine intake by enriching animal feeds and to evaluate the effectiveness of this supplementation. Universal sampling of women of childbearing age was used. However, women without children or who were not pregnant with their first child were excluded. Of the 45 women eligible, 41 women participated in some or all aspects of the study. The four who did not participate were absent from the village for the duration of the study.

Permission was given by the Batin (head man of the village) and assumed of individuals when they accepted the invitation to participate. Participants were assured of confidentiality.

Data collection
The prevalence of goitre was determined by palpation by three doctors from the Hospital Universiti Kebangsaan Malaysia (HUKM) using a standard World Health Organization (WHO) protocol.10 Classifications used were as follows: grade 0, no palpable or visible goitre; grade 1, goitre is palpable but not visible and it moves upward in the neck as the subject swallows; and grade 2, goitre is visible when the neck

| Table 1. Summary of iodine deficiency disorder (IDD) studies conducted in Peninsular Malaysia |
|-----------------------------------------------|-----------------------------------------------|
| Ref., Population group (location, ethnicity, age group) | Sampling method | Objective | Palpable goitre prevalence | Mean urinary iodine level | Conclusions |
| 3 | Kedah and Pahang (inland areas), Selangor (coastal area): Orang Asli, 18 years and older | n = 636, cluster sampling | To assess prevalence of goitre among Orang Asli communities living in a few selected areas | Inland, 30–44.7% Coastal, 6.0% | Not measured | Inland prevalence higher |
| 4 | Kelantan: general population, 15 years and older | n = 2034, cluster sampling | To determine prevalence of goitre in Kelantan | Inland, 45.0% Coastal, 31.4% | Inland, 56.8 µg/l/lg Coatal, 57.1 µg/l/lg creatinine | Measured urinary creatinine, not comparable to other studies |
| 5 | Kedah (inland area): One Orang Asli village (n = 63), two Malay villages (n = 299); Selangor (coastal area): Two Orang Asli villages (n = 67), one Malay village (n = 60), age not reported | n = 489, cluster sampling | To determine and compare prevalence of goitre in remote inland areas and coastal areas | Inland, 30.7% Orang Asli, 30.2% Malay, 30.8% Coastal, 6.3% Orang Asli, 6.0%, Malay, 6.7% | Inland, 17.9 µg/L Coastal, 20.4 µg/L | No difference between ethnic groups. Inland prevalence higher |
| 6 | Six villages in Pahang: Two Orang Asli (n = 58), four Malay (n = 151), one Malay village in Kuala Lumpur (n = 32); ages examined: less than 11 years (n = 16), adolescents (n = 20), adults (n = 55), elderly (n = 118) | n = 244, cluster sampling | To determine urinary iodine levels among Orang Asli and ethnic Malays in remote areas of Malaysia and to compare the same two ethnic groups living in Kuala Lumpur | Did not measure Remote, ranged from 15 to 38 µg/L (all villages in Pahang). Orang Asli, 24.0 µg/L, Malay, 43.0 µg/L (excluding Kuala Lumpur village) Kuala Lumpur, 77.0 µg/L | Orang Asli communities had a significantly lower urinary iodine levels than did Malay communities. Inland areas had significantly lower urinary iodine levels |
| 7 | One Malay and one Orang Asli village, 40 km from Kuala Lumpur, 7 years and older | 50 individuals selected randomly from each village | To assess prevalence of goitre among Orang Asli, living near Kuala Lumpur and compare to Malays living closely together with them | Orang Asli, 26.5% Malays, 19.6% | Did not measure | Slight difference between ethnic groups |
is in normal position. Urine samples were analysed for iodine content by a HUKM technician using the Sandell-Kolthoff reaction after applying the alkaline ashing method.

Demographic and dietary information was collected using pretested questionnaires administered by trained translators. The demographic questionnaire included questions related to personal information, maternal characteristics and food beliefs.

Dietary data were collected with a food frequency questionnaire. The food list was compiled as follows. Firstly, a list of food consumed by all of the women was obtained via multiple 24-h recalls. Following this, foods regarded as high in iodine content were identified through reference to standard nutrition textbooks and included in the food frequency questionnaire. Frequency of consumption (daily, weekly, monthly, yearly) and size of typical serve were recorded. Typical serving size was determined using standard household measures (cups, bowls, spoons). Dietary intakes were calculated using Malaysian Recommended Daily Allowances (RDA). Anthropometric measurements (weight and height) were recorded twice, using methods as outlined by Gibson.

Table 2. Frequency of consumption of iodine-containing foods by mothers in an Orang Asli community 46 km from Kuala Lumpur (n = 35)

<table>
<thead>
<tr>
<th>Food</th>
<th>1–2 times/day</th>
<th>4–6 times/week</th>
<th>1–3 times/week</th>
<th>1–3 times/month</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater fish</td>
<td>18 (52%)</td>
<td>1 (3%)</td>
<td>14 (39%)</td>
<td>2 (6%)</td>
<td>–</td>
</tr>
<tr>
<td>Sardines</td>
<td>2 (6%)</td>
<td>1 (3%)</td>
<td>22 (63%)</td>
<td>6 (17%)</td>
<td>4 (11%)</td>
</tr>
<tr>
<td>Seafood</td>
<td>–</td>
<td>1 (3%)</td>
<td>22 (63%)</td>
<td>9 (25.5%)</td>
<td>3 (8.5%)</td>
</tr>
<tr>
<td>Freshwater prawns</td>
<td>–</td>
<td>–</td>
<td>10 (28%)</td>
<td>16 (46%)</td>
<td>9 (26%)</td>
</tr>
<tr>
<td>Cockles</td>
<td>–</td>
<td>–</td>
<td>13 (37%)</td>
<td>11 (32%)</td>
<td>11 (31%)</td>
</tr>
</tbody>
</table>

The women obtained food from the following sources: their own home gardens, the jungle, the travelling fishmonger, the market, and two nearby shops. Iodine-containing food identified included seafish, freshwater fish, sardines, freshwater prawns, and cockles. Freshwater fish (usually reported as Tilapia) was the most common iodine source and was consumed by 51% of respondents once or twice daily. This was usually obtained free by fishing in the surrounding area, or occasionally from the local stores or fishmonger. Seafood is the best natural iodine source; 63% of the women reported consuming seafood one to three times per week. Frequency of consumption of iodine-containing foods is recorded in Table 2. Most food was fried in oil or boiled.

Cassava, which is considered goitrogenic due to its thiocyanate content, was consumed by all participants. The shoot was consumed by 43% of the women daily. Cassava root was consumed by 63% of the respondents one to two times per week.

A comparison of characteristics between women with and without goitre is presented in Table 3. Women with goitre had significantly lower protein and energy intakes than did those without the condition. Women with goitre also had lower monthly incomes and monthly food expenditures, although these differences were not statistically significant.

No differences were observed in mean age, mean cassava intake, or mean BMI.

Discussion

According to WHO criteria, our study population with a median urinary iodine level of 14.5 µg/L had a severe public health IDD problem. The mean urinary iodine level of the women, 16.2 µg/L ± 11.5, was similar to levels found in inland communities in Kedah, 17.9 µg/L, and in remote villages in Pahang, 15–38 µg/L. The goitre prevalence (32.4%) found in the women studied was also similar to the prevalence found in inland communities in Kedah, 30.7%, and in Pahang, 30–44.7%. These studies were all conducted in Orang Asli communities, and some also included Malay communities. Differences between ethnic groups were observed in one study in which the overall mean urinary iodine level for all Orang Asli communities studied was significantly lower than the level for all Malay communities studied (excluding the community in Kuala Lumpur). Although the community under study was not remote, the IDD prevalence was similar to the prevalence reported in remote communities.

Previous studies of Malaysian and Orang Asli communities have identified possible factors contributing to IDD as dependence on locally produced foods from potentially iodine-deficient soils, frequent consumption of cassava, and...
A low intake of seafood. These factors were also reflected in this study.

In previous studies, communities were also remote or isolated and had little access to iodine-rich foods such as seafood. Although the present community is largely reliant on locally produced food, it is neither remote nor isolated. The women in our study reported consuming a staple diet of freshwater fish, cassava, rice and green leafy vegetables. All but rice were locally produced.

Freshwater fish (reported to be Tilapia) was free and was the most frequently consumed iodine source. However, seafood, that generally contains higher amounts of iodine than freshwater fish, was consumed less often, was harder to access and was more costly than other iodine sources. Although the women consumed salt, iodized salt is not commonly available in Peninsular Malaysia.

Cooking methods may deplete dietary iodine intake further. Boiling has been estimated to decrease iodine content in fish by half, and approximately one–fifth may be lost by frying or grilling. On this basis, iodine loss from frying and grilling fish, as our study population reported doing, would also decrease dietary intake.

Other studies of iodine deficiency have indicated the possible interference of possible iodine absorption by goitrogenic food. It has been suggested that goitrogen-consuming communities have even greater iodine requirements, with the daily population requirement doubling from 150 to 300 µg. Cassava was a staple food for this study group, and was obtained from home gardens and the jungle at no cost. It should be noted that thiocyanate levels vary in cassava and that not all cassava is goitrogenic due to genetic and/or environmental factors. The cassava consumed by participants may have exacerbated any iodine deficiency; however, the extent of the exacerbation is not known.

Soaking of cassava root for 1 day has been shown to reduce the thiocyanate content; however, this was not a common method of cassava preparation in the community under study.

Few differences were found between women with goitre and those without. Women with goitre had lower mean protein and energy intakes: this may have been due to lower monthly incomes and food expenditures but these differences were not statistically significant.

As the women were the main food preparers, it might be assumed that the dietary patterns of their family members would be similar, indicating that the whole community may be at risk of severe iodine deficiency. Thus, other communities with dependence on locally produced food sources potentially low in iodine due to environmental conditions, regardless of remoteness, may also be at risk.

**Conclusion**

The iodine deficiency problem found in these women was ‘severe’, and this probably extends to the rest of the village. Possible contributing factors found in this and other Malaysian studies are similar: dependence on locally produced food that may be low in iodine, and frequent consumption of cassava. Other Malaysian studies mention low consumption of seafood as a possible contributing factor. The women in the current study reported eating seafood, but it was consumed with much lower frequency than was freshwater fish. Although this Orang Asli community was not remote, the IDD prevalence was similar to remote communities reported in earlier studies. This implies that ‘pockets’ of IDD in peninsular Malaysia may be more widespread than was previously thought and highlights the need for investigation of other communities with similar characteristics.

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**References**