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Nutritional assessment of rural villages and estates in Peninsular Malaysia*. III. Prevalence of anaemia

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ABSTRACT

As a part of the recent UPM-IMR collaborative study on the nutritional status of communities in rural villages and estates in Peninsular Malaysia from 1992-1995, this report presents findings on the haemoglobin levels and the prevalence of anaemia amongst these rural dwellers. A total of 69 villages and 7 estates located in 9 states in Peninsular Malaysia were studied. Results of the study on the 5 communities (total n=8024), namely fishing, padi, rubber, coconut and estate communities, are presented according to five age groups, namely less than 7 years (n=1418), 7-12.9 years (n=1778), 13-17.9 years (n=701), 18-59.9 years (n=3241) and ≥60 years (n=886). The extent of the anaemia problem varied considerably amongst the various age groups and community types. The prevalence of anaemia and mean Hb level (g/dl) for subjects of both sexes were respectively 24% and 12.1 for those < 7 years; 21.9% and 13.0 for the 7-12.9 years old; 17.8% and 13.7 for the 13-17.9 years; 21.0% and 13.8 for 18-59.9 years; and 22.7% and 13.6 for those 60 years of age and above. While the female adults (18-59.9 years) had a significantly higher prevalence rate for anaemia of 25% compared to 14%

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found in the male adults, no significant difference in the prevalence rates were found between the sexes for the other age groups. The problem was most serious among adult women, young children and the elderly. Amongst the various community types, the fishing community had the highest prevalence of anaemia at an overall rate of 50%, taking into consideration both sexes and all age groups. The rubber smallholders, in contrast, had the lowest prevalence of anaemia, at an overall rate of about 10%. Intervention and preventive health programmes should therefore be continued to be focussed on the above groups of rural subjects, particularly those in the fishing community.

INTRODUCTION

Iron deficiency anaemia (IDA) has been one of the most important micronutrient deficiencies in the country. It has been reported to affect young children and pregnant women in Malaysia since the early 1950's. Several large-scale surveys in the last 15 years showed that the highest prevalence of anaemia was often found in children in the first two years of life. It was estimated that the prevalence among children between six months to two years varied widely between 15% to 60% amongst different community groups. In pregnant women, several small-scale studies have shown the problem to be between 30% to 60% among the urban poor (Tee, 1993).

Several recent studies continued to highlight the high prevalence of the problem in the 1990's. In a study conducted in 1994 among 1408 adolescent girls in 3 schools near Kuching, Sarawak, the prevalence of anaemia was found to range between 9.1 and 36.8% (Tee et al., 1996). In a study of hospital records of 9,860 women attending the antenatal clinics in rural Kelantan, Zulkifli et al. (1997) reported that 47.5% of the women were anaemic (Hb < 11 g/dl) whereas 1.9% could be considered as moderately to severely anaemic (Hb < 9g/dl). Among 796 malnourished children below 8 years in Sabah, anaemia was detected in 26.3% of the subjects compared to 19.4% among 418 "normal" children staying in the same areas (Tee et al., 1997).

In order to obtain a more comprehensive picture of the extent of anaemia in the country, haemoglobin levels were determined in almost all subjects studied in the large-scale collaborative study of the UPM and IMR on the nutritional status of communities in rural villages and estates in Peninsular Malaysia from 1992-1995. This paper is the third in a series of publications arising from the study. The first was a report of the socio-economic profile of the households studied (Chee, Khor & Tee, 1997). The second paper reported on the nutritional status of children aged 18 years and below (Khor & Tee, 1997). Two other papers being prepared deal with the prevalence of overweight among adults and on blood cholesterol levels.

METHOD

Selection of study villages and estates

The selection of the study villages and estates is described in detail in the first paper in this series of studies of the nutritional status of communities in rural villages and estates in Peninsular Malaysia (Chee, Khor and Tee, 1997). Five types of communities were studied namely, fishing, padi-growing, rubber smallholding, coconut smallholding and estates in the peninsula. The padi, rubber and coconut households were selected by a multi-stage sampling method based on the 1990 census of the Department of Agriculture Malaysia. Likewise, the fishing households were selected from the 1991 list of the Fisheries Development Authority Malaysia (Lembaga Kemajuan Ikan Malaysia). The estates were chosen from a list of estates in Peninsular Malaysia provided by the National Union of Plantation Workers. Based on past reports on the prevalence of malnutrition in the Peninsula, 600 households were computed as the sample size required for each type of community in this study.

A total of 69 villages and 7 estates located in 9 states in Peninsular Malaysia were selected for the study. In each study village or estate, all the households were interviewed using a structured questionnaire. All household members were asked to be present at a centre set up specifically for the study, such as the village community hall, school hall or canteen, or KEMAS preschool centre. In the centre, anthropometric measurements, biochemical tests and clinical examinations were carried out. A medical doctor from the research team performed clinical examinations, including the measurements of blood pressure and providing medication for minor illnesses. The nutritionists in the team, assisted by medical laboratory technologists, performed the anthropometric measurements and biochemical tests on the subjects. Blood was collected by fingerprick from all subjects over one year of age for haemoglobin determination.

Determination of haemoglobin level

Blood samples were collected from the subjects in the examination centre using disposable lancets and determined for haemoglobin using the cyanmethemoglobin method. This is a commonly used method for haemoglobin estimation as well as serving as the standard for method comparison and standardization (WHO, 1994). A single sample of 0.02 ml of blood was collected from each subject in a capillary tube calibrated to measure exactly that volume. The capillary tube was immediately dropped in a test tube containing 5 ml of Drabkin's reagent (Sigma 525-2), mixed well and kept in the dark for at least 10 minutes. The colour developed was read in a colorimeter at 540 nm. Haemoglobin concentrations of the blood samples were determined from a calibration curve constructed using cyanmethaemoglobin standard (eg BDH 36210-28).

The following cut-off values for haemoglobin* were used to diagnose anaemia:

Age groups	Hb level below
Children under 6 years	11 g/dl
Children 6 - 14 years	12 g/dl
Men	13 g/dl
Non-pregnant women	12 g/dl
Pregnant women	11 g/dl

*according to WHO (1994)

Statistical analyses

Statistical analyses were performed using SPSS ver 8.0 for Windows. Comparisons of means between male and female subjects were performed using independent sample t-test. For comparing mean Hb levels among subjects of different communities, one-way ANOVA was used, followed by Bonferroni test as the multiple comparison procedure. In all statistical analyses, a P value of <0.05 was taken to denote significant difference.

RESULTS AND DISCUSSION

Results of the study on the 5 communities are presented according to five age groups, namely less than 7 years (young children), 7-12.9 years (primary school age), 13-17.9 years (secondary school age or adolescent), 18-59.9 years (adults) and ≥60 years (elderly).

Number and sex of study subjects

Tables 1a to 1e tabulate the number and sex of subjects studied for the different communities

Table 1. Number of subjects by sex and type of community

1(a) below 7 years

	Fishing	*Padi*	*Rubber*	*Coconut*	*Estates*	*All communities*
No. of males	119	202	190	121	69	701
No. of females	126	218	180	127	66	717
Male: female ratio	0.94	0.93	1.06	0.95	1.05	0.98
No. studied	245	420	370	248	135	1418
% of all communities	17.3	29.6	26.1	17.5	9.5	100.0

1(b) 7-12.9 years

	Fishing	*Padi*	*Rubber*	*Coconut*	*Estates*	*All communities*
No. of males	205	209	216	148	120	898
No. of females	201	233	202	148	96	880
Male: female ratio	1.02	0.90	1.07	1.00	1.25	1.02
No. studied	406	442	418	296	216	1778
% of all communities	22.8	24.9	23.5	16.6	12.1	100.0

1(c) 13-17.9 years

	Fishing	*Padi*	*Rubber*	*Coconut*	*Estates*	*All communities*
No. of males	54	84	77	73	39	327
No. of females	75	101	82	68	48	374
Male: female ratio	0.72	0.83	0.94	1.07	0.81	0.87
No. studied	129	185	159	141	87	701
% of all communities	18.4	26.4	22.7	20.1	12.4	100.0

1(d) 18-59.9 years

	Fishing	*Padi*	*Rubber*	*Coconut*	*Estates*	*All communities*
No. of males	213	302	321	256	138	1230
No. of females	381	555	538	364	173	2011
Male: female ratio	0.56	0.54	0.60	0.70	0.80	0.61
No. studied	594	857	859	620	311	3241
% of all communities	18.3	26.4	26.5	19.1	9.6	100.0

1(e) ≥ 60 years

	Fishing	*Padi*	*Rubber*	*Coconut*	*Estates*	*All communities*
No. of males	50	111	123	149	5	438
No. of females	66	131	130	115	6	448
Male: female ratio	0.76	0.85	0.95	1.30	0.83	0.98
No. studied	116	242	253	264	11	886
% of all communities	13.1	27.3	28.6	29.8	1.2	100.0

1(f) all age groups

	Fishing	*Padi*	*Rubber*	*Coconut*	*Estates*	*All communities*
No. of males	641	908	927	747	371	3594
No. of females	849	1238	1132	822	389	4430
Male: female ratio	0.76	0.73	0.82	0.91	0.95	0.81
No. studied	1490	2146	2059	1569	760	8024
% of all communities	18.6	26.7	25.7	19.6	9.5	100.0

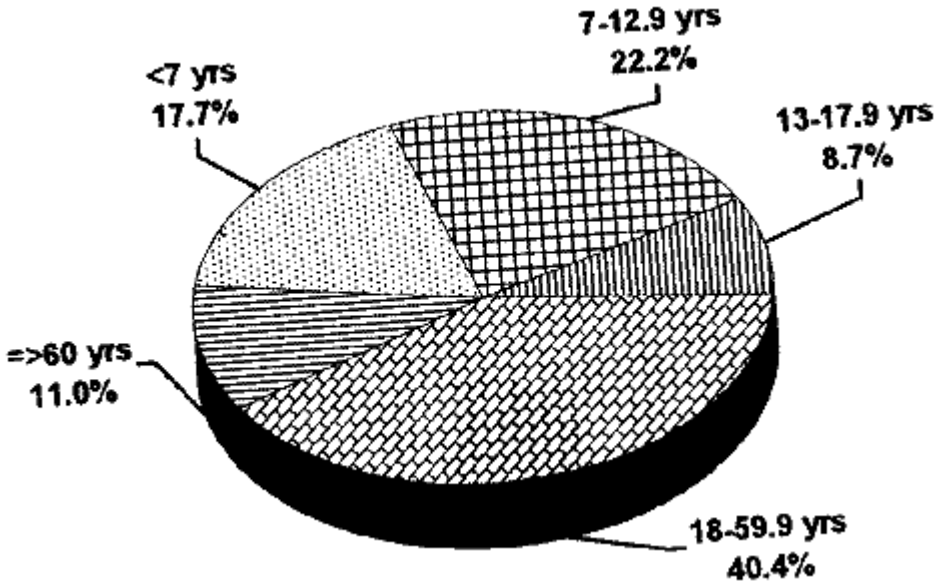


Figure 1. Distributation of study subjects by age groups

according to each of the five age groups. Figure 1 summarises the proportion of subjects according to each age group for all communities combined.

The number of subjects for the under 7 years group ranged from 135 for the estates to 420 for the padi farmers or 9.5 to 29.5% of the total of 1418 subjects for all the communities combined. These children comprised 18% of the total of 8024 subjects studied. For all the five types of communities studied, the number of boys and girls examined were very similar, with the male to female ratio ranging from 0.93 to 1.06 and a mean ratio of 0.98.

The number of subjects studied for the 7-12.9 years age group (n=1778) was about 1.3 times more than that of the younger age group or 22% of all subjects studied. The number for each community also ranged widely from 216 (or 12.1% of total N) for the estate community to 442 (24.9% of total N) for the padi farmers. Unlike for the younger children, there was greater variation in the the male to female ratio for the communities studied, ranging from 0.90 to 1.25, while the ratio for the communities combined was 1.02.

The number of adolescents studied (13-17.9 years) was the least for all the age groups (701), or about 9% of the total number of subjects. The distribution of subjects among the different communities was similar to the younger children. Except for the coconut growing community, there were fewer male than female subjects studied (ratio ranged from 0.72 to 0.94).

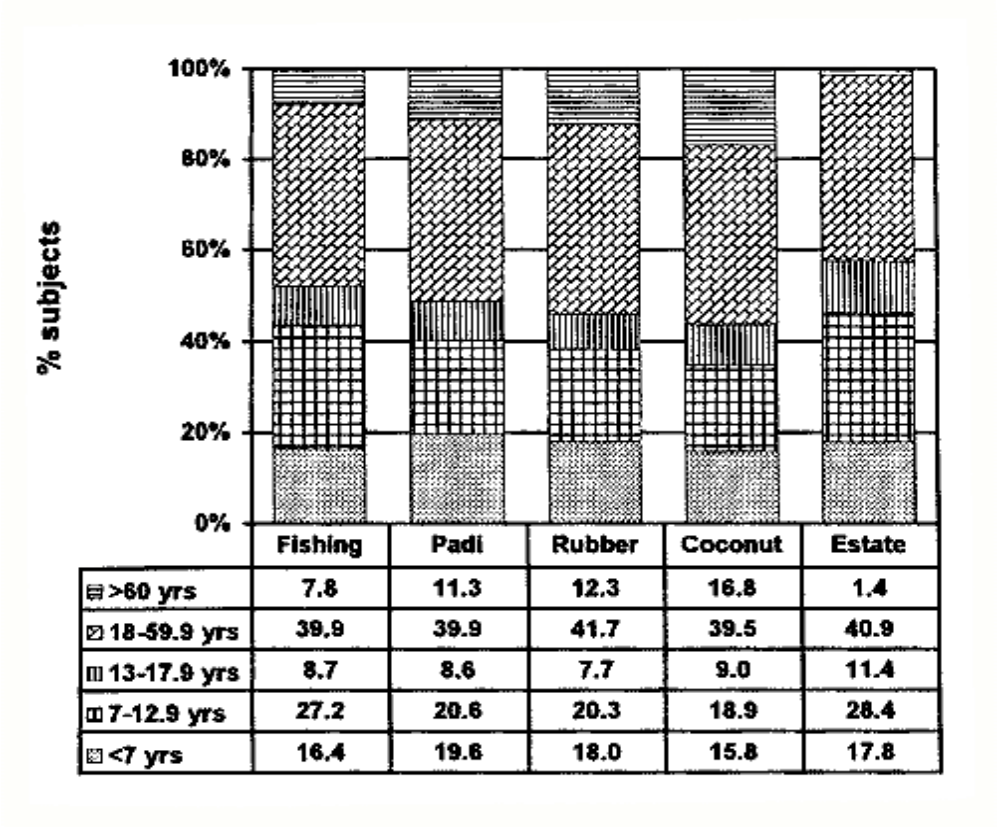
The adult subjects (18-59.9 years) comprised about 40% of the total number of subjects studied, the largest group in the study. The distribution of subjects among the different communities was also similar to that of the children studied. The number of male subjects was only half that of the females for most of the communities (male to female ratio ranged from 0.54 to 0.80, with a mean of 0.61 for the

communities combined). The elderly (≥60 years) group, on the other hand, comprised only 11% of the total number of subjects studied. The number of subjects for the different community types were therefore also very low, especially for the estate community where the number of subjects was only 11. The male to female ratio for all the communities combined was close to 1.0 but there was considerable variation amongst the 5 groups studied (ranging from 0.76 to 1.30).

The age distribution for each of the 5 communities studied (Figure 2) shows the greatest variation in proportions for the elderly subjects. The proportions for the other age groups are of the same order of magnitude for all the communities studied. For all age groups combined, there were higher proportions of subjects from padi farmers and rubber smallholders whereas the estate workers constituted the smallest group studied (Table 1f and Figure 3).

Age characteristics

The mean ages of children <7 years of age were similar in all the 5 communities studied (Table 2a-e). The mean age for the boys and girls in this age group for all the communities combined were both 4.3 years. As for the 7-12.9 years age group, the mean ages of the boys and girls were also very similar for all the community types, with a mean age of 9.8 years for both genders. A similar picture is seen for the adolescent group. All the community types had a mean age of about 15.1 years and was very similar for both sexes.



	Fishing	Padi	Rubber	Coconut	Estate
>60 yrs	7.8	11.3	12.3	16.8	1.4
18-59.9 yrs	39.9	39.9	41.7	39.5	40.9
13-17.9 yrs	8.7	8.6	7.7	9.0	11.4
7-12.9 yrs	27.2	20.6	20.3	18.9	28.4
<7 yrs	16.4	19.6	18.0	15.8	17.8

Figure 2. Distributation of study subjects by age groups and community types

Table 2. Age characteristics of subjects in the 5 communities

2(a) below 7 years

	Fishing			*Padi*			*Rubber*		
	Male	*Female*	*Both*	**Male**	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	4.2	4.3	4.2	4.3	4.4	4.4	4.2	4.2	4.2
Standard Deviation	1.8	1.8	1.8	1.6	1.7	1.7	1.7	1.8	1.8
Range	6.0	5.9	6.0	5.8	6.1	6.1	6.2	6.5	6.5
Minimum	1.0	1.0	1.0	1.2	0.9	0.9	0.8	0.5	0.5
Maximum	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
N	119	126	245	202	218	420	190	180	370

	Coconut			*Estate*			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	4.2	4.4	4.3	4.0	4.1	4.1	4.2	4.3	4.3
Standard Deviation	1.7	1.8	1.7	1.6	1.7	1.6	1.7	1.8	1.7
Range	6.0	5.9	6.0	5.7	5.9	5.9	6.2	6.5	6.5
Minimum	1.0	1.0	1.0	1.1	1.1	1.1	0.8	0.5	0.5
Maximum	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
N	121	127	248	69	66	135	701	717	1418

2(b) 7 – 12.9 years

	Fishing			*Padi*			*Rubber*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	9.9	9.8	9.9	9.8	9.8	9.8	9.9	9.6	9.7
Standard Deviation	1.8	1.7	1.7	1.7	1.7	1.7	1.8	1.6	1.7
Range	6.0	5.9	6.0	5.9	6.0	6.0	5.9	5.9	5.9
Minimum	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Maximum	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
N	205	201	406	209	233	442	216	202	418

	Coconut			*Estate*			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	9.8	10.0	9.9	9.7	9.8	9.8	9.8	9.8	9.8
Standard Deviation	1.7	1.5	1.6	1.7	1.6	1.7	1.7	1.6	1.7
Range	5.8	6.0	6.0	6.0	5.9	6.0	6.0	6.0	6.0
Minimum	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Maximum	12.8	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
N	148	148	296	120	96	216	898	880	1778

2(c) 13 – 17.9 years

	Fishing			*Padi*			*Rubber*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	14.8	15.0	14.9	15.1	15.0	15.1	15.0	15.6	15.3
Standard Deviation	1.5	1.5	1.5	1.4	1.3	1.3	1.3	1.5	1.4
Range	5.0	4.9	5.0	4.8	4.9	4.9	4.7	5.0	5.0
Minimum	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Maximum	17.9	17.9	17.9	17.9	17.9	17.9	17.7	17.9	17.9
N	54	75	129	84	101	185	77	82	159

	Coconut			*Estate*			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	15.1	15.2	15.2	15.2	14.7	14.9	15.0	15.1	15.1
Standard Deviation	1.4	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Range	4.9	4.9	4.9	4.7	4.4	4.8	5.0	5.0	5.0
Minimum	13.1	13.1	13.1	13.1	13.0	13.0	13.0	13.0	13.0
Maximum	17.9	17.9	17.9	17.8	17.5	17.8	17.9	17.9	17.9
N	73	68	141	39	48	87	327	374	701

2(d) 18-59.9 years

	Fishing			*Padi*			*Rubber*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	41.9	39.6	40.4	41.1	39.8	40.3	43.5	41.4	42.2
Standard Deviation	11.8	10.1	10.8	11.9	11.6	11.7	11.9	11.3	11.6
Range	41.6	41.6	41.6	41.4	41.7	41.7	41.8	41.7	41.8
Minimum	18.4	18.3	18.3	18.2	18.2	18.2	18.1	18.3	18.1
Maximum	59.9	59.9	59.9	59.6	59.9	59.9	59.9	59.9	59.9
N	213	381	594	302	555	857	321	538	859

	Coconut			*Estate*			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	45.0	41.9	43.2	38.1	35.5	36.6	42.3	40.2	41.0
Standard Deviation	11.5	10.3	10.9	10.6	8.8	9.7	11.8	10.9	11.3
Range	41.9	41.7	41.9	41.8	41.8	41.8	41.9	41.9	41.9
Minimum	18.1	18.3	18.1	18.0	18.0	18.0	18.0	18.0	18.0
Maximum	59.9	59.9	59.9	59.8	59.9	59.9	59.9	59.9	59.9
N	256	364	620	138	173	311	1230	2011	3241

2(e) ≥ 60 years

	Fishing			*Padi*			*Rubber*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	68.7	67.4	68.0	69.3	68.5	68.8	67.3	67.5	67.4
Standard Deviation	5.5	5.7	5.7	6.0	5.3	5.7	5.6	5.0	5.3
Range	19.5	20.7	20.7	23.0	23.0	23.0	21.5	21.5	21.5
Minimum	60.4	60.2	60.2	60.0	60.0	60.0	60.4	60.4	60.4
Maximum	79.9	80.9	80.9	83.0	83.0	83.0	81.9	81.9	81.9
N	50	66	116	111	131	242	123	130	253

	Coconut			*Estate*			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	68.5	66.7	67.7	71.0	71.1	71.0	68.4	67.6	68.0
Standard Deviation	6.2	5.1	5.8	4.7	3.3	3.8	5.9	5.3	5.6
Range	23.1	23.3	23.3	13.1	9.0	13.1	23.3	23.3	23.3
Minimum	60.2	60.3	60.0	64.7	64.7	64.7	60.0	60.0	60.0
Maximum	83.3	83.3	83.3	77.8	73.6	77.8	83.3	83.3	83.3
N	149	115	264	5	6	11	438	448	886

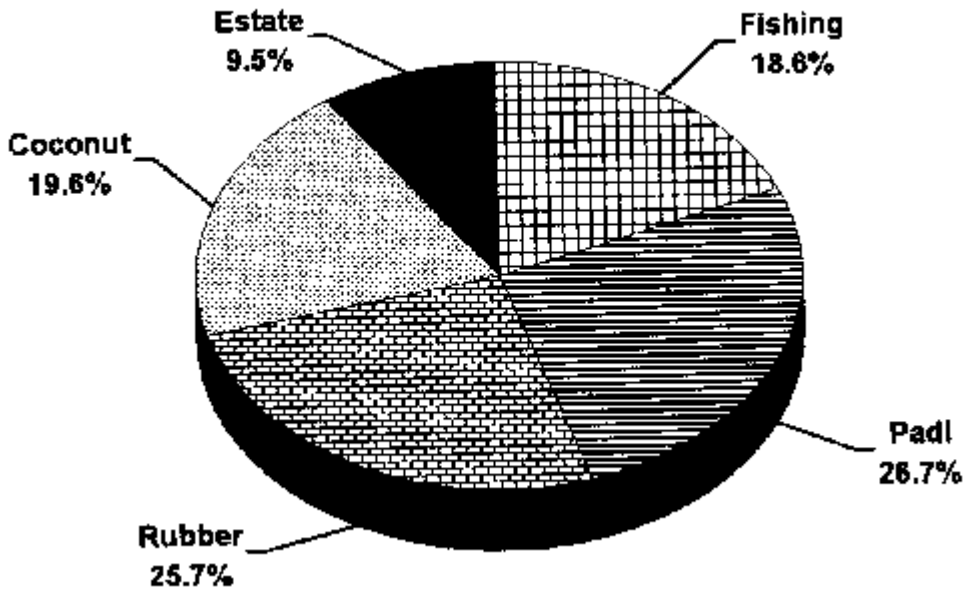


Figure 3. Distributation of study subjects by community groups

There appeared to be wider variation in the mean age for the adults and elderly groups between males and females as well as among the different community types. The mean age for the adult group was 41.0 years whilst that for the elderly group was 68.0 years. It should be noted that the proportions and means of the various age groups and gender represent those who attended the examination centres on the days of the survey, rather than the actual population of the various communities. The much higher proportions of adult women compared to adult men, for instance, may be attributed to more men being away at work. Similarly, there would be a greater tendency for younger children to be brought to the examination centres than for adolescents.

Haemoglobin levels and prevalence of anaemia

Tables 3a to 3e present the levels of Hb and the prevalence of anaemia for the male and female subjects and for the sexes combined according to the different age groups for each of the communities studied. Table 4 summarises the results of t-tests comparing Hb levels of male and female subjects for each age group, in each community type. Table 5 summarises the results of one-way ANOVA of mean Hb levels among the 5 types of communities for each age group.

In the group of young children (< 7 years), there was no significant difference in the mean Hb levels between the boys and girls for all the community types as well as for all the communities combined. The lowest mean Hb levels were observed for the fishing and estate communities (11.0 and 11.6 g/dl respectively). These two levels were not significantly different from each other but were significantly lower than the mean levels for the padi, rubber and coconut communities for both sexes as well as for the sexes combined.

Table 3. Haemoglobin levels (g/dl) and prevalence of anaemia of subjects in the 5 communities

3(a) < 7 years

	Fishing			*Padi*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	10.9	11.0	11.0	12.4	12.6	12.5
Standard Deviation	2.3	2.0	2.2	1.7	1.7	1.7
Range	11.7	9.8	11.7	10.8	11.0	12.2
Minimum	6.6	6.6	6.6	7.2	8.4	7.2
Maximum	18.3	16.4	18.3	18.0	19.4	19.4
No (%) anaemic	68 (57.1%)	68 (54.0%)	136 (55.5%)	34 (16.8%)	38 (17.4%)	72 (17.1%)
N	119	126	245	202	218	420

	Rubber			*Coconut*		
	Male	*Female*	Both	*Male*	*Female*	*Both*
Mean	12.6	12.6	12.6	12.2	12.3	12.2
Standard Deviation	1.5	1.3	1.4	1.4	1.3	1.3
Range	11.2	8.9	11.2	8.0	8.6	10.0
Minimum	7.7	8.2	7.7	6.9	8.3	6.9
Maximum	18.9	17.1	18.9	14.9	16.9	16.9
No (%) anaemic	23 (12.1%)	21 (11.7%)	44 (11.9%)	22 (18.2%)	21 (16.5%)	43 (17.3%)
N	190	180	370	121	127	248

	Estate			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	11.6	11.5	11.6	12.1	12.2	12.1
Standard Deviation	1.7	1.3	1.5	1.8	1.7	1.8
Range	11.6	6.4	11.6	12.3	12.8	12.8
Minimum	7.1	8.2	7.1	6.6	6.6	6.6
Maximum	18.7	14.6	18.7	18.9	19.4	19.4
No (%) anaemic	24 (34.8%)	22 (33.3%)	46 (34.1%)	171 (24.4%)	170 (23.7%)	341 (24.0%)
N	69	66	135	701	717	1418

*student's t-test comparing mean Hb levels of males and females in each community; significance difference if $p<0.05$

No significant difference between Hb levels of male and female subjects for all community groups

3(b) 7 –12.9 years

	Fishing			*Padi*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	11.8	11.8	11.8	13.7	13.7	13.7
Standard Deviation	2.3	2.0	2.1	1.6	1.8	1.7
Range	12.2	11.8	12.2	11.0	12.8	13.7
Minimum	7.0	7.4	7.0	9.3	6.6	6.6
Maximum	19.2	19.2	19.2	20.3	19.4	20.3
No (%) anaemic	107 (52.2%)	103 (51.2%)	210 (51.7%)	21 (10.0%)	28 (12.0%)	49 (11.1%)
N	205	201	406	209	233	442

	Rubber			*Coconut*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	13.5	13.6	13.5	13.0	13.1	13.0
Standard Deviation	1.4	1.4	1.4	1.0	1.1	1.1
Range	8.9	8.1	9.4	5.6	6.8	6.8
Minimum	9.1	10.4	9.1	9.5	9.0	9.0
Maximum	18.0	18.5	18.5	15.1	15.8	15.8
No (%) anaemic	23 (10.6%)	20 (9.9%)	43 (10.3%)	26 (17.6%)	22 (14.9%)	48 (16.2%)
N	216	202	418	148	148	296

	Estate			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	12.5	12.9	12.7	12.9	13.0	13.0
Standard Deviation	1.2	1.1	1.2	1.8	1.8	1.8
Range	8.0	5.6	8.0	13.3	12.8	13.7
Minimum	7.5	9.6	7.5	7.0	6.6	6.6
Maximum	15.5	15.2	15.5	20.3	19.4	20.3
No (%) anaemic	24 (20.0%)	15 (15.6%)	39 (18.1%)	201 (22.4%)	188 (21.4%)	389 (21.9%)
N	120	96	216	898	880	1778

*student's t-test comparing mean Hb levels of males and females in each community; significance difference if $p<0.05$
No significant difference between Hb levels of male and female subjects for all community groups

3(c) 13 –17.9 years

	Fishing			*Padi*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	12.5	12.4	12.5	14.7	13.8	14.2
Standard Deviation	1.8	2.5	2.3	2.0	1.3	1.7
Range	8.9	13.5	13.5	9.7	8.5	11.8
Minimum	8.5	6.6	6.6	10.6	8.5	8.5
Maximum	17.4	20.1	20.1	20.3	17.0	20.3
No (%) anaemic	26 (48.1%)	32 (42.7)	58 (45.0%)	11 (13.1%)	7 (6.9%)	18 (9.7%)
N	54	75	129	84	101	185

	Rubber			*Coconut*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	15.0	14.0	14.5	14.3	13.5	13.9
Standard Deviation	1.8	1.5	1.7	1.2	1.1	1.2
Range	10.3	8.1	10.3	6.0	5.4	6.8
Minimum	8.6	10.4	8.6	11.6	10.8	10.8
Maximum	18.9	18.5	18.9	17.6	16.2	17.6
No (%) anaemic	5 (6.5%)	4 (4.9%)	9 (5.7%)	5 (6.8%)	6 (8.8%)	11 (7.8%)
N	77	82	159	73	68	141

	Estate			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	13.2	12.2	12.6	14.1	13.3	13.7
Standard Deviation	1.7	1.4	1.6	1.9	1.8	1.9
Range	10.4	6.8	10.4	14.5	13.5	14.5
Minimum	5.8	8.1	5.8	5.8	6.6	5.8
Maximum	16.2	14.9	16.2	20.3	20.1	20.3
No (%) anaemic	13 (33.3%)	16 (33.3%)	29 (33.3%)	60 (18.3%)	65 (17.4%)	125 (17.8%)
N	39	48	87	327	374	701

*student’s t-test comparing mean Hb levels of males and females in each community; significance difference if $p<0.05$
Significant difference between Hb levels of male and female subjects for all community groups except for fishing community

3(d) 18 –59.9 years

	Fishing			*Padi*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	13.7	12.2	12.7	15.4	13.5	14.2
Standard Deviation	2.6	2.3	2.5	2.1	2.0	2.3
Range	12.9	13.5	14.0	15.4	15.1	15.4
Minimum	7.7	6.6	6.6	6.7	6.8	6.7
Maximum	20.6	20.1	20.6	22.1	21.9	22.1
No (%) anaemic	86 (40.4%)	187 (49.1%)	273 (46.0%)	31 (10.3%)	101 (18.2%)	132 (15.4%)
N	213	381	594	302	555	857

	Rubber			*Coconut*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	15.8	13.6	14.4	14.8	13.1	13.8
Standard Deviation	2.2	1.8	2.2	1.6	1.6	1.8
Range	16.2	16.3	17.2	12.2	11.1	12.6
Minimum	6.3	7.2	6.3	6.6	6.2	6.2
Maximum	22.5	23.5	23.5	18.8	17.3	18.8
No (%) anaemic	23 (7.2%)	78 (14.5%)	101 (11.8%)	23 (9.0%)	75 (20.6%)	98 (15.8%)
N	321	538	859	256	364	620

	Estate			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	14.9	12.3	13.4	15.0	13.1	13.8
Standard Deviation	1.4	1.8	2.1	2.2	2.0	2.3
Range	11.2	11.3	11.8	16.2	17.3	17.3
Minimum	7.9	7.3	7.3	6.3	6.2	6.2
Maximum	19.1	18.6	19.1	22.5	23.5	23.5
No (%) anaemic	12 (8.7%)	64 (37.0%)	76 (24.4%)	175 (14.2%)	505 (25.1%)	680 (21.0%)
N	138	173	311	1230	2011	3241

*student's t-test comparing mean Hb levels of males and females in each community; significance difference if $p<0.05$

Significant difference between Hb levels of male and female subjects for all community groups

3(e) ≥ 60 years

	Fishing			*Padi*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	12.1	11.9	12.0	14.4	13.5	13.9
Standard Deviation	2.4	2.1	2.2	2.7	1.9	2.3
Range	10.0	9.1	10.0	13.5	14.4	15.3
Minimum	7.9	8.8	7.9	8.6	6.8	6.8
Maximum	17.9	17.9	17.9	22.1	21.2	22.1
No (%) anaemic	33 (66.0%)	36 (54.5%)	69 (59.5%)	22 (19.8%)	21 (16.0%)	43 (17.8%)
N	50	66	116	111	131	242

	Rubber			*Coconut*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	14.5	13.5	14.0	14.2	13.2	13.7
Standard Deviation	2.0	1.7	1.9	1.6	1.3	1.5
Range	11.0	12.6	12.6	9.6	6.9	9.6
Minimum	9.3	7.7	7.7	9.2	10.0	9.2
Maximum	20.3	20.3	20.3	18.8	16.9	18.8
No (%) anaemic	18 (14.6%)	19 (14.6%)	37 (14.6%)	29 (19.5%)	21 (18.3%)	50 (18.9%)
N	123	130	253	149	115	264

	Estate			*All*		
	Male	*Female*	*Both*	*Male*	*Female*	*Both*
Mean	14.8	12.9	13.8	14.1	13.2	13.6
Standard Deviation	1.3	2.6	2.2	2.2	1.8	2.1
Range	3.4	7.3	8.5	14.2	14.4	15.3
Minimum	13.4	8.3	8.3	7.9	6.8	6.8
Maximum	16.8	15.6	16.8	22.1	21.2	22.1
No (%) anaemic	0	2 (33.3%)	2 (18.2%)	102 (23.3%)	99 (22.1%)	201 (22.7%)
N	5	6	11	438	448	886

*student's t-test comparing means of males and females in each community; significance difference if $p<0.05$

Significant difference between Hb levels of male and female subjects for all community groups except for fishing community.

Significance test not performed for estate community as the sample size was extremely small.

Table 4. Independent sample t-tests comparing Hb levels of male and female subjects for each age group, in each community

4(a)

	t-value	*p-value*		*t-value*	*p-value*		*t-value*	*p-value*
< 7 years			7-12.9 years			13-17.9 years		
Fishing	-0.49	0.619	Fishing	0.15	0.882	Fishing	0.23	0.815
Padi	-0.86	0.387	Padi	0.26	0.795	Padi	3.53	<0.001
Rubber	0.40	0.687	Rubber	-1.11	0.266	Rubber	3.81	<0.001
Coconut	-0.97	0.332	Coconut	-1.18	0.237	Coconut	4.06	<0.001
Estate	0.27	0.787	Estate	-1.96	0.051	Estate	3.10	0.002
All	-0.72	0.474	All	-1.24	0.214	All	5.88	<0.001

4(b)

	t-value	*p-value*		*t-value*	*p-value*
18-59.9 years			≥ 60 years		
Fishing	7.6	<0.001	Fishing	0.41	0.683
Padi	13.3	<0.001	Padi	3.21	0.002
Rubber	16.4	<0.001	Rubber	4.22	<0.001
Coconut	13.4	<0.001	Coconut	5.45	<0.001
Estate	13.6	<0.001	Estate	1.46	0.178
All	26.2	<0.001	All	6.73	<0.001

Table 5. One-way ANOVA of mean Hb levels among the 5 types of communities

	Male	*Female*	*Both*
< 7 years			
F ratio	22.74	25.26	47.60
F probability	<0.001	<0.001	<0.001
Fishing	a	a	a
Padi	b	b	b
Rubber	b	b	b
Coconut	bc	b	b
Estate	ac	a	a

	Male	*Female*	*Both*
7-12.9 years			
F ratio	44.31	46.11	90.05
F probability	<0.001	<0.001	<0.001
Fishing	a	a	a
Padi	b	b	b
Rubber	bc	bc	b
Coconut	bc	bc	c
Estate	c	c	c

	Male	*Female*	*Both*
13-17.9 years			
F ratio	21.08	17.34	36.89
F probability	<0.001	<0.001	<0.001
Fishing	a	a	a
Padi	b	b	b
Rubber	b	b	b
Coconut	b	b	b
Estate	a	a	a

	Male	*Female*	*Both*
18-59.9 years			
F ratio	35.67	42.69	58.32
F probability	<0.001	<0.001	<0.001
Fishing	a	a	a
Padi	bc	b	b
Rubber	b	b	b
Coconut	c	c	c
Estate	bc	a	c

	Male	*Female*	*Both*
≥60 years			
F ratio	13.66	10.77	23.69
F probability	<0.001	<0.001	<0.001
Fishing	a	a	a
Padi	b	b	b
Rubber	b	b	b
Coconut	b	b	b
Estate	ab	ab	b

Cells with different superscripts in the same column are significantly different by Bonferroni test.

There was no significant difference in mean Hb levels of these three latter communities. The prevalence of anaemia was also highest in the fishing and estate communities, that is 55.5% and 34.1% respectively. Prevalence of anaemia among the three other communities was less than 18% or three and two times lower than the prevalence in the fishing and estate communities respectively. The lowest prevalence (about 12%) was observed for the rubber smallholder community. It is also noteworthy that the prevalence of anaemia in this group of children below 7 years old were similar for both sexes in all the community types.

A similar pattern was observed for the primary school-age children (7-12.9 years) in that there was no significant difference in mean Hb levels between the boys and girls for all the community types as well as for the communities combined. The lowest mean Hb levels (11.8 and 12.7 g/dl respectively) were again observed for the fishing and estate communities which were significantly lower than mean levels for the other three communities. The mean Hb level for the coconut community (sexes combined) was also significantly lower than levels for the padi farmers and rubber smallholders. The highest prevalence of anaemia was again observed for the fishing community (51.7%). The prevalence of anaemia amongst the four remaining communities was not more than 20% with the lowest prevalence of about 10% observed for the padi and rubber communities. It can also be observed that there were no marked differences in the prevalence of anaemia amongst boys and girls for all the communities studied.

Among the adolescents (13-17.9 years), the female subjects had significantly lower mean Hb levels than the male for all the community groups, except for the fishing community in which there was no significant difference. Comparing mean Hb levels amongst the various communities, the fishing and estate communities again had significantly lower mean levels (respectively, 12.5 and 12.6 g/dl). The mean Hb levels of the remaining three communities were not significantly different from each other. As for the previous two age groups, the prevalence of anaemia was again the highest amongst the fishing and estate communities (45.0 and 33.3% respectively). At only about 6%, the prevalence was lowest amongst the rubber community.

For all community types, the mean level of Hb of the adult male subjects were significantly higher than that for the female subjects. The distribution of the Hb level of the male subjects for all the communities combined was generally higher than that for the female subjects (Figure 4). For the female subjects, the lowest Hb levels were observed for the fishing and estate communities (12.2 and 12.3 g/dl respectively) which were sigificantly lower than the other three communities whereas the level of the coconut community was significantly lower than that for the padi and rubber communities. The prevalence of anaemia was observed to be higher amongst the female subjects for all the 5 community types; about twice in the case of padi, rubber and coconut and about 5 times in the

case of subjects in the estates. The prevalence was highest amongst the fishing and estate communities, as was observed for all the other age groups. With almost half (49.1%) of the female subjects grouped as anaemic for the fishing community, the prevalence was about 2.5 times higher than subjects in the padi, rubber and coconut communities. The lowest prevalence of anaemia was observed for the women in the rubber smallholders community. The adult male subjects in the fishing community also had a surprisingly high prevalence of about 40% or about 6 times the prevalence observed for the male subjects in the rubber smallholders community.

When the adult subjects were examined for prevalence of moderate and severe anaemia (Hb <9 g/dl), the prevalence was 1.0% amongst men, 3.0% amongst women and 2.3% for both sexes combined. This prevalence appeared to be lower than the data reported by the Information and Documentation System (IDS) of the Ministry of Health in 1993, which varied from 1.1% in Perlis to 13.4% for Sabah and a national average of 5.0%.

For the elderly group, the mean Hb values of the males were also higher than those of the females for all the community types but were not significantly different for the fishing and estate communities. The fishing community again had the lowest mean Hb level which was significantly different for the female subjects (11.9 g/dl), compared with

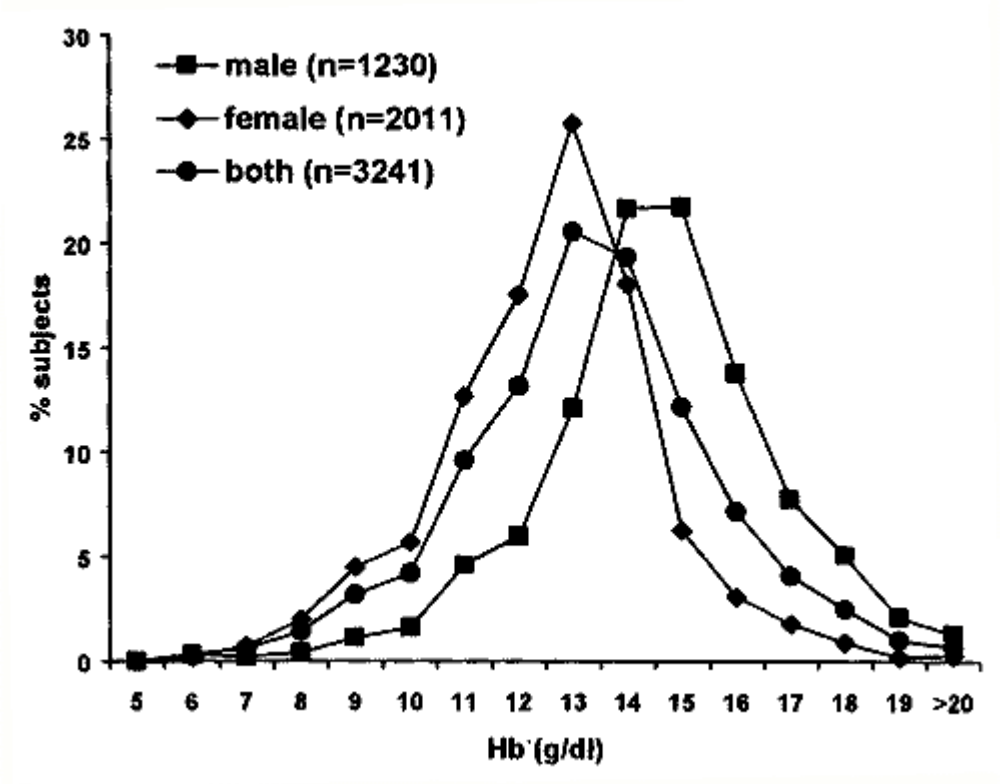
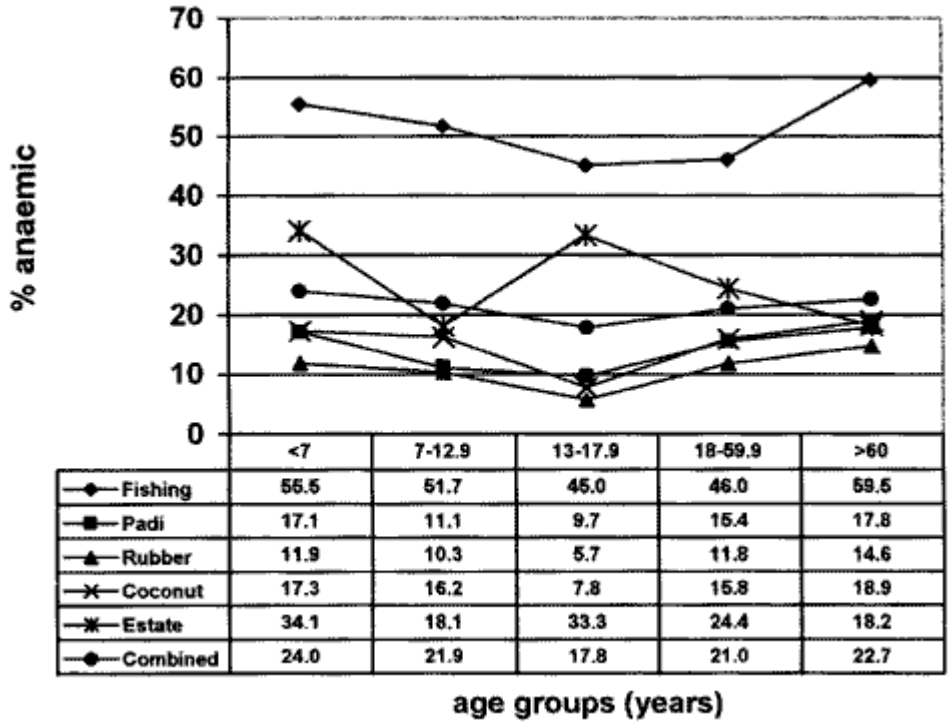


Figure 4. Distributation of Hb levels of adult subjects by sex

other communities. The situation was slightly different for the elderly subjects with regards to prevalence of anaemia: there were more anaemic men than women in the fishing, padi and coconut communities as well as when all community types were combined. Prevalence was again highest amongst the fishing community where 66% of the men and 54.5% of women had low Hb levels.

There was a generally similar pattern of mean Hb level for the different community types with increasing age (Figure 5). Except for the estate community, mean Hb increased with age and peaked for the adolescent subjects. Thereafter, mean Hb level declined slightly for the adults and thence further declined for the elderly group. For all the age groups, mean Hb levels were the lowest for the fishing and the estate communities. The generally lower Hb status of the under 7 years and 7-12.9 years children of all community types combined is also seen in the Hb distribution curves which are shifted to the left compared to the curves for the other age groups (Figure 6). This pattern of Hb level for the different age groups is also reflected in the plot of Hb levels of subjects for each age group for all the communities combined (Figure 7).

Comparing the prevalence of anaemia for the different age groups and sexes combined, a similar pattern for all the communities studied (except the fishing community) can be observed



	<7	7-12.9	13-17.9	18-59.9	>60
Fishing	55.5	51.7	45.0	46.0	59.5
Padi	17.1	11.1	9.7	15.4	17.8
Rubber	11.9	10.3	5.7	11.8	14.6
Coconut	17.3	16.2	7.8	15.8	18.9
Estate	34.1	18.1	33.3	24.4	18.2
Combined	24.0	21.9	17.8	21.0	22.7

Figure 5. Mean Hb values by age groups and community types, sexes combined

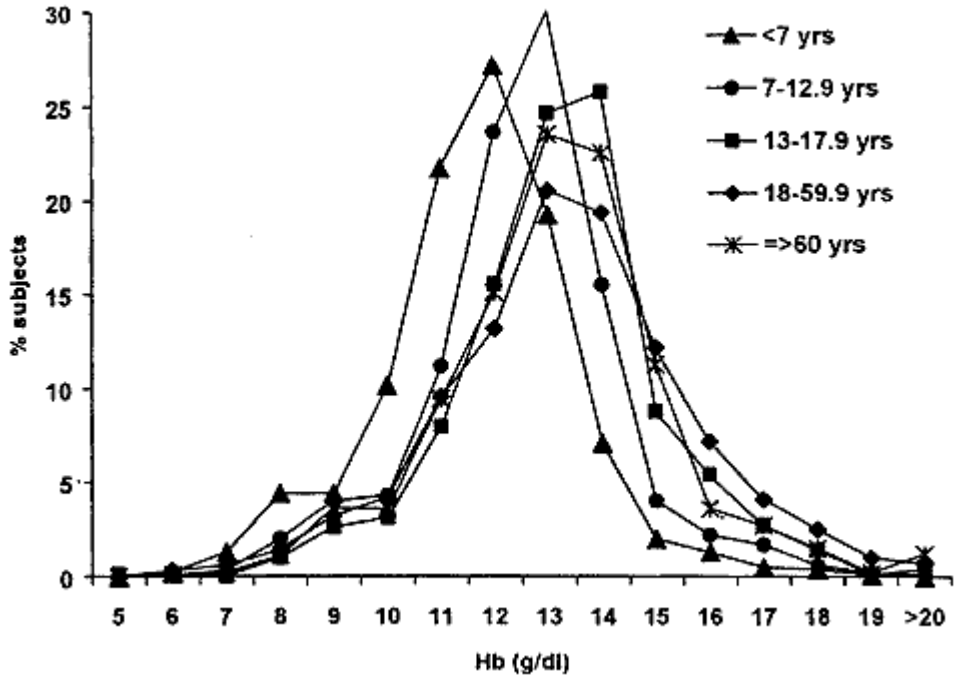


Figure 6. Distributation of Hb levels of subjects in different age groups, both sexes, all communities combined

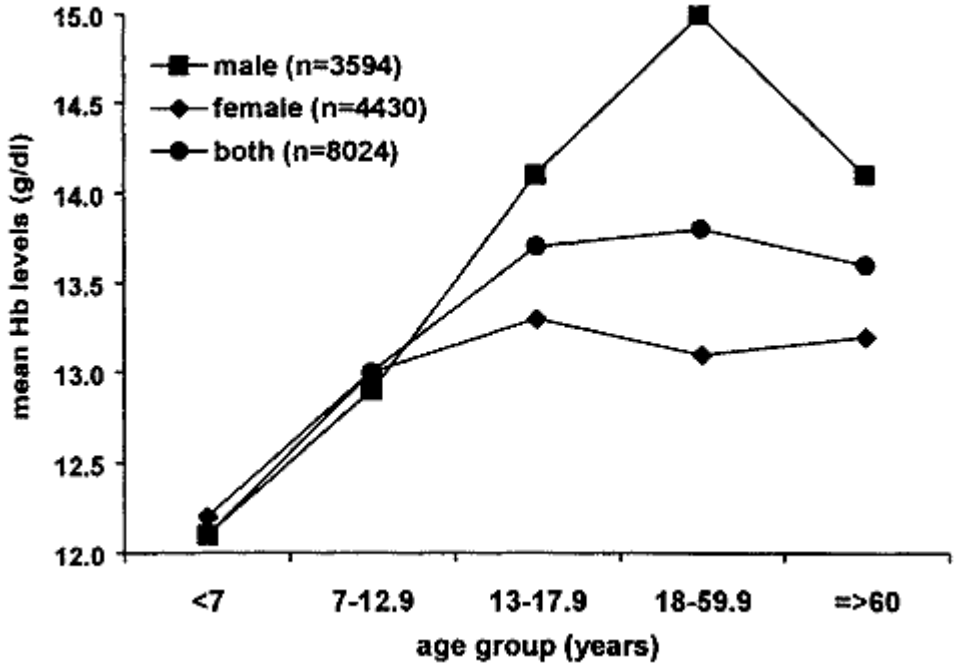
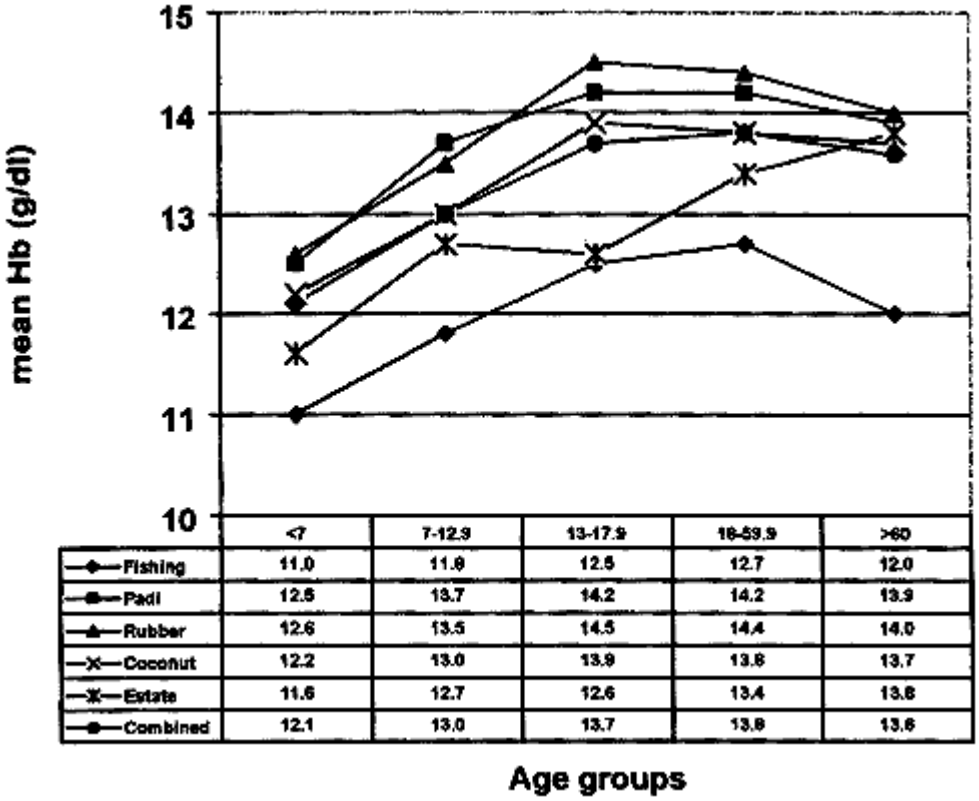


Figure 7. Mean Hb values of subjects according to age group and gender



	<7	7-12.9	13-17.9	18-59.9	>60
Fishing	11.0	11.9	12.5	12.7	12.0
Padi	12.5	13.7	14.2	14.2	13.9
Rubber	12.6	13.5	14.5	14.4	14.0
Coconut	12.2	13.0	13.9	13.8	13.7
Estate	11.6	12.7	12.6	13.4	13.8
Combined	12.1	13.0	13.7	13.8	13.6

Figure 8. Prevalence of anaemia by age group and community type, sexes combined

(Figure 8). This pattern was similar to that observed for mean Hb levels. The prevalence was relatively highest amongst the youngest age group (<7 years), declined for the older children and further declined for the adolescent group. The prevalence then rose amongst the adults and continued to rise in the elderly group to a level which is similar to or higher than that of the young children group. Prevalence of anaemia was the highest amongst the fishing community and for all age groups in this community. The problem was next highest for the estate community. The lowest prevalence was observed for the rubber smallholders, and for all the age groups. This pattern in Hb level and prevalence of anaemia was not observed for the estate community. The pattern of prevalence of anaemia for the different age groups when the community types are combined is summarised in Figure 9. For all age groups, except for the adults, it can also be seen that the prevalence for the male and female subjects was similar, although the former were slightly higher than that for the females. For the adults, the prevalence amongst female subjects were about twice that of the adult men.

The data obtained in this study are compared with a relatively large scale study (n=2,794) conducted by the IMR between 1979 and 1983 on 14 rural poverty villages in 4 states of Peninsular Malaysia (Chong et al.,

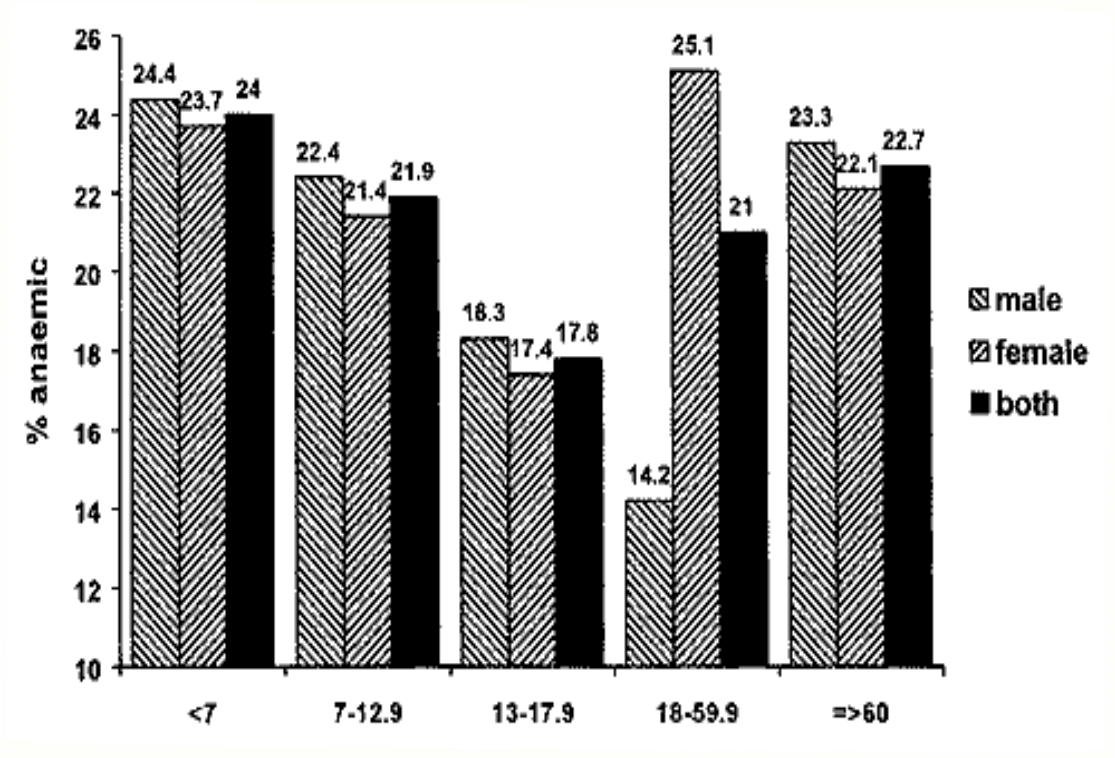


Figure 9. Prevalence of anaemia by age group and gender

1984). The method of Hb analysis and the cut-offs used to determine prevalence of anaemia were the same as the present study. The age groupings used, although slightly different for the two studies, are not expected to affect the comparison. The sample sizes for the IMR study were however much smaller for all the age groups compared to the present study.

When the mean Hb levels and the prevalence of anaemia in the study of Chong et al. (1984) (Table 6) were compared with the present study (Table 3), it was found that anaemia was was more severe in the former study for children below 6 years of age, primary school children (6-11.9 years), adolescent boys (12-17.9 years) and elderly men. The prevalence of anaemia in these groups were, on the average, about 35% higher than the corresponding groups in the present data.

This difference was not observed for the adolescent girls, adult women and elderly women, where the prevalence of anaemia reported for the two studies are not different by more than 15%. On the other hand, the prevalence of anaemia among adult men in the present study was double that reported for the earlier study.

It should however be pointed out that although the overall picture

Table 6. Haemoglobin levels (g/dl) and prevalence of anaemia in poverty villages of Peninsular Malaysia

	1.0-5.9 yrs	*6.0-11.9 yrs*	*12-17.9 years*	
	Both sexes	*Both sexes*	*Male*	*Female*
Mean	11.6	12.3	13.6	13.2
Standard Deviation	1.7	1.5	1.5	1.3
% anaemic	33.0	39.0	32.0	15.0
N	512	910	148	183

	18-45.9 years		‡*46 years*	
	Male	*Female*	*Male*	*Female*
Mean	15.3	13.1	13.7	12.7
Standard Deviation	1.8	2.0	1.9	1.7
% anaemic	7.0	25.0	32.0	24.0
N	210	493	154	184

Source: Chong et al., 1984

obtained from the present study appeared to be better than those of the earlier study, the situation among the fishing community, which is the worst of all the community types, did not differ from the two areas in the earlier study, namely Kota Baru and Baling. Overall, it may be said that the problem of iron deficiency anaemia among the various communites in the present study are less severe than that reported for the poverty villages by the IMR some 10 years ago.

Concluding Remarks

This study on the prevalence of anaemia as determined by Hb levels is the most comprehensive to date, both in terms of sample size as well as coverage throughout Peninsular Malaysia. It showed that the extent of anaemia varied considerably amongst the various age groups and community types. In some communities, the problem affected about half of the population whereas in others, the prevalence was less than 10%.

The pattern of severity of anaemia amongst the various age groups is similar amongst almost all the community types studied. The prevalence was highest amongst the youngest age group (<7 years), declined for the older children and further declined for the adolescent group. The prevalence then rose amongst the adults and continued to rise in the elderly group to a level which is similar to that of the young children group.

Overall, the problem of anaemia appeared to be most serious amongst the youngest group of subjects (<7 years) (both sexes), primary school-age children (both sexes), adult women and elderly group (both

sexes). The average prevalence of low Hb among these groups was about 23%. The lowest prevalence of anaemia was observed for the adult men and adolescents (about 16%). For all the age groups, there was no differences in the prevalence of anaemia between males and females subjects, with the exception of the adults (18 years and above). The prevalence of anaemia amongst adult females (25%) was almost twice that of the adult males (14%). It is noteworthy that the poverty village study reported by Chong et al. (1984) likewise found the prevalence of anaemia amongst women of childbearing age to be more than 3-fold higher than their male counterpart.

Upon examining the anaemia problem amongst the community types, it was observed to be most serious in the fishing community. Amongst young children, the prevalence of anaemia was about 56%, about 52% amongst primary school-age children, 45% amongst adolescents, 49% amongst adult females and 60% amongst the elderly subjects. On the other hand, the rubber smallholders had the lowest prevalence of anaemia; even amongst the worst affected age group (young children), the prevalence was only 17%.

The problem of anaemia as observed among the various communites in the present study were generally less serious than that reported for the 14 rural poverty villages in Peninsular Malaysia some 10 years ago by the IMR. Among preschool and primary school children, adolescent boys and elderly men, the prevalence of anaemia was 35% lower in the present study.

In view of the continued persistence of anaemia over the years, the extent of the problem needs to be closely monitored systematically, especially in the sectors of the population at highest risk, like preschool and school children and adult women, in particular, women of childbearing age. Intervention programmes for these population groups need to be continued and even intensified for communities most severely affected. No efforts should be spared in promoting the consumption of iron-rich foods. Since young children are amongst the most seriously affected groups, nutrition education should be given greater emphasis. Food-based intervention programmes remain the long-term solution to eradication of the problem. Food fortification can also contribute towards increased iron intake. For women of childbearing age, the emphasis should be on ensuring a satisfactory iron status before pregnancy. Approaches to reaching the non-pregnant women, including adolescent girls, should thus be given greater attention.

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