NUTRITIONAL DISORDERS ENCOUNTERED IN CHILDREN IN THE DEPARTMENT OF PAEDIATRICS, SINGAPORE

By F. M. Paul

SYNOPSIS

Ninety-six cases of severe malnutrition and associated nutritional disorders were encountered in children in the department of paediatrics for the year 1971.

The predominant age group was in children under the age of two years.

Malay and Indian children were affected more than the Chinese children with malnutrition.

Protein caloric malnutrition had already affected the growth pattern of these children as the majority were below the 50th percentile in height and weight comparing them with Hong Kong childrens' height and weight standards. Seventy-five per cent of the children presented with infection.

Fifty-four per cent of the families with malnutrition had three to six children and in two thirds of the families the income was from $100/- to $249/- per month.

Forty per cent of the children lived in the kampong type of houses with no proper sanitation. Worm infestation was common in this group.

The mean haemoglobin, serum iron levels, and serum folic acid levels were lower in the Indians and Malays.

Protein caloric malnutrition must be treated early because of its irreversible effects on brain and bone growth.

It is recommended that some form of allowance either in the form of food or money be given to these children from poor social-economic background.

When the diet is suboptional because of lack of quality certain recognisable dietary deficiency syndromes result, such as dwarfism and underweight due to protein deficiency, or anaemia due to lack of iron and folic acid, or blindness due to lack of Vitamin A, or rickets due to lack of Vitamin D. Malnutrition occurs in various degrees and in the children's ward malnutrition is a major socio-economic problem. Wong in 1970 showed that using weight as a criteria of malnutrition and excluding all long term illnesses which would cause underweight approximately one out of four children admitted to the paediatric unit would be malnourished. Of course, infection follows malnutrition like a shadow and the majority would be admitted for infection rather than malnutrition per se.

Wong (1970) has shown that 50% of all deaths are due to infection in the paediatric department and knowing the close relation between malnutrition and infection he states that this constant mortality due to infection is in large measure due to malnutrition.

The purpose of this survey was to study the severe nutritional disorders encountered in the children admitted to the department of paediatrics over a one year period from January 1971 to December 1971. Ninety-six cases were studied in detail and this would represent only 2% of all admissions to the department of paediatrics, i.e. these are the very bad cases or the cases seen at the peak of the malnutrition curve.

The criteria used for selection were the weight and height of the children which was below the 50th percentile using Hong Kong standards, the clinical state of marasmus and malnutrition and the haemoglobin of the child which was below 10 grams%. All endocrine causes and all other chronic illnesses which would cause gross underweight and stuntedness were excluded from the study. All other causes of anaemia, like Thalassaemia were excluded from this study. Haemoglobin estimations were done by the M.R.C. grey wedge haemoglobinometer, peripheral blood films were stained with Leishman's stain. Bone marrow aspirations were done wherever possible and the bone marrow specimens were also stained for iron. Serum folic acid levels were done by biological assay using Lactobacillus casei.

Age Distribution

It will be noted from Fig. 1 that over 50% of the children with malnutrition occurred in children under the age of two years. The first two

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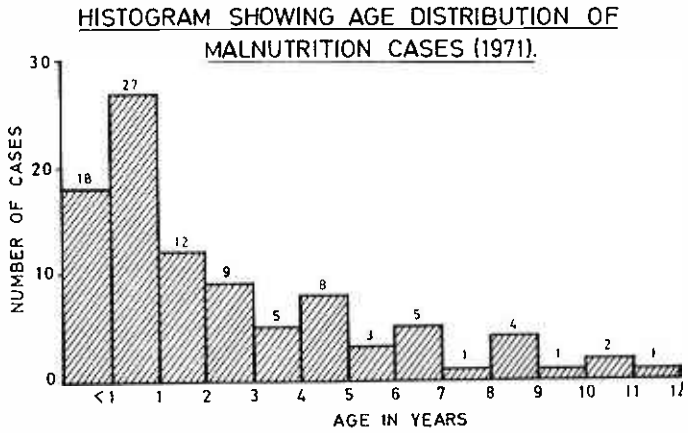

Fig. 1. Note that 51 of the 96 cases were in children under the age of two years.

years are a very vital period in the child's life when the brain grows very rapidly. Any nutritional deficiency particularly protein deficiency will affect the growth and function of the brain cell.

From Fig. 2 it will be seen that the predominance of nutritional deficiencies occurred in children under the age of two years in all three ethnic groups. This was closely related with the feeding habits of all three ethnic groups as shown by Selinus in 1972. She found that the feeding habits of infants below the age of six months did not differ much between the three ethnic groups. The child is kept on a liquid diet up to the age of six to seven months of age. Breast feeding and partial breast feeding were getting rare in Singapore (1971) and very often the mother would receive free samples of milk powder

CORRELATION OF THE AGE GROUP WITH THE ETHNIC GROUP AFFECTED WITH NUTRITIONAL DEFICIENCIES

Age-Group	Chinese	Malay	Indians
Under 1 year	9	8	1
1 year	13 } 66%	9 } 53%	6 } 56%
2 years	4	5	2
3 years	3	5	1
4 years	1	2	2
5 years	1	6	1
6 years	1	2	0
7 years	1	3	1
8 years	0	1	0
9 years	3	0	1
10 years	1	0	0
11 years	2	0	0
12 years	0	0	1
TOTAL	39	14	16

Fig. 2. Note that over 50% of the children with malnutrition in all ethnic groups occurred in children two years and below.

for the child in the maternity hospital or the maternal and child health centre and the mother would often keep to the same brand. If she cannot afford to give the proper amount she would give a more dilute milk or condensed milk. Imported baby cereals are given to the child from the third month but this is often given as a thin gruel from the feeding bottle. Rice water is also given from the third month and the child is kept on the liquid diet till six or seven months of age. Eggs are very seldom given to the small child under one year in all three ethnic groups.

For babies from six to eleven months with a tight family budget it is impossible to afford patent baby food and powdered milk, so a dilute condensed milk with over-cooked rice is given. A sprinkle of meat or fish with soya sauce is added.

The child is introduced to the family diet at the age of one year. The amount of meat, fish and vegetables in the diet would differ much. Being the youngest member of the family the older children at the table would often consume more of the food than the youngest sibling at the family dining table.

Sex Distribution

It will be noted from Fig. 3 that more male children than female children were affected with nutritional disorders and comparing this with the population of Singapore the difference between the male and female children is statistically significant with a probability of occurring by chance of less than 0·01. This is because of the preference of male children to female children in certain ethnic groups and if a male child was ill the parents would bring the child more readily than a female child. This male preponderance was also encountered in another series by Tan (1972) of nutritional anaemia in Singapore children.

DISTRIBUTION OF MALNUTRITION CASES BY AGE AND SEX.

SEX / AGE (YEARS)	MALE		FEMALE		TOTAL	
	Number	Percent	Number	Percent	Number	Percent
Under 1	14	77·7	4	22·3	18	100
1 –	19	70·4	8	29·6	27	100
2 –	10	83·0	2	17·0	12	100
3 –	4	44·4	5	55·6	9	100
4 –	4	80·0	1	20·0	5	100
5 –	7	87·5	1	12·5	8	100
6 –	1	33·3	2	66·7	3	100
7 –	4	80·0	1	20·0	5	100
8 –	0	0·0	1	100·0	1	100
9 –	3	75·0	1	25·0	4	100
10 –	1	100·0	0	0·0	1	100
11 –	1	50·0	1	50·0	2	100
12 – under 13	0	0·0	1	100·0	1	100
TOTAL	68	70·8	28	29·2	96	100

Note: Statistically more males than females, especially in children under five ($p = < \cdot 01$).

Fig. 3. Note that more males than females were affected with malnutrition in this series.

Racial Distribution

Nutritional disorders from our study as in the other series by Tan (1972) were more common among Malays and Indians compared with Chinese. This was probably related to the economic status of the Indian and Malay families and also to the eating habits of the Chinese who are relatively good eaters. The method of preparation of the food is equally important as the Indians and Malay tend to overcook the vegetables which would destroy folic acid giving rise to megaloblastic anaemia.

As seen from Figs. 5(a) and 5(b) the majority of our cases with nutritional deficiencies fell below the 50th percentile in weight, using the weight of southern Chinese children in Hong Kong (Chang *et al*, 1965). If percentile charts of Caucasian children were used the low weight would be even more marked. It should be noted that in both males and females there were a number of the age of five and six years who were nutritionally well below the 3rd percentile in weight.

Height of the Malnutrition children

Selinus (1972) showed among a study of infants and children in Singapore that most of the children with a weight for age below the malnutrition border line (W.R.R.O. standard) had a height for age falling in the middle sector. In this series too it will be seen from Figs. 6(a) and 6(b) that the majority of the children were below the 50th percentile in height using Hong Kong Chinese height as normals. Note that in both Malay female and male children there were some children who were nutritional dwarfs at the age of three years and above. The stuntedness is related to food intake, particularly proteins and calories. When the supply of calories is insufficient the protein supplied through the food or protein stores in the human body will be used for energy. Selinus (1972) has shown that the protein intake for the poor growers was not as high as the good growers and in addition the caloric deficiency was larger. Therefore one would expect a large part of the protein consumed would be used for energy production and in addition the protein intake may also be used for energy and will result in protein caloric malnutrition and nutritional dwarfism.

DISTRIBUTION OF MALNUTRITION CASES BY RACE

	Cases of Malnutrition		Singapore Population
	Number	Per cent	
Chinese	39	40·6	76·2
Malay	41	42·7	15·0
Indian/Pakistan	16	16·7	6.7
Others	0	0·0	2·1
TOTAL	96	100·0	100·0

Fig. 4. Note that there are more Malay and Indian children affected with malnutrition than Chinese children.

Note: There are more Malays in sample compared to the general population (p = <·01) There are more Indians in sample compared to the general population (p = <·01) There are less Chinese in sample compared to the general population (p = <·01).

Primary Presenting Symptoms

75% of the children were admitted not because of nutritional disorders or malnutrition but because of infection, as seen in Fig. 7. Gastroenteritis was the primary cause in 32·3% of cases and respiratory disorders in 16·6% of cases. Other infections included measles, haemorrhagic fever, tuberculosis,

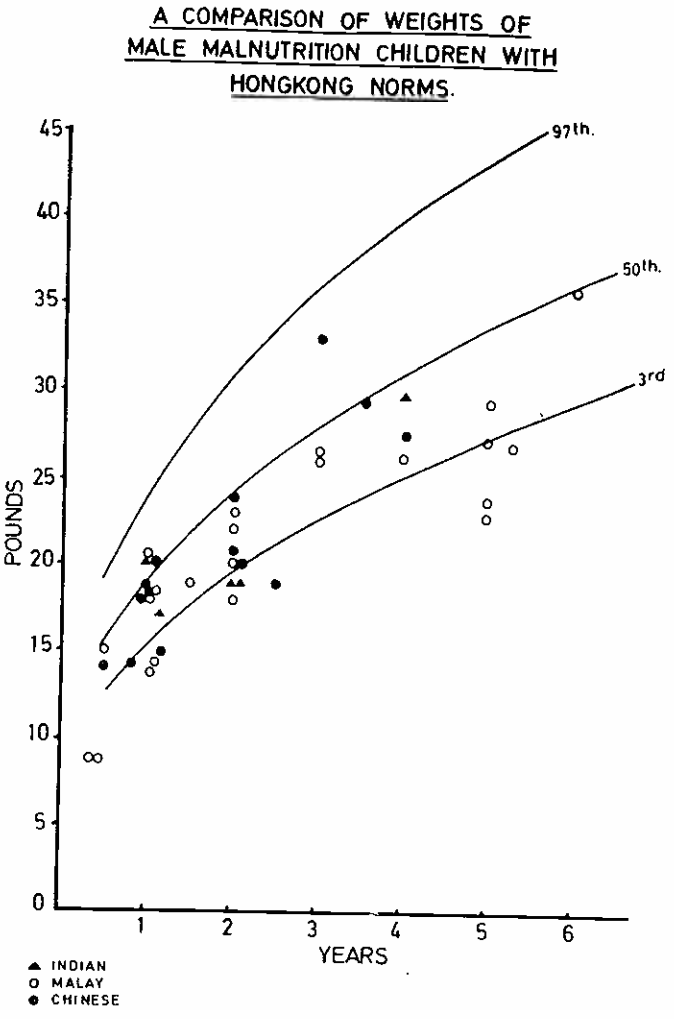

Fig. 5(a).

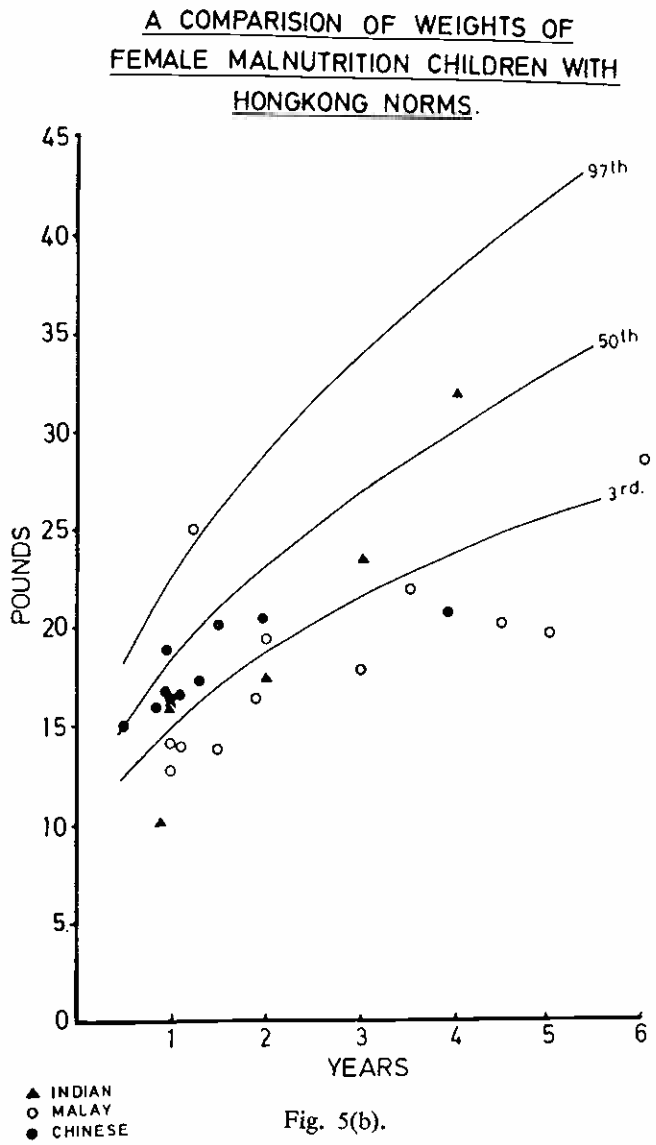

Fig. 5(b).

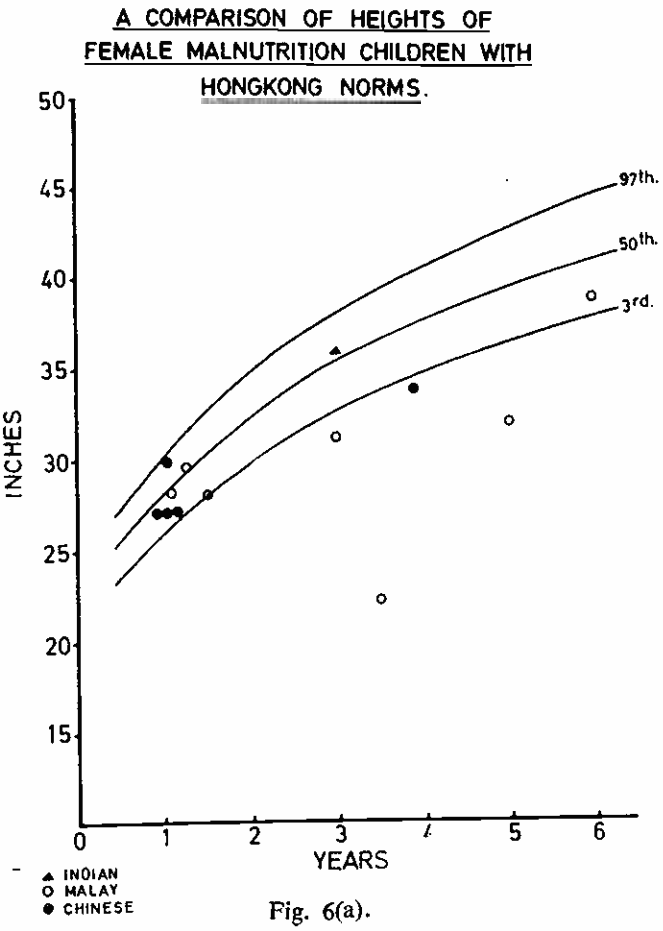

Fig. 6(a).

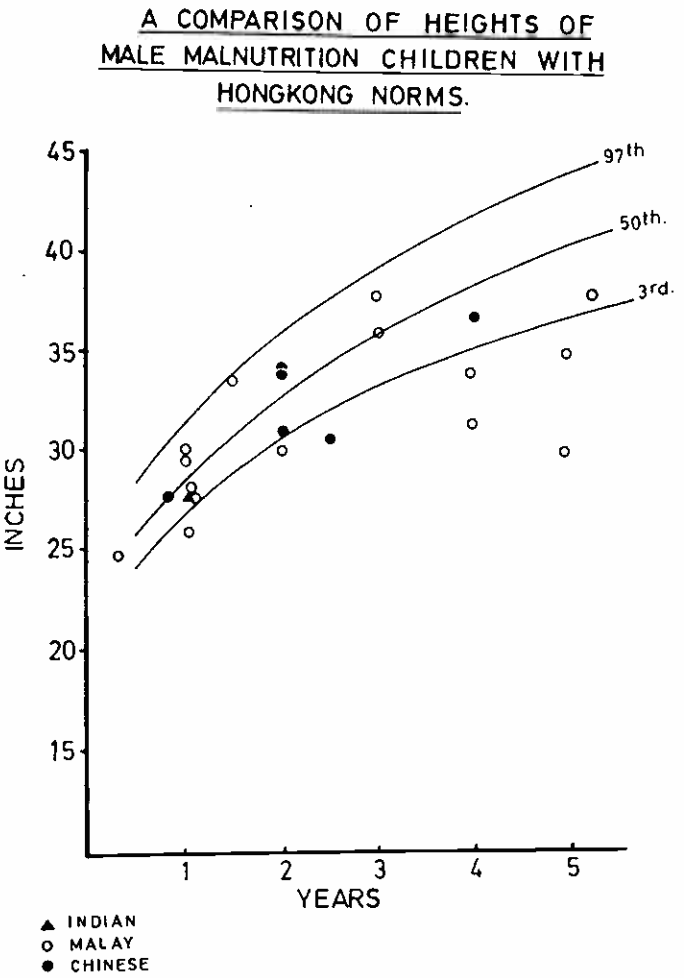

Fig. 6(b).

malaria, acute nephritis, rheumatic arthritis and febrile convulsions. The infestation with helminths occurred only in 7% of cases.

PRIMARY PRESENTATION OF MALNUTRITION CASES

Diagnosis	No. of Cases	%
1. Anaemia	18	18·7%
2. Gastroenteritis	31	32·3%
3. Respiratory Infections	16	16·6%
4. Worm Infestation	7	7·4%
5. Others	24	25·0%
TOTAL	96	100%

Others Included

(a) Viral Infections eg. Measles, Haemorrhagic Fever.
(b) Tuberculosis.
(c) Malaria.
(d) Acute Nephritis.
(e) Rheumatic Arthritis.
(f) Convulsions.
(g) Thalassaemia Minor.

Fig. 7. Note that 75% of the children with malnutrition presented with infection.

SIZE OF LIVER AND SPLEEN IN MALNUTRITION CASES

Size of Liver (Below costal margin in midclavicular line)	No. of Cases
0 cm.	59 cases
Just palpable	6 cases
1 cm.	12 cases
2 cms.	13 cases
3 cms.	5 cases
4 cms.	1 case
TOTAL	96 cases

Size of Spleen (Below costal margin)	No. of Cases
0 cm.	81 cases
Just palpable	2 cases
1 cm.	7 cases
2 cms.	4 cases
2 cms.	2 cases
TOTAL	96 cases

Fig. 8. Note that in the majority of cases with malnutrition there was no hepatosplenomegaly.

FAMILY SIZE

NUMBER OF CHILDREN PER FAMILY IN MALNUTRITION FAMILIES

No. of Children	Chinese	Malay	Indian	Total	
1	1	0	0	1	
2	2	0	0	2	
3	7	5	2	14	54%
4	9	5	2	16	
5	3	4	5	12	
6	2	7	1	10	
7	1	3	0	4	
8	6	3	0	9	
9	3	5	0	8	
10	0	1	0	1	
11	2	2	2	6	
12	1	3	0	4	
13	0	0	0	0	
14	2	0	1	3	
15	0	1	2	3	
16	0	2	1	3	
TOTAL	39	41	16	96	

Fig. 9. Note that 54% of the families had three to six children.

Size of the Liver and Spleen

The size of the liver and spleen were measured below the costal margin before treatment was commenced. As seen from Fig. 8 in the majority of cases, there was no hepatosplenomegaly. In those cases where the spleen was palpable the children had iron-deficiency or nutritional megaloblastic anaemia. The child with a liver of 4 cm. and a spleen of 2 cm. had benign tertian malaria.

Family Size

In all three ethnic groups in 54% of cases there were three to six children in the families. The large family size together with the low family income would account for the nutritional deficiencies. It would be noted from Fig. 8 that in some families there were 16 children.

MONTHLY INCOME PER FAMILY WITH CHILDREN WITH MALNUTRITION

Monthly Income Per Family	No. of Families
$100/-	6
$100 - $249	66
$250 - $499	15
$500 - $749	3
$750 and above	0
Unknown	6
TOTAL	96

Fig. 10. Note that in two thirds of the families the income was from $100 to $249 per month.

Income of the Families

Information concerning the combined family income was used in this survey. Note that in two-thirds of the families the income varied from $100 to $249 per month. Protein caloric malnutrition and nutritional anaemia was found mainly in the lower social economic groups of Singapore. Selinus (1972) also showed that among Singapore children most of the children with a low caloric supply come from the low income sector. She also found significant differences in the growth of the children between the lower income and higher income group, particularly for the Chinese and the Malays.

Type of Housing

In 90% of cases home visits were done by the social worker of the department of paediatrics and

in some cases in conjunction with the department of Social Medicine and Public Health, of the University of Singapore.

TYPE OF HOUSING

Ethnic Group / Type of House	Chinese	Malays	Indians	Total	%
Flat	5	8	3	16	29·6
House	6	4	6	16	29·6
Kampong	8	10	4	22	40·8

Fig. 11(a). Note that 40·8% of the children lived in the kampong type of houses.

40·8% of the children lived in attap houses and 29% in houses made of plank and zinc and in most cases there was no electricity and no running water available, tenants having to use either well water or water from public standpipes. (Figs. 11(a), 11(b) and 11(c)).

Fig. 11(b). Note the typical kampong type of house with no proper drainage.

The children in these types of houses had bucket latrines or no proper latrines and infestations with soil-transmitted helminths was common in this group.

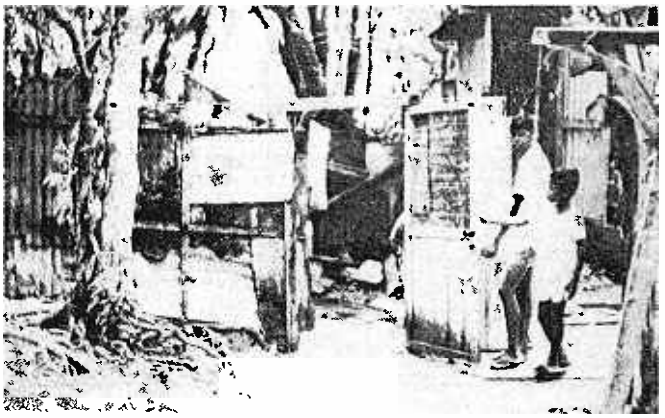

Fig. 11(c). Note the bucket latrine with open air bathroom

Although it was not possible to do a detail study of the education level of the mothers and fathers in this group, it was noted from an interview that the majority had received no education or at the most three years of schooling.

With the majority of the families coming from the poor sanitary environment one would expect infestation with worms. However worm infestation was found only in 7% of cases. Infestation with hookworm, round worm and trichuriasis was common with iron deficiency and megaloblastic anaemia.

Haemoglobin Levels

The haemoglobin levels of the three ethnic groups varied but the mean haemoglobin level of the Malays and Indians was 6·63 grams %. The low haemoglobin levels are due to lack of protein, iron and folic acid in the diet. The low haemoglobin levels were also due to hookworm infestation in some children.

Serum Iron Levels

The range of the serum iron levels was wide varying from 20 to 130 micrograms %. However,

OVA IN STOOLS OF CASES OF MALNUTRITION

Type of Cases	No. of Cases Examined	No. and % with Ova	Hookworm	Ascaris	Trichuris
Iron-Deficiency Anaemia	40	12 30%	8 20%	8 20%	8 20%
Megaloblastic Anaemia	7	2 29%	2 28·5%	28·5%	1 14%
Protein-Caloric Malnutrition	14	9 60%	7 50%	7 50%	8 57%

Fig. 12. Note that infestation with worms was common in all cases of malnutrition where stools were examined for ova.

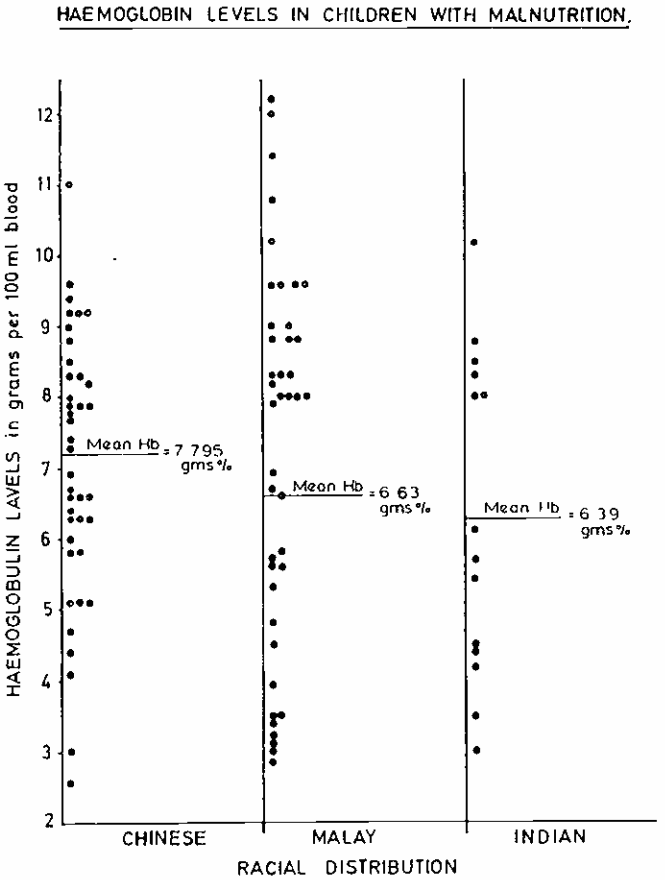

Fig. 13. Depicts the mean haemoglobin levels of the three ethnic groups. Note the mean haemoglobin levels of the Malay and Indian children were much lower than the Chinese.

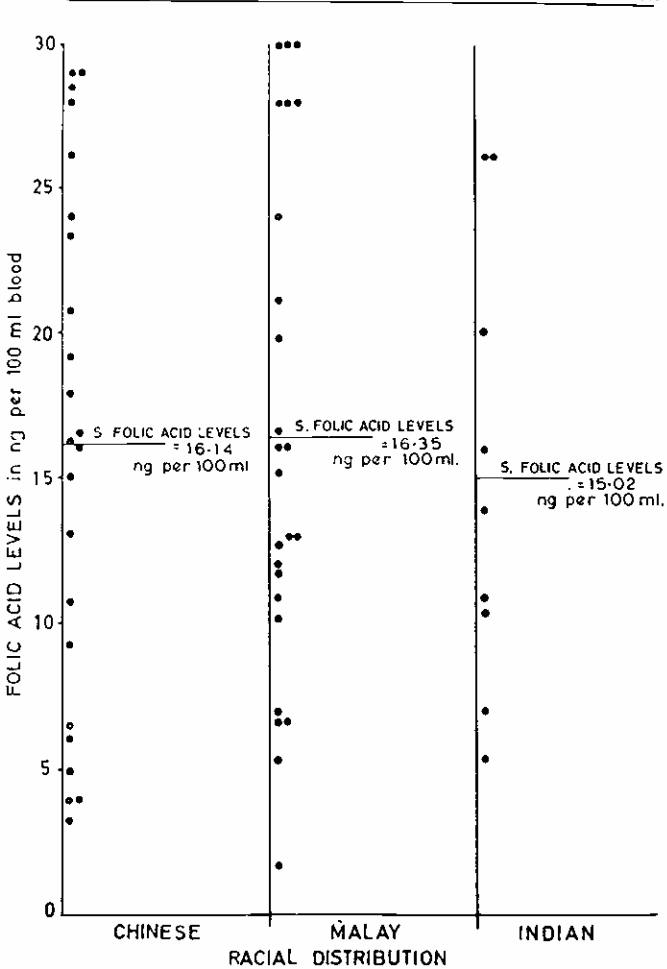

Fig. 15. Note that the mean serum folic acid levels were lower for Indians compared to Chinese and Malays.

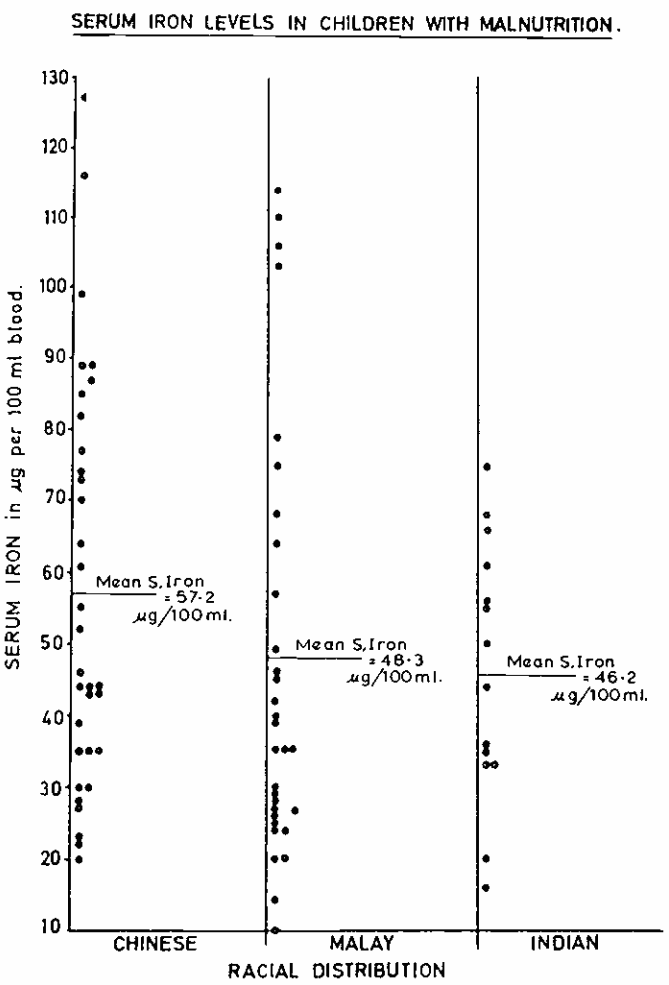

Fig. 14. Note that the mean serum iron levels are lower for Malays and Indians than for Chinese.

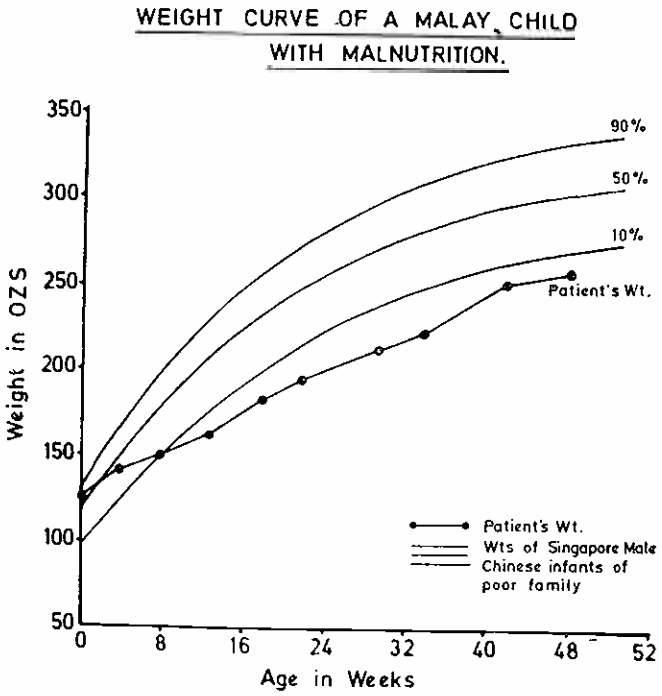

Fig. 16. Weight curve of a Malay child under one year with malnutrition.

the mean serum iron range was 57·2 mgm. per 100 ml. in Chinese (Fig. 14) while the mean serum iron levels of the Malays and Indians were much lower being 48·3 mgm. per 100 ml. and 46·2 mgm. per 100 ml. of blood respectively. However, serum iron levels are so variable and in most cases we did a bone-marrow and looked for iron stores by staining with Prussian blue. In most of the iron-deficiency anaemias there were no iron stores.

A high prevalence of nutritional anaemia both iron-deficiency and folic acid deficiency has been reported by Wong (1970). This study further points out the fact that nutritional iron-deficiency anaemia is common in Singapore children. Below the age of 24 months the intake of iron on an average is insufficient (Selinus, 1972). The milk diet of an infant is poor in iron but the infants of well nourished mothers are born with iron stores which should be sufficient for the first few months of life. Later on the child needs extra supply of iron. Selinus (1972) has shown that this is because the mother keeps the child entirely on a milk diet and does not introduce new food items like egg, green vegetables or minced meat early. In her survey of a dietary study of children 0 to 23 months, she showed that in all three ethnic groups of the poor growers with deficient calories 85% of the Chinese in toddler group had low iron stores while 91% of the Malays in the toddler age had a diet low in iron while in the Indians the figure was 85·7%.

Serum Folic Acid Levels

The criteria used for the diagnosis of a megaloblastic anaemia was a low serum folic acid level and the presence of megaloblasts in the bone-marrow. In 1970 Wong showed that in a study of 83 cases 75% also suffered from folate deficiency. Tasker in 1954 pointed out that a combination of iron-deficiency and folate deficiency may mask the bone-marrow picture to such an extent that the characteristic morphological changes of megaloblastic anaemia are not seen. During treatment of iron-deficiency anaemia, megaloblastic changes in the bone-marrow appear. The serum folate level is of help in diagnosing folic acid deficiency. However, the range of serum folic acid levels was very variable, ranging from 2 mgm. to 30 mgm. per ml. (Fig. 15). The mean folic acid levels were not very low except for the Indian children which had lower levels than the Chinese and Malay children. (Fig. 15). Folic acid is labile and excessive boiling and cooking as in the Indian diet would lead to folate deficiency.

Case Illustration (No. 1)

K. b. A. was a 13 month old child admitted because of fever and vomiting. He was the youngest in a family of eight children. The physical milestones were delayed and he was able to sit up at 9 months, stand with support at one year. The child had been fed on dilute condensed milk. His diet at the age of 13 months consisted of a cup of coffee and a slice of bread at breakfast. For lunch he had rice with vegetables and sauce and at 2 p.m. he had diluted condensed milk. The food for the dinner were the same items as lunch and before retiring to bed the child had diluted condensed milk. Physical examination revealed a stunted child measuring 70 cms. which was below the 3rd percentile using Singapore standards. The child was pale. No abnormality would be detected in the heart, lungs or abdomen. The peripheral blood film showed microcytic hypochromic cells and the bone-marrow showed giant myelocytes with eosinophil precursors. The haemoglobin was 7·9 grams%. Fig. 16 shows the growth curve of the child, the figures of the weights having been obtained from the infant welfare clinic. It will be noted that the child was thriving till the age of eight weeks after which the curve of the weight chart flattened and was moving below the 3rd percentile of Malay children of the same age. This weaning period at the age of three months is a vital period when adequate solids are not adequately introduced to the diet for his growth.

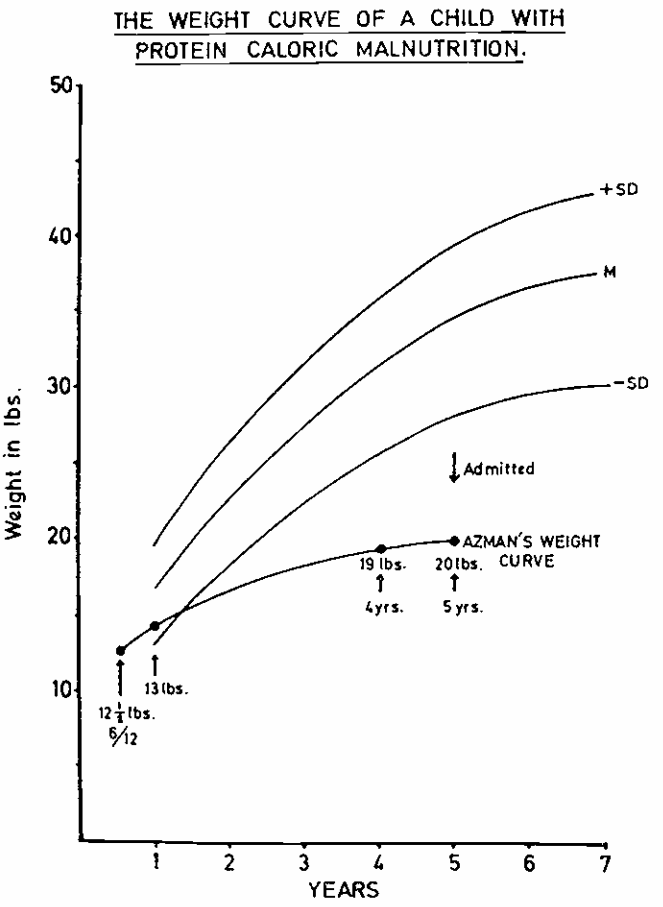

Fig. 17. To illustrate the weight curve of a 5-year old boy with protein caloric malnutrition.

Case Illustration (No. 2)

The next patient was a 5-year old child admitted because of fever and gastroenteritis. He was the youngest of six children and his milestones were delayed. He was able to hold up the head at 13 months, sit up at two years, walk at 2½ years, and talk at 2½ years. This child had been fed purely on humanised lactogen till the age of three years when he was weaned to ground rice and water. The child refused to take eggs, vegetables, meat or fish at this age. On physical examination he was 30 inches tall which was well below the 3rd percentile for Malay boys of that age and weighed 20 lbs. which was below the 3rd percentile. His intelligent quotient on the Weschler Intelligent Scale was only 74 (verbal and non-verbal tests). The skin was dry and pale. The liver was enlarged to 2 cms. below the right costal margin and the spleen was not palpable. The haemoglobin was 3·2 grams% and the serum iron was 114 micrograms %. The serum folic acid level was 30 micrograms%. The peripheral blood film revealed hypochromic microcytic cells with giant myelocytes and metamyelocytes. The bone marrow smear showed the presence of megaloblasts and on staining for iron, there were no iron stores. On obtaining the weight figures from the infant welfare clinic a weight curve was plotted and it was found that the child was well below minus two standard deviation for his age. In fact he was a nutritional dwarf and intellectually backward. Apart from protein caloric malnutrition he had iron deficiency and folic acid deficiency anaemia.

MANAGEMENT

All the children with very low haemoglobin levels were transfused with packed cells and given the hospital Mist Ferrous Sulphate three times a day. Those with megaloblastic anaemia were given folic acid 10 mgms. three times a day. All the patients in this series showed a good response to this hospital diet. A three month stay at the Convalescent Home, Changi was arranged for those from poor home conditions. Here they are given a good balanced diet and being situated by the sea, this is an ideal spot for these children for recovery. A regular school teacher seconded from the government helps the children with their lessons. The matron of the home and the doctors advise the parents about the importance of eating the right type of diet, within the limits of the family income. In many cases this is very difficult with the rise in the cost of living. The children are then followed up by the paediatric department on return home.

DISCUSSION

From this study and in previous studies by Wong (1970) and Tan (1972) it will be seen that nutritional deficiencies do exist in Singapore. Rickets and scurvy are rare in our children here. Scurvy only exists in severely subnormal children here when parents do not feed them on orange juice or mashed papaya. As seen in the two cases described protein caloric malnutrition is a condition which can be treated if detected early. The flattening of the growth curve occurs round almost the fourth month, when weaning is delayed. If the baby can be weaned early on to good weaning diet, protein caloric malnutrition can be prevented. The second case described was one of protein caloric malnutrition which has been produced over the years resulting in growth and intellectual retardation. In a study by Foong in 1971, he showed that children who failed Primary VI were below the third percentile in height and weight using Hong Kong standards, and he related this to the poor nutritional status of the children.

Nutritional iron-deficiency anaemia is relatively common in Singapore. These 96 cases only represent the very bad cases of malnutrition with anaemia that warrant hospital admission. There are a large number that are treated as outpatients. Megaloblastic anaemia was rare before, but in 1970 (Wong) and Tan (1972) reported an increase in megaloblastic anaemia in Singapore children.

Factors responsible for our nutritional disorders in Singapore children are poverty. The majority in this study were in the lower income group and with the rise in the cost of essential food products like rice, wheat, meat, and fish, the poor children are bound to suffer. Meat is an expensive item in Singapore and all dairy products are very expensive.

Other contributing factors are the large number of children in the families and the lack of education. Ignorance with regard to the right type of food for the baby was noted in this survey. Poor sanitation and worm infestation was noted in children from the rural areas.

RECOMMENDATIONS

1. Breast feeding in Singapore has declined very rapidly, to rock bottom levels. The study by Selinus (1972) shows that these levels are dangerous for the lower income groups as all the artificial milk products are expensive. Breast feeding must therefore be encouraged at all levels including maternity hospitals, infant welfare clinics and paediatric units.

2. The first sign of protein caloric malnutrition is a flattened curve in the weight and height chart. Before this curve flattens the child should be treated with a proper diet.
3. Selinus (1972) recommended cheap food available in the local market in the form of soyabean, green vegetables and fish. She also recommended wheat-soya-blend which will be provided through world-food programme for malnourished children.
4. Family planning was essential as the majority in the lower income groups had large families.
5. In the very poor families a nutritional allowance, either in the form of money or food was essential to provide food for adequate growth and calories. This is essential because unless you treat malnutrition you are bound to get educational retardation and nutrition dwarfs in school children and as these children are future citizens of this island, therapeutic and preventive measures against malnutrition must be adopted.

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