1.1.4. Micronutrient Deficiencies

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1.1.4.1. Anaemia

a. Anaemia in Malaysian children

Documentation of anaemia amongst Malaysian children was available from around the 1950's. The study reported by Bourne (1949) immediately after the Japanese occupation of Malaya was probably one of the earliest large scale nutrition surveys in the country. The survey included haemoglobin determinations of various groups of children. In the group of some 1,200 children from welfare centres, orphanages and a refugee camp, the prevalence of anaemia (Hb <70% of Tallqvist scale) was found to be high, ranging from 42 to 90%. The prevalence of anaemia among some 10,000 school children studied was lower, ranging from 40 to 63%. Although the socio-economic status of some of these children was better than that of the first group of children, their haemoglobin status was found to be poor.

Two studies in the 1960's highlighted the anaemia problem amongst children. The ICNND (1964) study of some 260 children of civilian and military dependents reported that 36% of children less than 5 years of age and 13% in the age group 5-14 years were anaemic (Hb <12 g/dl). The study of Chappel and Janowitz (1965) of 142 rural Malay children in a land development scheme reported that the prevalence of anaemia (Hb <10 g/dl) was highest amongst the younger children less than 6 years-old (ranging from 30 to 70%) and appeared to be highest for the 1-2 years-old group. In both studies, dietary iron deficiency was thought to be an important causative factor.

A relatively large-scale hospital-based study in the 1960's was that by Lie-Injo and Virik (1966). Anaemia was studied in 2,025 children admitted to the children's ward of the General Hospital, Kuala Lumpur. Results presented showed that the lowest haemoglobin levels occurred in children aged 6-36 months and that 13% of the children had very low haemoglobin levels of 8 g/dl or less.

Anaemia amongst children continued to be given emphasis in the 1970's. Studies by Chong and co-workers (Chong, 1970; Chong 1974; Chong *et al.*, 1972) revealed that rural children in Ulu Terengganu in the East Coast state of Terengganu had the highest prevalence of anaemia (based on haematocrit values of <32%), compared with children from the ANP pilot area of Telok Datok and a group of army children.

In the study reported by Amir Abbas (1973), a total of 425 pre-school children (aged between 6 months to 7 years) in Kampung Selisek, Ulu Selangor district were examined. The percentage of anaemic pre-school children in all the villages studied ranged from about 50% to 70%, with a mean prevalence rate of 62.1% (Hb <11.5 g/dl).

The studies of Kandiah and co-workers (Kandiah, 1977; Kandiah and Lim, 1976, 1977) of some 1,000 children in two Malay rural communities and an Indian estate population provided further data on the anaemia situation (Table 1.5). Prevalence of anaemia (Hb <11 g/dl for pre-school children and <12 g/dl for school children) was higher amongst pre-school (range 23 to 51%) than school children (range 10 to 37%), and the problem was worst amongst Indian children in the rubber estate. Most of the anaemic cases were thought to be due to iron deficiency.

Table 1.5
Prevalence of Anaemia Amongst Children in Two Malay Communities and an Indian Estate Population

	Pre-school children	school children	
Rural Malays, Ulu Jempol, Negri Sembilan (Kandiah & Lim, 1976)			
n	72 (1-6 yrs)	486 (7-14 yrs)	70 (15-19 yrs)
% anaemic	51.0	18.6	10.0
Malays, SLDA* Scheme, Ulu Rening, Selangor (Kandiah, 1977)			
n	39 (1-6 yrs)	73 (7-17 yrs)	
% anaemic	23.1	11.0	
Indians, rubber estate, Selangor (Kandiah & Lim, 1977)			
n	57 (0-7 yrs)	247 (8-18 yrs)	
% anaemic	47.4	37.2	

*SLDA = State Land Development Authority
Criteria for anaemia:
pre-school children, Hb < 11.0 g/dl
school children, Hb < 12.0 g/dl

Several studies by A.J.U. Anderson on over 3,000 children of various communities in Sarawak are of significance (Anderson, 1976a, 1976b, 1977a, 1977b, 1978a, 1978b). The anaemia problem amongst the various ethnic groups was generally of the same order of magnitude (Table 1.6). The highest prevalence of anaemia (Hb <11.0 g/dl for children 0 to 11 months and Hb <12 g/dl for children 6 to 8 years), and ranging from 30 to 60%, was observed for the the first two years of life, for all the communities studied. This was thought to be due to inadequate supplementary feeding and poor weaning practices, with lack of iron, protein and other nutrients. Intestinal helminths were said to be a contributory causal factor in the anaemias encountered.

Table 1.6
Prevalence of Anaemia Amongst Children of Various Communities in Sarawak

	Age groups									
	6-11 mth	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6 yrs	7 yrs	8 yrs	all ages
Land Dayak Tebakang										
n	-	-	-	-	-	-	-	-	667	
% anaemic	-	-	-	-	-	-	-	-	27.7	
Iban Middle Mukah River										
n	51*	64	59	66	64	69	70	51	51	545
% anaemic	31.3	35.9	33.8	12.1	10.9	7.2	20.0	13.7	3.9	18.7
Iban, Lemanak River										
n	32	59	61	51	51	53	54	58	59	487
mean Hb, g/dl	10.6	10.3	11.2	11.4	11.5	11.8	12.0	12.0	12.0	11.5
% anaemic	59.4	57.6	23.0	21.6	27.5	11.3	51.9	39.7	32.2	35.1
Iban Sut and Mujong River										
n	24	67	67	68	58	55	46	47	41	473
mean Hb, g/dl	10.2	10.4	11.6	11.9	12.0	12.2	12.3	12.0	12.2	11.7
% anaemic	50.0	58.2	26.9	14.7	15.5	7.3	28.3	44.7	36.6	29.8
Malays, Srk River Delta										
n	32	44	43	48	41	48	68	68	87	479
% anaemic	40.6	52.3	23.3	29.3	19.5	16.7	50.0	36.8	32.2	34.0
Penan Gunong Mulu										
n	24	67	67	68	58	55	46	47	41	473
mean Hb g/dl	10.2	10.4	11.6	11.9	12.0	12.2	12.3	12.0	12.2	11.7
% anaemic	50.0	58.2	26.9	14.7	15.5	7.3	28.3	44.7	36.6	29.8

* = 0-11 months
Criteria for anaemia:
6 mths - 5 yrs, Hb < 11.0 g/dl
6 yrs - 8 yrs, Hb < 12.0 g/dl
(Sources: Anderson 1976a, 1976b, 1977a, 1977b, 1978a, 1978b)

Prevalence of anaemia (based on Hb <11 g/dl for children 6 months to 6 years and Hb <12 g/dl for children 6 to 14 years) was reported by Chen *et al.* (1981) for over 3,000 children below 13 years of age of various ethnic groups in the Interior, West Coast and Kudat Divisions of Sabah (Table 1.7). Prevalence rates ranged from 15 to 30%, with children below 2 years the worst affected. There was no clear trend of sex difference in the prevalence rate of anaemia.

Table 1.7
Prevalence of Anaemia Amongst Children of Various Ethnic Groups in the Interior, West Coast and Kudat Divisions, Sabah

	% anaemic		
age (years)	male	female	combined
0.5- 2	34.5	27.4	30.9
2- 4	14.8	26.4	20.2
4- 6	32.4	19.1	25.0
6- 8	28.1	31.7	29.8
8-10	29.6	27.4	28.5
10-12	22.8	23.3	23.0
12-13	17.6	13.5	15.8
0.5-13	26.4	25.6	26.0

Study population: 0- 4 yrs = 28
5-12 yrs = 2877
total n = 3672

Criteria for anaemia: 6 mths - 6 yrs, Hb < 11.0 g/dl
6 yrs - 14 yrs, Hb < 12.0 g/dl

(Source: Chen *et al.*, 1981)

Several studies on various Malay rural poor communities in different states of Peninsular Malaysia, carried out from 1979 to 1983, were reported by Chong and co-workers. This series of systematic studies covered close to 2,000 children below 12 years, and provided significant understanding of the anaemia problem in the country in the 1980's. The anaemias encountered were said to be primarily due to iron deficiency. Prevalence rates varied widely in the different areas and amongst children of different age groups (Table 1.8) (criteria for anaemia given below table). Children in Baling appeared to be worst affected, with prevalence rates ranging from 37 to 83%.

Table 1.8
Selected Data on the Prevalence of Anaemia Amongst Rural Poor Malay Children

Communities studied	Infants	Pre-school children	Primary school child	
Kuala Terengganu, Terengganu				
(Chong, 1974)				
n	-	399		-
% anaemic:				
Hb < 11.0 g/dl	-	23		-
PCV < 33%	-	9		-
Kota Bharu, Kelantan				
(Chong *et al.*, 1979)				
n	-	64		174
% anaemic	-	33		73 (boys) 56 (girls)
Mersing, Johore				
(Chong *et al.*, 1981)				
n	-	123		146
Hb, mean ± SD, g/dl	-	12.3 ± 1.5		13.3 ± 1.4
% anaemic	-	16		16
Baling, Kedah				
(Chong *et al.*, 1982)				
n	30	243	122 (boys)	120 (girls)
Hb, mean ± SD, g/dl	10.3 ± 1.3	11.2 ± 1.4	11.9 ± 1.8	12.5 ± 1.6
% anaemic	83	41	45	37
MCHC, mean ± SD, %	32.9 ± 5.5	30.8 ± 3.2	31.5 ± 3.8	31.9 ± 3.1
% anaemic	36	53	40	38
Perak Tengah, Perak				
(Chong *et al.*, 1983)				
n	24	187		283
Hb, mean ± SD, g/dl	10.9 ± 1.1	11.4 ± 1.7		12.6 + 1.5
% anaemic	12	32		27

Criteria for anaemia: < 6 yrs, Hb < 11 g/dl
6-14 yrs, Hb < 12 g/dl
and MCHC < 31%

Another recent study was a survey of children 0-6 years in three malaria endemic villages of Bengkoka Peninsula, Sabah (Kandiah *et al.*, 1984). It was noted that anaemia was observed as early as infancy and amongst the very young children (Table 1.9). Based on haemoglobin levels of less than 11 g/dl, 18 to 67% of the children were said to be anaemic, with the highest prevalence rates observed for children under two years of age. The anaemia encountered was said to be related to iron deficiency, whilst malaria, estimated to affect 24% of the children, was also believed to play a role.

Table 1.9
Anaemia Amongst Pre-school Children in Three Malaria Endemic Villages of Bengkoka Peninsula, Sabah

Age groups (months)	Haemoglobin		MCHC		PCV
	mean ± SD (g/dl)	% children <11 g/dl	mean ± SD (%)	% children < 11%	mean ± SD (%)
< 12	10.7 ± 1.6	67	31 ± 2.7	50	36 ± 2.3
12-23	10.5 ± 1.9	53	30 ± 2.7	67	36 ± 2.3
24-35	11.1 ± 1.3	36	32 ± 2.1	55	36 ± 3.1
36-47	11.4 ± 0.8	53	31 ± 1.7	50	36 ± 1.2
48-59	11.4 ± 1.6	38	32 ± 2.5	31	36 ± 3.2
60-72	11.8 ± 0.9	18	33 ± 2.4	22	37 ± 1.9
all ages (n=90)	11.1 ± 1.5	44	31 ± 2.7	48	36 ± 2.9

(Source: Kandiah *et al.*, 1984)

These studies reviewed have shown that the anaemia problem among children has been highlighted for the past three decades, and there appeared to be only a slight decrease in the magnitude of the problem. There was a mild to moderate prevalence of anaemia amongst children in the communities studied, ranging from 10 to 50%, with most areas having 20-30% prevalence rate. The situation in Peninsular Malaysia is no better than those in Sarawak and Sabah. Anaemia was said by various investigators to be mostly of the iron deficiency type. Some research groups noted a higher prevalence amongst the 12-36 month old children.

b. *Anaemia and Pregnancy in Malaysia*

Early investigators in the country had recognized that anaemia was a major cause of maternal mortality, especially during pregnancy. Several early reports had emphasized the importance of nutrient deficiencies in the causation of anaemia and that pregnancy aggravated the condition (Corke and Bush, 1940; Pallister, 1934; Reed, 1940). Tasker *et al.* (1956) pointed out that the incidence of anaemia amongst pregnant women was high and that they appeared to be the most susceptible group of the population. Anaemia was said to be one of the main complications of pregnancy (Tasker, 1956, 1958).

Early detailed studies of the anaemia problem amongst ante-natal subjects in the General Hospital, Kuala Lumpur were reported by Tasker *et al.* (1956) and Tasker (1958). Several aspects were described, such as the prevalence of anaemia in pregnancy, its management and its effects (fetal loss and prematurity) on pregnancy outcome. Tasker had emphasized that iron deficiency was almost invariably present in patients with nutritional anaemia. Besides this basic deficiency, additional types of anaemia were detected, of which that associated with a megaloblastic marrow was said to be the most important and common.

Greater emphasis on the problem of anaemia during pregnancy was given in the 1960's. Lourdenadin (1964) summarised the prevalence of severe anaemia as seen in the Maternity Hospital, Kuala Lumpur in a retrospective study for the period 1957-1961. From close to 47,000 deliveries, the incidence of severe anaemia (Hb <6.5 g/dl) was reported to be 2.2%. It was observed that microcytic anaemia, said to be caused by "defective nutrition and iron deficiency", formed about 76% of the total number of anaemic patients. The remaining was mostly macrocytic anaemia, with folic acid and vitamin B_{12} deficiencies implicated. In the same report (Lourdenadin, 1964), the results of a prospective study of the haemoglobin levels of a thousand consecutive pregnant women attending the ante-natal clinic of the Hospital were also reported. A total of 76.9% of these women studied were found to be anaemic.

Similar figures were reported by Llewellyn-Jones (1965) for the same hospital, but for a longer time period, between 1953 and 1962. A total of 73,048 women were seen at the Maternity Hospital during the period; 3.1% were found to have severe anaemia (Hb <6.5 g/dl) and the majority of cases was of the iron deficient type.

Fewer studies into the nutritional anaemia problem during pregnancy were reported in the 1970's. One such study of importance was reported by Ong (1973) on the haematological status of 278

pregnant Orang Asli women at the Orang Asli Hospital, Gombak, Kuala Lumpur. The results were said to suggest a mild degree of iron deficiency anaemia in the average pregnant Orang Asli women. The better haematological status of the "deep" jungle women compared to the "outside" jungle populations was briefly discussed. It was thought that this difference could be due to migration of the latter group to settle down near villages or towns, which caused changes in their life style, having to earn money to buy food. Due to their low purchasing power, the little amount of money spent on food could result in poor nutrition and anaemia, especially in the pregnant women.

Several studies in the 1980's on anaemia amongst pregnant women at the Maternity Hospital, Kuala Lumpur were recently reported. The first is a study of 96 women who attended the antenatal clinic at the Hospital (George *et al.*, 1980). The results were analysed according to trimesters (Table 1.10). With the progression of pregnancy, there was a fall in haematological parameters. The prevalence of low haematological values increased markedly from the second trimester onwards.

Table 1.10
Haematological Data of 96 Women at Maternity Hospital, Kuala Lumpur

	Hb (g/dl)		MCV (fl)		MCH (pg/l)		MCHC (ng/l)		ferritin (µg/l)	
	mean	%<12	mean	%<77	mean	%<26	mean	%<32	mean	%<12
First trimester	12.9	0	90.2	0	30.8	0	34.0	0	86.6	0
Second trimester	11.4	52	87.4	0	29.6	8	33.0	10	12.6	24
Third trimester	10.9	59	83.0	15.2	28.0	30.9	33.0	11.9	11.3	26

(Source: George *et al.*, 1980)

A smaller series of 19 women in the same Hospital were studied by Jaffar Ali *et al.* (1981). Mean serum iron and transferrin saturation values were extracted and tabulated in Table 1.11. No prevalence rates of low values for these parameters were presented. These authors had determined the corresponding cord blood for the same parameter and investigated the mechanism of transport of iron to the fetus in pregnancy. Table 1.11 also gives the haemoglobin levels of 191 pregnant women at the same Hospital reported by these authors in another study (Jaffar Ali *et al.*, 1982) - that of folate and vitamin B_{12} status discussed in the following paragraph. In this series, 18.7% of women were found to have a haemoglobin level of <10.5 g/dl.

Table 1.11
Serum Iron Parameters and Haemoglobin of Maternal Blood at Parturition

	Iron (µg/dl)*	TIBC (µg/dl)*	Transferrin* saturation (%)	Haemoglobin** (g/dl)
mean	74.0	310.6	26.4	11.4
SD	35.9	108.6	14.5	1.3
range	15.4-142.8	107.7-571.4	5.0-60.0	6.5-14.6
n	19	19	19	191

(Sources: * Jaafar Ali *et al.* 1981
** Jaafar Ali *et al.*, 1982)

The third recent study at the Maternity Hospital, Kuala Lumpur was that of the status of folate and vitamin B_{12} of pregnant women admitted at term at the Hospital (Jaffar Ali *et al.*, 1982). Cord blood was also analysed for the same vitamins. This is one of the few studies on these vitamins in the country. As can be seen from the results summarised in Table 1.12, 58.5 percent of these women could be considered to have low serum folate levels, and 32.4 percent had lowered RBC folate levels. In contrast, none of the women were found to have a low serum vitamin B_{12} value. It was however pointed out that the number of subjects studied for this last parameter was very small. Table 1.12 also shows that the cord blood levels of these vitamins were significantly higher than the corresponding levels in the maternal blood. The authors suggested the possible involvement of an active process in the transfer of folates and vitamin B_{12} to the fetus. This mechanism would ensure adequate supply of these nutrients to the fetus even in maternal deficiency.

Table 1.12
Folate and Vitamin B_{12} of Malaysian Maternal and Cord Blood at Parturition

	maternal blood	cord blood
Serum folate		
mean ± SD, ng/ml	5.0 ± 3.5	19.9 ± 17.4
range, ng/ml	1.0 - 18.5	5.9 - 68.0
% < 5 ng/ml	58.5	not given
n	104	35
RBC folate		
mean ± SD, ng/ml	338.4 ± 227.5	569.6 ± 444.2
range, ng/ml	70.0 - 845.2	91.0 - 1408.9
% < 160 ng/ml	32.4	not given
n	71	7
Serum vitamin B_{12}		
mean ± SD, pg/ml	370.4 ± 114.7	496.6 ± 188.7
range, pg/ml	195.0 - 691.0	351.8 - 975.0
% < 100 pg/ml	0	not given
n	14	9

(Source: Jaafar Ali *et al.*, 1982)

Yet another study at the Maternity Hospital recently concluded in the 1980's (Tee *et al.*, 1984) has shown that there was a moderately high prevalence of anaemia amongst the 309 pregnant women studied, all of whom were from the lower socio-economic strata. As shown in Table 1.13, based on Hb values, 30-60% of the women could be considered anaemic; approximately half of them presented with unsatisfactory serum iron, transferrin saturation and ferritin values; 45-77% had low serum folate levels; and about 30% may be considered to be of poor protein nutriture (cut-off levels given in Table 1.13). Anaemia in the study population was seen to

Table 1.13
Nutritional Anaemia Amongst Pregnant Women in the Maternity Hospital, Kuala Lumpur

Parameters	Ethnic groups			
	Chinese	Malays	Indians	Combined
Hemoglobin				
n	104	109	63	276
mean ± SD (g/dl)	11.48 ± 1.80	11.15 ± 1.51	10.51 ± 1.68	11.13 ± 1.70
% < 11 g/dl	30.8	47.7	58.7	43.8
Packed Cell Volume				
n	104	109	63	276
mean ± SD (%)	36.03 ± 4.58	34.75 ± 4.50	33.67 ± 4.42	34.99 ± 4.60
% < 33%	24.0	31.2	47.6	32.2
Serum Iron				
n	117	121	71	309
mean ± SD (%)	60.18 ± 35.07	48.45 ± 33.53	47.38 ± 38.88	52.65 ± 35.89
% < 50 µg/dl	45.3	60.3	69.0	56.6
Transferrin Saturation				
n	117	121	71	309
mean ± SD (%)	19.45 ± 9.91	15.87 ± 8.44	15.23 ± 8.39	17.08 ± 9.21
% < 15%	38.5	51.2	54.9	47.2
Ferritin				
n	110	103	67	280
mean ± SD (%)	21.86 ± 25.34	11.09 ± 8.80	12.61 ± 15.32	15.69 ± 19.02
% < 12 ng/ml	40.9	61.2	62.7	53.6
Serum Folate				
n	104	101	66	271
mean ± SD (%)	4.70 ± 5.06	3.30 ± 3.83	2.47 ± 2.44	3.64 ± 4.19
median	3.15	2.40	1.60	2.40
% < 3 ng/ml	45.2	66.3	77.3	60.9
Serum Protein				
n	117	121	71	309
mean ± SD (%)	6.03 ± 0.35	6.21 ± 0.43	6.13 ± 0.36	6.12 ± 0.39
% < 6 g/dl	36.5	23.1	25.4	28.8
Serum Albumin				
n	117	121	71	309
mean ± SD (%)	3.24 ± 0.24	3.11 ± 0.32	2.99 ± 0.30	3.13 ± 0.30
% < 3 g/dl	11 1	25.6	46.5	24.9

(Source: Tee *et al.*, 1984)

be related mostly to iron and to a lesser extent, folate deficiency. It was also observed that there were statistically significant differences in the haematological, iron, folate and protein status of the women from the three racial groups of the study population. These indices were observed to be poorest amongst the Indian women, better in the Malays, and generally best in the Chinese. Birth records of 160 of these women revealed that one of the infants had a birth weight of <2.0 kg; incidence of low-birth weight, <2.5 kg, was 8.3%. Although there was a trend of deteriorating haematological, iron and protein status of women from the 0, 1-3 and >4 parity groups, these differences were not statistically significant.

For obvious reason, the studies reviewed above were all hospital-based. Some were retrospective, making use of existing hospital records. Another point to note is that they were mostly concentrated in the Kuala Lumpur area. It is hoped that data from hospital in other areas of the country would be made available. Haemoglobin is determined as a routine test in most ante-natal clinics. What is needed is of course satisfactory results obtained with proper quality control, and a collation of all these data. It is also to be noted that except for the three studies cited above, determination of folic acid and vitamin B_{12} has not been carried out. As discussed earlier on in this review, other haemopoietic nutrients besides iron, especially folic acid, could play an important role in the etiology of anaemia in the tropics. It is hoped that other studies would deal with this vitamin more thoroughly in the future.

c. *Anaemia amongst Malaysian labourers and industrial workers*

There have been several studies on anaemia amongst labourers, particularly of the estate labour force. Although these studies were mostly carried out some years ago, they were of importance and were surely much appreciated at that time. For example the study of Battray in 1918, in which 110 Indian and 221 Chinese "coolies" who had just arrived to work on a rubber estate in Johore were studied. Haemoglobin was determined by Tallqvist's haemoglobinometer, stool examined for *Ancylostoma*, *Ascaris* and *Trichuris* infestation and the pigmentation of the papillae of the tongue noted. Based on the results of the study, it was recommended that all newly recruited workers be examined for haemoglobin and helminthiasis, and treated if necessary.

In a study of the vital statistics of some estates in Perak before and immediately after the Japanese occupation, Reed (1947) noted that one of the greatest problems at that time was anaemia, and that it appeared to be a more serious problem than before the war. It was said that anaemia amongst these Indian labourers was a great cause of prolonged sickness and loss of working power and

a great contributory cause of mortality. The cause of the anaemia was said to be almost entirely nutritional, with both iron deficiency anaemia and "tropical macrocytic anaemia" occuring frequently.

Another study carried out after the Japanese occupation was a large scale survey by the British Military Administration reported by Bourne (1949), covering several nutritional indicators. Of 1,978 rubber estate labourers and dependents examined in Selangor, 47.3% of males, 61.7% of females and 71.8% of children had a haemoglobin value of less than 60% (Tallqvist scale). In Penang and Province Wellesley, of the 851 workers examined, 60-70% of the adult males and females had haemoglobin values of less than 60% All the workers were said to be suffering from a considerable degree of malnutrition. On the other hand, among the 405 industrial workers (including workers in an automobile repair shop, power station employees and employees of a tin mining company) studied, only 4.2% were found to have haemoglobin values below 60%.

England (1952) reported that in routine inspections of an estate labour force of about 2,700, about "4-7% showed clinically gross anaemia". The condition was said to be "due to a combination of *Ancylostoma* infestation and undernutrition". The report discussed more detailed investigations and treatment methods for the more severe cases.

A more comprehensive study was reported by Lamprell and Cheek (1952). The study was carried out between the end of 1950 and early 1952 on a rubber and coconut plantation, consisting of a labour force of 1,375 Indians. The plantations, on the coast of Selangor, were said to be virtually malaria-free. From an examination of the haemoglo bin levels of 268 labourers and their dependents (by the cyanmethaemoglobin method), it was observed that these levels were below the average for Southern Indian labourers in Malaya. Anaemia was said to be particularly common amongst women of child-bearing age and the group of women and men who were doing the heaviest work. It was felt that the anaemia was essentially dietary in origin; various measures for improvement were implemented in the plantation concerned. A second survey carried out on 100 of these subjects after the implementation of some of these measures showed significant increase in haemoglobin levels.

Other studies of labourers around the time were those of Tasker (1951) and Tasker *et al.* (1952). These reports dealt with smaller series of labourers and were mainly concerned with detailed investigations into their anaemia conditions. Burgess and Laidin (1950) in the study of various occupational groups in Malacca also paid attention to a group of labourers.

In a later study, Kandiah and Lim (1976) reported on the nutritional status of labourers in a rubber estate community. Of the

78 adult males examined for haemoglobin concentration, 20 (25.6%) were said to be anaemic; 72 of the 105 adult women examined (68.6%) were anaemic.

In 1978, some data on the nutritional biochemistry of industrial workers in Shah Alam, Selangor, were reported (Ng, 1978). This was part of a larger study carried out by the Ministry of Health to obtain baseline information regarding the health and socio-economic status of the workers. Some haematological data were also reported for 135 male and 85 female workers. While only 10% of the male workers had low haemoglobin levels (<13 g/dl), a much larger prevalence of 26% was observed for the female (<12 g/dl). Mean values of the serum iron and percent transferrin saturation of the females workers were also found to be lower than that of the male workers. The author expressed concern over the anaemia problem faced by these workers, particularly the women.

No studies on anaemia in Malaysian labourers and industrial workers have been published in the 1980's. A study of the major functional groups of the Malaysian population to be undertaken from 1992 to 1995 is expected to provide new data on these groups of workers in the country.

1.1.4.2. Vitamin A deficiency

Amongst the earliest documentations of vitamin A deficiency in the country were those by Viswalingam (1928). The ophthalmologist described his experiences with cases of keratomalacia, said to be confined mainly to the labouring classes of the community, mostly the Indians. It was most frequently observed among ill-nourished children up to 5 years of age, and was closely associated with poverty and ignorance. He concluded that the disease was due to deficiency of fat and fat-soluble vitamins. No mention, however, was made of vitamin A. Signs and symptoms affecting the eyes were described, and photographs of three affected children were presented. The importance of improved diets, including a liberal supply of "vitaminous foods" to prevent this eye-sight impairing disorder was emphasized.

Also in the early part of the century, Field (1931) reported data from surveys carried out in North Perak and Negri Sembilan on 1585 Indian and 1259 Malay children. Prevalence of xerophthalmia amongst the Indians was found to be 4.2%, much higher than the 0.5% observed for the Malays. No exact figures were available for the Chinese, but this disease was said to be one of comparative rarity. Factors contributing to the widespread distribution of vitamin A deficiency among Tamil labour forces in the country and their consequent lowered resistance to infection were discussed in this rather comprehensive report. Faulty diet and a low socio-economic status were said to be prime factors bringing about the condition.

Williamson (1948, 1952) described the occurrence of vitamin A deficiency amongst infants and young children. The causal factors of the disorder were discussed, emphasizing on the use and abuse of sweetened condensed milk as the most important single factor. In the treatment of the patients, the provision of a balanced diet was said to be important, besides giving a large dose of vitamin A concentrate. In relation to treatment of the disorder, Thompson (1953) also described the use of red palm oil, skim milk, and vitamin oil for afflicted children.

McPherson (1965) reported his experiences on the vitamin A problem in various clinics, hospitals, and schools in several districts in Kelantan. Over 700 subjects were examined in the investigations which were carried out in December 1955 to January 1956. Keratomalacia was said to be the most common single cause of blindness. The commonest age of onset was found to be 2-3 years, occurring commonly with malnutrition. The diet of these children usually consisted almost solely of rice and fish. Vegetables were given infrequently or not at all, due to ignorance or prejudice of the mothers.

Fewer reports on vitamin A deficiency were encountered in the 60's. There were however two important documentations of the problem in the country by the Institute for Medical Research. The first was a report of serum vitamin A and carotene levels in two series of children (IMR, 1963). This was one of the first reports of biochemical determinations of vitamin A deficiency in the country. The first series was 28 apparently normal children of police personnel, whilst the second was a group of 9 children from the eye clinic of the General Hospital, diagnosed and treated as cases of vitamin A deficiency. Among the police children, a close correlation between mild eye signs of the deficiency and a low serum vitamin A level was observed. On the other hand, carotene levels were found to vary widely. Mean serum vitamin A of children in this group was 13.0 µg/dl. Ten of the children had a serum level of <20 µg/dl, and 4 of them had <10 µg/dl. Serum vitamin A levels of the children from the eye clinic were found to be extremely low, ranging from 0.8 to 18.4 µg/dl. The background of each child from the clinic was described.

Thompson, then head of the Division of Nutrition in the Institute for Medical Research, and two local investigators (Thompson *et al.*, 1964) reported an interesting study of serum vitamin A levels of 517 women at delivery in the labour ward, comprised of women from the three major racial groups. In each case the cord blood of the infant was also collected for determination. Serum vitamin A levels below 20 µg/dl was found in 25% of the subjects studied. It was found that when the vitamin A level of the maternal blood was near normal, the cord blood level of the infants was about half that of the mothers. However, when the mothers' vitamin A levels were low, the infant blood levels were, on the average, not correspondingly

reduced and in some instances were actually higher than those of the mothers. Breast milk was also obtained from 317 women on the third day after delivery for determination of vitamin A. Mean vitamin A level in the breast milk was about 60 µg/100 ml. About 60% of the subjects were said to have a low breast milk vitamin A level, taken to be below 68 µg/100 ml. This cut-off level appears to be rather high, since FAO/WHO (1988) indicated that reported retinol concentration in breast milk varies widely from country to country, between 20 and 70 µg/dl.

The third report from the 1960's that will be cited was a large scale nutrition survey carried out by the Interdepartmental Committee on Nutrition for National Defense in late 1962 (ICNND, 1964). Various states in Peninsular Malaysia were covered, and a total of 8,172 clinical examinations and 729 biochemical determinations were carried out on military personnel, their dependents and civilians. The biochemical determination of vitamin A status of the military dependents and civilians have been extracted and tabulated in Tables 1.14 and 1.15. There appears to be higher prevalence of hypovitaminosis A among the female subjects, and among the younger age groups of these subjects. Percent with "deficient" serum vitamin A was about 8.5% in the 5-9 age group. The percentage of subjects, for both sexes, with "deficient" serum carotene level was much lower.

Table 1.14
Plasma Vitamin A Levels of Military Dependents and Civilians in Peninsular Malaysia

Age groups	No. of subjects	Serum vitamin A			
		Mean (µg/dl)	S.E.	% of subjects "low"[1]	% of subjects "deficient"[2]
Males					
5-9 years	57	28.0	1.7	24.6	0
10-14	79	30.3	1.7	21.5	2.5
15-44	75	42.9	1.5	1.3	0
>45	22	40.2	3.4	4.5	0
Females					
Non-pregnant, non-lactating					
5-9 years	59	27.6	2.0	22.0	8.5
10-14	70	27.6	1.5	17.1	5.7
15-44	111	36.6	1.4	6.3	2.7
>45	24	34.6	3.8	20.8	4.2
Pregnant	8	32.8	3.7	12.5	0
Lactating	25	29.0	2.1	12.0	4.0

1 "low" = serum vitamin A level between 10-19 µg/dl
2 "deficient" = serum vitamin level <10 µg/dl

(Source: ICNND, 1964)

Table 1.15
Plasma Carotene Levels of Military Dependents and Civilians in Peninsular Malaysia

Age groups	No of subjects	Serum carotene			
		Mean (µg/dl)	S.E.	% of subjects "low"[1]	% of subjects "deficient"[2]
Males					
5-9 years	57	67	4	17.5	0
10-14	79	83	5	5.1	1.3
15-44	75	88	4	5.3	0
>45	22	69	7	13.6	4.5
Females					
Non-pregnant, non lactating					
5-9 year	59	70	5	18.6	0
10-14	70	78	3	8.6	0
15-44	111	94	4	5.4	0.9
>45	24	98	7	8.3	0
Pregnant	8	115	14	0	0
Lactating	25	84	6	8.0	0

1 "low" = serum carotene level between 20-39 µg/dl
2 "deficient" = serum carotene level <20 µg/dl

(Source: ICNND, 1964)

In the 70's, several rather comprehensive studies on the problem were reported. Chandrasekharan (1975) reported a study of 10 primary schools in Ulu Terengganu. All children were examined clinically and those with signs of vitamin A deficiency or generally malnourished, numbering 215 or about 10% of the children, were selected for biochemical determinations and dietary studies. Mean serum levels of vitamin A and carotene were reported (Table 1.16); however, the number of children with low levels was not reported. Dietary studies showed that the consumption of foods rich in pre-formed vitamin A was found to be very low and infrequent. Over 95% of the vitamin A consumption was in the form of provitamin A from vegetables and fruits. Findings of the study were said to suggest that the apparently low level of serum vitamin A in these children could partly be attributed to poor utilisation of the provitamins because of the inadequate intakes of fat and protein in the diet, both in terms of quantity and quality.

Table 1.16
Serum Vitamin A and Carotene Levels of Primary School Children in Ulu Terengganu

Location	No. of children	Mean serum level (µg/dl)	
		Vitamin A	Carotene
Matang	20	21	42
Kua	20	25	37
Kuala Dura	20	19	39
Bukit Gemuroh	22	25	49
Bukit Diman	23	25	35
Tapah	8	18	42
Kuala Brang	50	26	48
Bukit Apit	20	26	45
Tengkawang	17	16	41
Tanggol	22	25	50
Pulau Perhentian	27	32	29

(Source: Chandrasekharan, 1975)

At about the same time, Chong *et al.* (1972) reported findings from several studies carried out by the Institute for Medical Research, and a community in Ulu Terengganu was also studied. Serum vitamin A and carotene values of pre-school children in this community were said to be "dangerously low", similar to those of children from the General Hospital (Table 1.17). Some 10% of these children were reported to have clinical signs of xerophthalmia.

Table 1.17
Mean Serum Vitamin A and Carotene Levels of Malay Pre-school Children

Group	No. of subjects	Carotene (µg/dl)	Vitamin A (µg/dl)
Ulu Terengganu	44	29	11.2
Army children	62	62	28.9
Terengganu (coastal kampungs)	10	38	27.9
Children with eye signs of vitamin A deficiency, General Hospital, Kuala Lumpur, 1969	11	28	13.5

(Source: Chong *et al.*, 1972)

Teoh (1973) reported a dietary study of 205 households in Rembau, Negri Sembilan. In general, it was found that vitamin A intake was low, the median value of the percentage of requirement met by households was about 47%. Seventy per cent of the households had intakes below the recommended daily intake. Analysis of the percentage of retinol and provitamin A intake showed that about 80% of the vitamin A was from the less efficient precursors of vitamin A, and mainly from fruits and vegetables.

The study of Ng and Chong (1977) emp hasized on biochemical determinations of serum vitamin A. A total of 407 subjects (of all ages) from two villages in Selangor, Ulu Rening and Sungai Choh, was studied. Some 32% of the pre-school children studied were said to be "at risk" (serum vitamin A <20 µg/dl) (Table 1.18). About 20% of school-age children were said to be "at risk". The adult population was found to be the least affected, and had satisfactory serum vitamin A level. Eye signs of vitamin A deficiency were not detected for the subjects in Ulu Rening. In Sungai Choh, some 11% of the primary school children were found to exhibit mild signs of xerophthalmia.

Table 1.18
Vitamin A Status of Two Rural Communities—Ulu Rening and Sungai Choh

Community	Age group	No. of subject	Serum vitamin A (µg/dl)	% at risk[1]	% with clinical signs
Ulu Rening	Pre-school	38	25 ± 8	32	0
	School	69	32 ± 11	16	0
	Adult	89	42 ± 11	3	0
Sungai Choh	Pre-school	22	24 ± 6	32	1.6[a]
	School	80	26 ± 11	27	10.8[b]
	Adult	109	36 ± 13	7	5.5[c]

[1] serum vitamin A level <20 µg/dl
[a] no. of subjects = 65
[b] no. of subjects = 251
[c] no. of subjects = 202

(Source: Ng and Chong, 1977)

In the middle of the 1970's, several studies on the nutritional status of various communities in Sarawak were documented by A.J.U. Anderson of the Sarawak Medical Services (Anderson, 1976a, 1976b, 1976c, 1977a, 1977b, 1978a, 1978b, 1978c). These must be the largest nutrition surveys carried out in the State, and included various native groups, the Land Dayak, Melanau, Iban, Penan, Kayan, and Kenyah. All age groups were studied, and a combination of anthropometric measurements, clinical examination, dietary assessment, and minimal biochemical determinations (frequently haemoglobin) were carried out. Dietary studies were mostly food consumption patterns of families and not much direct inference may be made regarding

the consumption of vitamin A-rich foods. The results of clinical examinations provided some useful data on the extent of the vitamin A deficiency problem amongst these communities because ocular signs were consistently reported in a uniform manner (Table 1.19).

The cases of xerophthalmia reported were, in most cases, conjunctival xerosis, followed by corneal xerosis. The occurrence of each type was not separately reported. There was only one child with Bitot's spots and two with keratomalacia in the total of over 3,000 children under 7 years of age examined. The problem was thus of moderate severity. The prevalence rates of xerophthalmia, however, varied considerably from community to community, ranging from 2% among the Melanau to 38% in Malay children. A common pattern for all the communities was an increasing prevalence with increasing age, with peaks at about 4 to 6 years. At these age groups, the prevalence rates were about double the mean values tabulated in Table 1.19.

Table 1.19
Prevalence of Xerophthalmia among Children under 7 Years of Age of Various Communities in Sarawak

Community	Location	No. of children	% with xerophthalmia
Land Dayak	Tebakang area, 1st Division	552	6.9
Melanau	Tilian River, 3rd Division	352	2.0
Iban	Middle Mukah River, 3rd Division	460	3.9
Iban	Lemanak River	388	12.9
Malay	Sarawak River Delta, 1st Division	361	38.2
Iban	Sut and Mujong River, 7th Division	414	20.5
Penan	Mulu area, 4th, 5th Division	131	19.1
Kayan & Kenyah	Middle Baram River, 4th Division	556	11.5

(Sources: Anderson, 1976a, 1976b, 1976c, 1977a, 1977b, 1978a, 1978b, 1978c)

The largest nutrition survey carried out in Sabah to date is probably that by Chen *et al.* (1981). This fairly extensive study was started in mid-1978 and continued until April 1980 in the Interior, West Coast, and Kudat Divisions. The predominant ethnic groups in the study areas were (in descending order) the Kadazans, Chinese, Bajaus, Malays, and the Muruts. Clinical examination (including eye signs of vitamin A deficiency) carried out on a total of 3,672 children upto 13 years of age did not reveal any clear or frank case of any form of nutritional deficiency. Food consumption studies of a sub-sample of the households revealed that a significant proportion of the households for some of the communities, particularly the Kadazans, were deficient in vitamin A intake (<50% of the recommended allowance) (Table 1.20).

Table 1.20
Adequacy of Household Vitamin A Intake among Various Communities in Sabah

Community	No. of Households	% of HH with requirements for vitamin A equal to	
		50-99%[a]	<50%[a]
Muruts	28	5	0
Rungus Dusun	7	30	0
Kadazan (coastal plains)	29	13	62
Kadazan (upland)	32	9	56
Chinese	10	30	10

[a] Percent of the recommended daily requirements for vitamin A intake: households meeting <50% of the requirements considered as "deficient"

(Source: Chen *et al.*, 1981)

In a series of comprehensive nutrition surveys carried out between 1979 and 1983 by the Institute for Medical Research in 14 rural villages in Peninsular Malaysia (Chong *et al.*, 1984), a total of 3,584 persons of all age groups were examined for clinical signs of nutrient deficiencies. Xerophthalmia was reported to be rare. The most common eye sign was dryness and wrinkling of the conjunctiva with 13% of primary school boys and 8% of girls affected. Serum vitamin A levels were not determined on all subjects due to insufficient availability of blood samples, especially young children. Results for slightly under 700 subjects were presented, with most of them between 18 and 46 years (Table 1.21).

Table 1.21
Serum Vitamin A Levels of Rural Communities, Peninsular Malaysia

Age group	No. of subjects	Mean ± SD (µg per dl)	% with "low"[1] vitamin A
Pre-school children	25	31 ± 9.5	12
Primary school children	40	33 ± 12.5	10
Boys, 12-17.9 years	32	44 ± 22.0	16
Girls, 12-17.9 years	61	55 ± 19.0	3
Males, 18-45.9 years	152	46 ± 19.0	7
Females, 18-45.9 years	353	47 ± 24.0	12
Males, ≥ 46 years	14	54 ± 33.0	0
Females, ≥ 46 years	14	42 ± 17.0	7

[1] "low" = serum vitamin A <20 µg/dl

(Source: Chong *et al.*, 1984)

The authors concluded that vitamin A deficiency did not pose a problem in this age group since only about 10% of the subjects were found to have a serum vitamin A level of <20 µg/dl (ICNND "low" category). Results obtained for the younger children and adolescents also indicated that there was no serious vitamin A deficiency problem among these subjects. Nevertheless, the authors recognized that the sample size was rather small. Dietary studies showed that household consumption of animal foods rich in vitamin A was poor, much lower than the figures for the food balance sheet. Even consumption of fruits and vegetables was much lower. These would indicate that dietary intake of vitamin A was probably unsatisfactory. It would appear, therefore, that even though the number of cases of frank xerophthalmia was small, marginal vitamin A deficiency probably exists in considerable numbers in the communities studied.

Various studies carried out in different parts of the country have served to provide an insight in the vitamin A deficiency problem in the country. The studies cited are by no means complete. Emphasis has been placed on studies that focussed on the vitamin A deficiency problem, although several large scale general nutrition surveys were also included.

These studies have shown vitamin A deficiency to be an important sight-threatening disorder, affecting mainly young children on unbalanced diets. In the 1950's, it was found to be the major single cause of blindness. The disease was most prevalent among the lower socio-economic segments of the population. Vitamin A intake was generally low, with little or no retinol, and most of it from the provitamins. Even then, the amount of vegetables and fruits consumed were generally low.

No exact estimates of the magnitude of the problem are presently available. However, as seen from reports in the literature, the problem appears to be confined to certain groups, mainly in the rural areas, and does not pose a major health hazard nationwide. The problem appears to have lessened over the years, judging from reports upto the late 1970's and the early 80's. There are probably very few cases of children with eye signs past the conjunctival xerosis (X1A), and with serum vitamin A <10 µg/ml. It is however recognized that there are many remote areas in the country where the vitamin A status is not known, including parts of Peninsular Malaysia. Furthermore, the problem has been little studied among urban squatters. Most of the studies relied on clinical signs and dietary inquiries, due to the lack of laboratory facilities to carry out biochemical investigations. For the latter, investigators have been faced with the difficulty of obtaining sufficient blood from subjects. A reliable micro-method would have to be established for local use. It is recommended that the extent of the problem be investigated in communities considered at greater risk of vitamin A deficiency because of poverty, characteristics of the diet, or a higher prevalence.

1.1.4.3. Iodine Deficiency Disorders

The problem of endemic goitre in Malaysia was documented from the 1930's. A large-scale survey in Kedah by Vickers and Strahan (1936) reported the occurrence of goitre in the districts of Sok and Jeneri. Prevalence of goitre was said to be high in Kampong Banggol Berangan and Banggol Batu.

An early large scale study of endemic goitre in Malaysia was that of Polunin (1951). Some 1,500 subjects, comprising of approximately equal numbers of Malays and aborigines, were examined for thyroid enlargement, and iodine content of water was also studied. Goitre gland enlargement was observed in about 40% of both ethnic groups. Analysis of some samples of river water showed very low levels of iodine. The contribution of low iodine in water, the non-consumption of sea foods, and low iodine content of salt to the etiology of goitre was discussed.

Polunin (1971) subsequently reported data of extensive goitre surveys, carried out in various parts of the country, with particular emphasis on women. Among 4,080 women examined in different states of Peninsular Malaysia, visible goitres were observed in 25.3% of Malay women and in 34.7% of Indian women aged 15 years and above. In general, the more remote interiors of the States of Perak, Kedah, Kelantan, Terengganu and Pahang were found to have very high prevalence rates of goitre. Prevalence of endemic goitre in other states was much lower. It was estimated that the population exposed to risks of complications from endemic goitre was probably of the order of 5% of all adult women in West Malaysia.

Visible goitres were found in 39.0% of 1,750 women studied in the 1st, 2nd, 3rd and 5th Divisions of Sarawak. This prevalence rate was the highest amongst all the states surveyed in this series of studies. The ethnic groups most affected were the Ibans and Kejamans, and prevalence rates were distinctly higher in the remote areas. These findings supported previous data that nearly all populations in the inland regions of Sarawak have a high goitre rate.

In Sabah, studies were carried out among 963 women in the West Coast, Sandakan and Interior Residences. Visible goitres were found in 26.1% of the women 15 years and above. None of the several isolated inland communities studied had a very high prevalence of goitre, except for the hill people inland from Bandau. Endemic goitre in Sabah appeared to be patchily distributed, widely scattered in many isolated communities.

The consumption of salt and sea foods amongs the study populations were also described. The importance of providing iodised salt to the communities, particular in Sarawak, was emphasized. Various detailed recommendations were made with regards to the iodisation of salt for West Malaysia, Sarawak and Sabah.

Subsequent reports of endemic goitre in Malaysia were mostly of studies carried out in Sarawak. Ogihara *et al.* (1972) reported a thorough study of some 600 subjects in four districts in the 3rd Division of Sarawak by physical examination and a variety of analyses. The overall prevalence of goitre was found to be 22.3%, and prevalence rates were four times greater in females (33.2%) than in males (8.1%). No cretinism was encountered. Urinary iodine excretion was low, but there was no significant difference between goitrous and non-goitrous subjects. Iodine content in drinking water was extremely low in all the districts studied. Thyroid parameters such as PBI, T3 resin sponge uptake and cholesterol were all within normal limits. Anti-thyroid antibodies were not demonstrated in sera from either goitrous and nongoitrous subjects. Experimental feeding of cassava on members of the research team for two weeks did not show any change in thyroid parameters including potassium cyanide discharge test. It was felt that iodine deficiency was probably a major causative factor for the endemic goitre observed.

Another study of the endemic goitre problem in Sarawak was reported by Maberly and Eastman (1976). A comparative health, epidemiological and anthropometric survey was carried out among some 300 Ibans, in three regions of the 2nd Division of Sarawak. The prevalence of goitre was found to be 99.5% and 74% respectively in the Ai River and Rubu regions, while only a few people in the Bajong region were detected with goitre. Neurological cretinism was estimated at 3.6% in the severely goitrous Ai River region but was not detected in the other regions. Dietary studies indicated that iodine deficiency was a significant contributory factor in the development of endemic goitre in the study populations. There was no significant difference in anthropometric measurements among the three communities exhibiting greatly differing endemicity of goitre. Haemoglobin, serum total protein and albumin concentrations were also similar in the three communities. The investigators called for urgent attention to iodine supplementation to ameliorate the problem.

In a subsequent report, Maberly *et al.* (1978) described findings from an iodised-oil injection programme covering 2,000 subjects in the severely goitrous region of Lubok Antu District. A sub-sample of the subjects was followed-up at yearly intervals by determining goitre size and thyroid function. At the end of the first year of instituting the programme, the prevalence of goitre was reduced from 75% to 33%, and 80% of the goitrous subjects showed a reduction in goitre size. A concomitant rise in serum T3 level and the appearance of symptoms and signs of thyrotoxicosis in a number of subjects was however observed. The investigators pointed out the need for long-term prospective studies of the duration and effects of iodised-oil programme, in order to determine the benefits and possible detrimental effects of these programmes.

Alexander (1979) reviewed the prevalence of endemic goitre in Sarawak, based on studies carried out in the Upper Lemanak River area in the 2nd Division and the Kanowit Town and Kanowit District, as well as several published reports by other investigators. A high prevalence of goitre was reported for the State, both in the coastal as well as in the inland areas. On average, visible goitres were found in 39% of all women aged 15 years and above. The report also reviewed the salt iodization programme in Sarawak. Salt iodization plants were established in Kuching in 1957 and in Sibu in 1959. The programme in Kuching was reported to be not performing well and the iodization plant was working well below capacity. Only a small proportion of the iodized salt reached the 1st, 2nd and 4th Divisions, and goitre prevalence, particularly in the 2nd Division remained high. In Sibu, the programme was said to be performing better. Nevertheless, the voluntary salt iodization programme in Sarawak had failed to significantly reduce the prevalence and prevent the development of endemic goitre in the State. The author called for legislation for the compulsory iodization of all salt in the state.

The prevalence of goitre in the riverine longhouse communities along the Tinjar River, Baram District, 4th Division of Sarawak was reported by Chen and Lim (1982). The subjects, mostly Kenyah, Kayan and Iban, were selected from six locations along the river so that the degree of remoteness varied. The overall palpable goitre amongst 555 subjects aged 5 to 14 years and 202 females aged 15 years and above was 74% for the former group and 78% for the latter. At all locations of the study, the prevalence of goitre was over 60%. On questioning 126 households, only 9 used iodised salt while 74 households used only uniodised coarse salt, and 7 used only uniodised fine salt. The remaining 36 households used both fine and coarse uniodised salt. The importance of providing iodised salt, including iodised coarse salt, to the communities was emphasized.

Tan (1982) reviewed the various studies of the endemic goitre problem carried out in Sarawak since the 1950's. Available data indicated that 12 of the State's 25 districts could be identified as goitrous, with varying rates of prevalence, the highest being in the inland areas (Table 1.22). It was estimated that there were at least 20,000 cases of endemic goitre in Sarawak, representing about 1.5% of its total population. The problem was said to be caused primarily by iodine deficiency in the diet, but the importance of goitrogens in cassava was also considered worth investigating.

The implementation of endemic goitre control programmes in Sarawak was also reviewed by Tan (1982). To further improve the availability of iodised salt, legislation was passed in January 1982 making the import of iodised table salt compulsory. The use of iodised oil injections was felt to be unsuitable because of the high prevalence of thyrotoxicosis and the rapid depletion of iodine stores from the

Table 1.22
Summary of Goitre Studies in Sarawak

Location	Ethnic groups	Age (years)	Total number	Prevalence (%)
First division	Chinese, Malay	10-14 (female)	273	49.8
	Biduyah	> 15 (female)	157	52.2
Second division	Iban, Malay	10-14 (female)	147	38.8
	Chinese	> 15 (female)	161	80.7
Third, sixth and seventh	Iban, Chinese	10-14 (female)	252	34.5
divisions	Malay, Kejaman	> 15 (female)	589	55.2
Fifth division	Malay, Chinese	10-14 (female)	20	45.0
	Iban	> 15 (female)	151	45.0
	Total	> 10 (female)	1750	50.0
		> 15 (female)	1058	58.0
Third division	Iban	All ages	608	8 (male)
Rejang River (interior)		(both sexes)		33 (female)
Second division	Iban	> 11 (both sexes)	167	99.5
Lubuk Antu (interior)				
Ruba (coastal)	Iban	> 11 (both sexes)	38	74.1
Bajong (coastal)	Iban	> 11 (both sexes)	122	3.0
Second division	Iban	5-8 (both sexes)	388	76.5
Lemanak River (interior)		mothers only	166	90.5
Fourth division	Kayan/Kenyah	< 7 (both sexes)	556	30.4
Middle Bayam		4-8 (both sexes)	372	55.1
(intermediate)		mothers only	142	50.0
Muda area (interior)	Punan	All ages		
	(nomadic tribe)	(both sexes)	334	59.3
Seventh division	Iban	< 7 (both sexes)	414	7.0
Sut/Mujong River		mothers only	106	30.2
(interior)				
Second division	Iban	> 15 (female)	75	93.3
Upper Lemanak River		8-12 (both sexes)	152	21.7
(interior)				
Third division	Iban	> 15 (female)	137	38.7
Kanowit District				
(Rejang River interior)				
Kanowit Town	Iban Chinese	7-12 (both sexes)	542	0.7
Fourth division	Kayan, Kenyah	10-14 (female)	110	78.0
Tinjar River	Iban	> 15 (female)	157	77.7
		10-14 (female)	114	78.6

Source: Tan (1982)

body. A third programme instituted was the fitting of an iodinator into the existing gravity-fed village water supply. The method was said to have produced encouraging results.

A survey conducted in 1988 on the availability of iodine enriched salt in Sarawak by the Department of Medicine and Health Services in the state has indicated the persistence of a number of problems in the production and distribution of iodized salt (Mohd. Taha Arif *et al.*, 1988). Of 345 samples analyzed, only 39% were found to contain iodine. Low availability of iodine enriched salt was found in areas in the Divisions of Kuching, Samaharan, Sri Aman and Limbang (12.2%), compared to the Divisions of Sibu, Sarikei and Kapit (70.5%).

Few studies on the endemic goitre problem in Sabah have been reported. A recent study by Chen *et al.* (1988) examined 366 females aged 15 years and above in four areas of differing remoteness in the Keningau Division of Sabah. An overall endemicity of 76.5% was reported, and the incidence of goitre was found to correlate with the remoteness of the areas. The investigators pointed out the need for urgent implementation of a salt iodisation programme as it was found that only 3.0% of the people used iodised salt.

A recent study of the epidemiology of endemic goitre in selected villages in Kedah in Peninsular Malaysia was reported by Hanis *et al.* (1987). A total of 1,075 subjects aged 5 years and above in 7 villages in the district of Sik and Baling was studied. Two of the villages in the district of Sik were previously severely endemic. A regional pattern was noted, with the highest goitre prevalence in the innermost villages (over 50%), and very low prevalence rate in a coastal village (less than 10%). In all the regions studied, goitre prevalence was consistently higher in the females than the males. In the innermost villages, all or almost all households presented with at least a case of visible goitre. The investigators emphasized the severity of the problem and called for large-scale programmes to arrest the disorder. The need for epidemiological studies to be carried out in other inland areas in the country was also stressed.

Available data indicate that endemic goitre does not appear to be a major nutritional problem in Peninsular Malaysia, except for a few studies which have indicated high prevalence rates in isolated parts of the Peninsula. However, in the absence of public health interventions to prevent iodine deficiency, goitre has been recently found to be still highly endemic in villages of Kedah, where a very elevated prevalence was recognized 50 years ago. The suspect that there may be many other foci of endemic goitre in the state, and possibly in other inland areas of Peninsular Malaysia suggests the need for a systematic assessment of the prevalence of iodine deficiency disorders in these parts of the country. The problem is much more extensive in Sarawak. There is continued interest in studying the endemic goitre problem in Sarawak and Sabah, including extensive characterisation of the problem as well as further studies on intervention programmes.

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