Malnutrition among Semai children

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Summary

A comprehensive assessment of the nutritional status of the Semai children in Perak was undertaken. Anthropometric measurements of 1180 children, biochemical analyses of blood and urine samples from 506, and dietary evaluation by weighing food intake of 30 preschool children were carried out. Widespread underweight and stunting were found with a relatively lower incidence among the infants and female adolescents. Iron deficiency anemia affected a high percentage of the children, who also showed low excretory levels of urea nitrogen and poor hydroxyproline index indicating slow growth rate. Dietary intake is characterised by sub-optimal quantitative levels and a high reliance on tapioca tuber for calories and nutrients.

Key words: Dietary assessment, biochemical assessment, Semai children.

Introduction

Since Polunin's report in 1953[1] on the medical natural history of the Orang Asli, there have been several studies on health problems affecting the different tribes, especially on malaria infections[2] and parasitic infestations.[3] Studies pertaining to their nutritional status are relatively few.[4,5] This report presents results from a study on the nutritional status of the Semai who form the largest sub-tribe of the Orang Asli.[6]

Materials and methods

The Batang Padang district in Perak was selected as the study area primarily for its high concentration of Semai. Two-third of the total Semai population of nearly 20,000 can be found in Batang Padang. Out of a total of 61 villages in that district, 13 were randomly chosen from rural to jungle fringe locations for the study which was completed in 1985.

Anthropometric measurements were carried out on 1180 children aged below 18 years old drawn from 341 households. This sample represents about 80% of the total number of children from the selected villages. Body weight, stature, left mid-upper arm circumference and triceps skinfold thickness were the anthropometric indices used. The weight of infants was taken by means of a baby weighing balance (Seca 725) to the nearest 100gm, whilst older children were weighed on a beam balance (Seca 710) to the nearest 500gm. A portable infantometer specially constructed following the design in Jelliffe[7] was used to measure the recumbent length of infants. With older children, a Microtoise tape (Stanley Mabo) was used to measure their upright height. The mid-upper arm circumference was determined to the nearest 0.1cm by means of a fibre-glass tape. A skinfold caliper (Harpenden) was used to measure triceps skinfold thickness to the nearest 0.1mm.

Table I
Breakdown by sex and age of children assessed by anthropometry

Age groups	Male	Female	Total
12 months and below	49	40	89
1.0 to 6.0 years old	234	201	435
6.0 to 12.0 years old	226	252	478
12.0 to 18.0 years old	87	91	178
Total	596	584	1180

Table II
Prevalence of underweight, stunting and wasting

		Male (%)	Female (%)
I	Underweight		
	12 months and below	24.1	23.4
	1.0 to 6.0 years old	53.0	49.0 *
	6.0 to 12.0 years old	51.2	45.8 **
	12.0 to 18.0 years	65.2	19.8 ***
III	Stunting		
	12 months and bleow	42.1	44.4
	1.0 to 6.0 years old	73.2	62.7 ***
	6.0 to 12.0 years old	70.5	64.5 ***
	12.0 to 18.0 years old	78.1	70.5 ***
III	Wasting		
	6.0 years and below	8.0	8.5
	6.0 to 12.0 years old	5.5	4.5

Underweight: Weight for age $\leqslant$ 2s.d. of NCHS median[13]
Stunting: Height for age $\leqslant$ 2s.d. of NCHS median
Wasting: Weight for height $\leqslant$ 2s.d. of NCHS median

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Blood collection for biochemcial analyses was done with the help of a field laboratory assistant from the Gombak Hospital. Fingertip prick was made on children aged twelve and below for the determination of haemoglobin, hematocrit, total protein and albumin according to procedures of WHO[8] and ICNND.[9] These tests were carried out in the laboratory of Tapah District Hospital. Venous blood was drawn from older children for additional determination of serum iron and total iron-binding capacity.[10] Urine samples were collected in 25-ml bottles preserved with 1.ON HC1. Creatinine,[9] urea nitrogen[11] and hydroxyproline[12] content in the urine were determined. Both blood and urine samples were collected early in the morning before the children had taken any food.

As for dietary assessment of the children, it was decided that with the Semai, methods that depended upon interview and rccollection such as the 24-hour recall could not be relied upon. Consequently, the weighing method was used and only children, aged two to four, who had been weaned of breastmilk, were selected. Thirty such children were randomly chosen and each child had his/her intake assessed over three consecutive days. Two trained enumerators assisted the writer to complete this aspect of the study.

Results

Anthropometric assessment

The prevalence of underweight, stunting and wasting among the Semai children are shown in Tables I, II, III. Underweight and stunting were widespread in all age groups with a relatively lower incidence among the infants. Their better body size may be due to the common practice of breastfeeding. There is a significantly less girls over 12 years old who are underweight and stunted compared to the boys. In general, the girls partake in more sedentary activities about the house than their male counterparts. The index of wasting which relates body mass to stature showed up in less than 10% of the preschoolers and about 5% among those between 6 to 12 years old.

Table III

Prevalence of malnutrition as assessed by arm circumference and skinfold thickness

	Malnourished arm circumference (%)	Malnourished triceps skinfold thickness (%)
1.0 to 6.0 years old		
male	51.1	18.5 ***
female	47.0	37.8
6.0 to 12.0 years old		
male	67.8	47.5
female	58.5**	45.2
12.0 to 18.0 years old		
male	68.3	13.2
female	24.2 ***	24.6

Malnourished arm circumference : ⩽ 5th percentile Frisancho[14]
Malnourished triceps skinfold thickness : ⩽ 10th percentile Frisancho

* $p > 0.05$
** $p < 0.01$
*** $p < 0.001$

Table IV

Nutritional status by selected biochemical parameters

	1 to 6 years (both sexes) n = 169	> 6 to 12 years (both sexes) n = 199	> 12 to 18 years (males) n = 69	(females) n = 69
Haemoglobin g/dl				
$\bar{x} \pm SD$	11.0 ± 1.9	11.6 ± 1.8	12.9 ± 2.0	12.5 ± 3.0
% deficient	44	41	24	29
Hematocrit				
$\bar{x} \pm SD$	35.7 ± 3.5	38.5 ± 3.5	41.2 ± 4.2	39.2 ± 4.0
% deficient	10	4	17	25
Serum iron ug/dl				
$\bar{x} \pm SD$	–	–	92.0 ± 49.4	77.8 ± 35.2
% deficient			18	24
Transferrin saturation %				
$\bar{x} \pm SD$	–	–	35.2 ± 8.9	25.2 ± 6.6
% deficient			25	28
Serum protein g/dl				
$\bar{x} \pm SD$	7.3 ± 1.0	7.8 ± 1.1	8.0 ± 0.9	8.0 ± 1.1
% deficient	11	10	4	5
Serum albumin g/dl				
$\bar{x} \pm SD$	3.9 ± 0.9	3.9 ± 0.7	3.9 ± 0.6	3.8 ± 0.7
% deficient	13	4	6	5
Urinary urea N/creatinine ratio			(both sexes)	
$\bar{x} \pm SD$	7.1 ± 4.8	7.8 ± 4.0	6.6 ± 2.1	
% with unstaisfactory index	36	41	38	
Hydroxyproline index				
$\bar{x} \pm SD$	1.3 ± 0.7	1.7 ± 1.1	–	–
% with unsatisfactory index	56	51		

Deficiency levels as follows:

a) haemoglobin, hematocrit, serum iron, transferrin saturation: WHO[8]
b) serum protein, albumin: ICNND[9]
c) urea N/creatinine ratio: Dugdale & Edkins[19]
d) hydroxyproline index: Chandrasekharan & Candlish[20]

Evidence of malnutrition as assessed by two their anthropometric indicators is presented in Table III. Malnourished arm circumference reflecting inadequate muscle protein mass and sub= cutaneous fat prevails in more than half of the male children aged one to 18 years. It is significantly less widespread among the female Semai above six years old. The triceps skinfold thickness as a measurement of subcutaneous fat serves as an indicator of calorie reserves. A lack of calorie store is most prevalent among children between six to 12 years old. There is no significant difference for the sexes with respect to calorie inadequacy for all ages except for the preschool age group (Table IV).

Figures 1 to 3 compare the growth performance of the Semai with that of other Malaysian children. Children from the poorer sector including the Semai, rural Malays and various ethnic groups in Sabah showed slower physical growth by both boys and girls at all ages below 18 years when compared to that achieved by their counterparts from urban upper-income groups.

Biochemical assessment

The biochemical tests served to assess the iron and protein intake status of the Semai childrn. The prevalence of low haemoglobin concentrations within the realms of anemia ranges from 24% among male adolescents to 44% of the preschoolers (Table IV). By the hematocrit test, a lower percentage of the children was revealed to be iron-deficient; however, this test is not considered as reliable a means of diagnosing anemia as is thè haemoglobin concentrations.[18] Confirmatory tests for iron-deficient anemia, i.e. serum iron and transferrin saturation tend to support the haemoglobin concentration result, in that approximately one-quarter of the male and female adolescents was found to be deficient in transport iron.

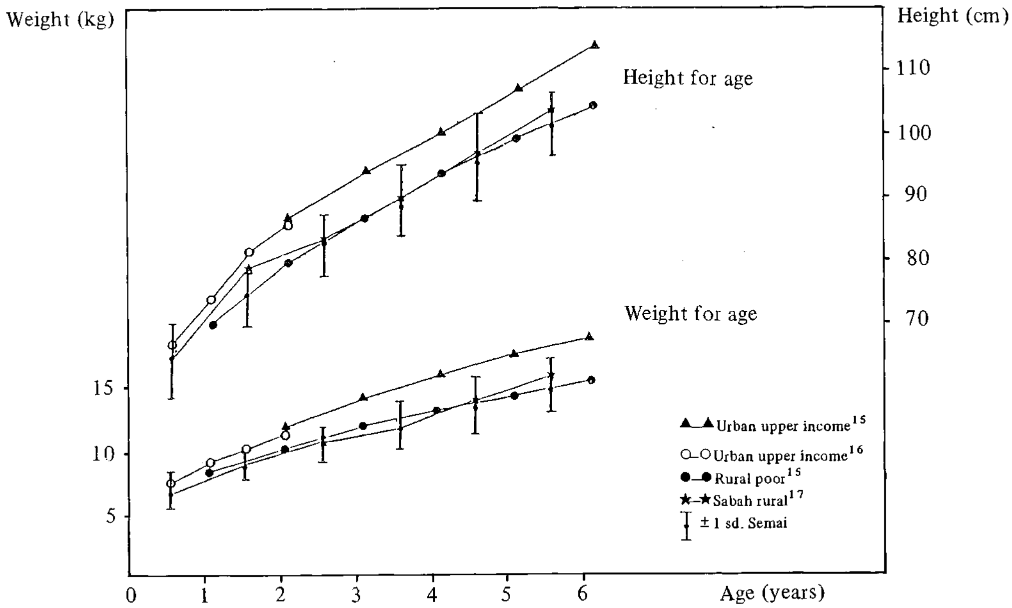

Fig. 1 Distribution of preschool children (sexes combined) according to mean height and weight for age

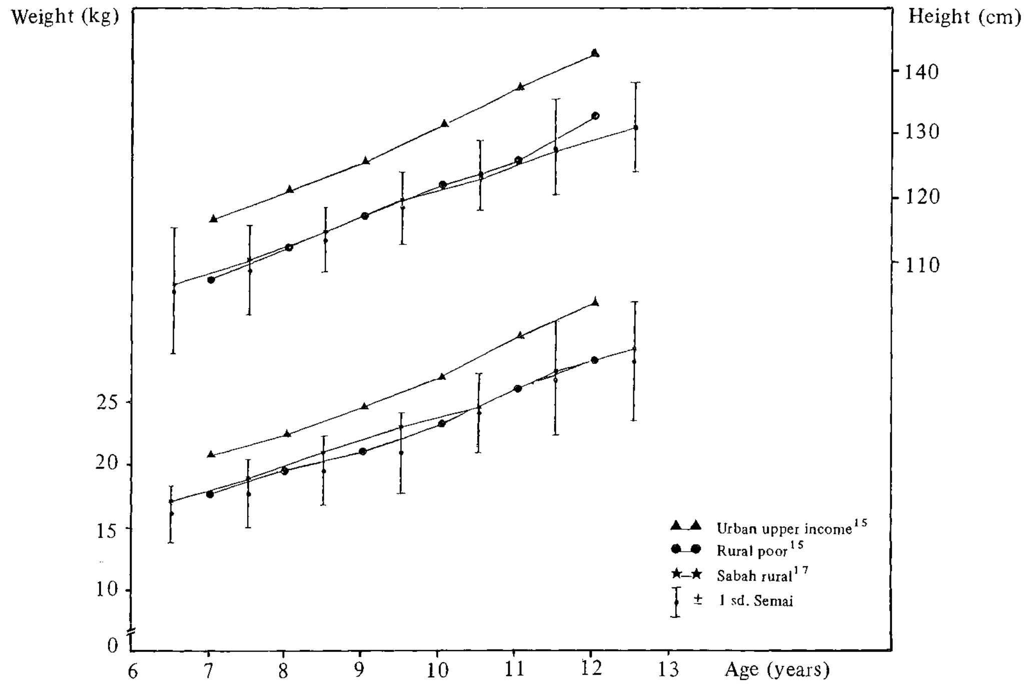

Fig. 2 Distribution of male children according to mean height and weight for age

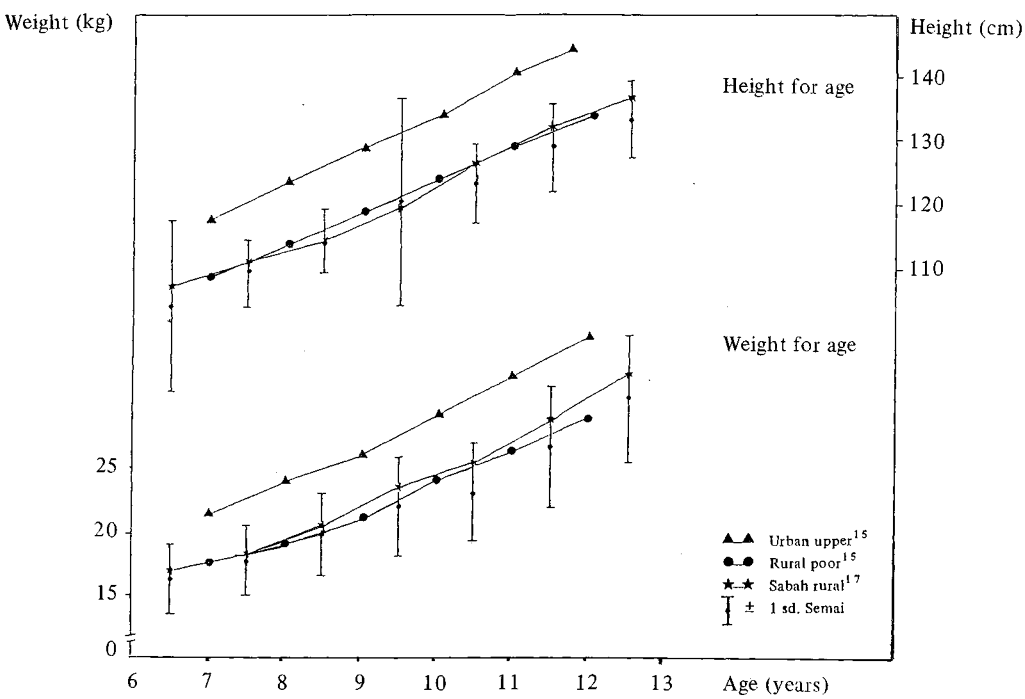

Fig. 3 Distribution of female children according to mean height & weight for age

Deficiency in protein intake as reflected by serum protein and albumin was shown to be highest in the preschool-aged group. All age groups manifested a high percentage amongst them with unsatisfactory urinary N/creatinine index, indicating weight maintenance at low levels of protein intake. More than half of the children aged twelve and below can be considered to be experiencing a rather slow rate of growth as reflected by their poor hydroxyproline index.

Dietary assessment

Food consumption by the preschool children is characterised by the sub-optimal level of intake of calories and most nutrients (Table V). The notable level of vitamin C is derived mainly from tapioca tuber and leaves, which are also the primary sources of thiamin and vitamin A respectively. As indicated in Table VI, the diet of the Semai, particularly the younger children, is devoid of variety and lacks food of animal origin. Small wildlife are not readily available in jungle fringe areas. Fish, rice and maize may not be available every day, in which case, the ubiquitous cassava tuber constitutes the sole dietary item.

Discussion

The anthropometric, biochemical and dietary results provided evidence of signnificant malnutrition amongst the Semai children. There is a wide prevalence of current and chronic protein-energy deficiency as indicated by the high proportion of the children who are underweight and stunted. The lower percentage of wasting found seems to imply that the majority of them possess a small body built, well-proportioned but small for age. This has been postulated to be a biological adaptation to protracted malnutrition.[22] When faced with chronic deficient food intake, growing children appear to reduce their rate of linear and mass growth without altering

Table V
Nutrient intake of children aged four to six (both sexes)
(n = 30)

Nutrients	Intake (mean ± SD per day)	Recommended Daily Allowances[21] (RDA)	Intake as % of RDA
Calories (kcal)	770 ± 100	1830	42%
Protein (g)	16 ± 2	29	55%
Calcium (mg)	185 ± 27	450	41%
Iron (mg)	3 ± 0.4	10	29%
Vitamin A (ug)	204 ± 34	300	68%
Thiamin (mg)	0.44 ± 0.08	0.7	63%
Vitamin C (mg)	20 ± 13	20	100%

Food intake determined by weighing method; mean of 3 days

Table VI

Principal sources of calories and protein

Age \ Sources	Calories	Protein
Two to three	cassava roots sweetened condensed milk rice maize	sweetened condensed milk maize rice
Three to four	rice cassava roots maize	fish rice sweetened condensed milk maize

normal mass for length relationships.[23] Man's metabolic response to prolonged restriction of protein intake also takes the form of increased recycling of the limited amount of urea nitrogen that is produced.[24] Not only is urea believed to be able to serve as a nitrogen source under such a circumstance, but Oomen[25] has suggested the presence of nitrogen-fixing intestinal microorganisms which are responsible for providing additional nitrogen. Adaptations may also be social or behavioural e.g. the energy intakes of children may be adequate to support satisfactory growth rates, but only at the expense of a reduction in total energy expenditure.[26] The result is less physical activity which may impair the child's capacity for exploration and play, and hence this mental, functional and social development.[27] Since improvements in environmental factors including nutrition can result in heavier and taller children than their less privileged counterparts of the same ethnic origin,[28] it is more appropriate to assess nutritional status in terms of underweight and stunting, rather than wasting, an adaptive response.

Another notable feature of the results is their poor diet in quality and quantity. A lack of food of animal origin leads to widespread iron deficiency anemia among the children. The situation is aggravated by parasitic infestation. It was found that Semai children below twelve were affected by ascariasis (57%), trichuriasis (49%) and hookworm (14%).[6] Infections would take further toll on the malnourished body.

In conclusion, nutritional indicators have identified widespread chronic and on-going malnutrition among the Semai children. It is important that consideration for the health status including nutritional improvement of the children be incorporated into development programmes.

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Reference

1. Polunin I. The medical natural history of Malayan Aborigines. Med. J. Malaysia 1953; 8:62–174.

2. Bolton J.M. The control of malaria among the Orang Asli in West Malaysia. Med. J. Malaysia 1972; 27:10–19.

3. Dunn F.L. Intestinal parasitism in Malaysian aborigines. Bull WHO 1972; 46:99–113.

4. Robson P., Bolton J.M., Dugdale A.E. The nutrition of Malaysian aboriginal children. Am. J. Clin. Nutr. 1973; 26:95–100.

5. Khoo T.E. Some aspects of the nutritional status of Temiar in Kemar. M. Public Hlth. Universiti Malaya: Kuala Lumpur 1977.

6. Khor G.L. A study of the nutritional status of the Semai. Ph. D. Thesis, Universiti Malaya: Kuala Lumpur 1985.

7. Jelliffe D.B. The assessment of the nutritional status of the community. WHO Monograph Series No. 53, World Health Organization: Geneva 1966.

8. World Health Organization. The health aspects of food and nutrition. WHO Western Pacific Regional Office: Manila 1976.

9. Interdepartmental Committee on Nutrition for National Defence (ICNND) US Government Printing Office: Washington 1963.

10. Jung D.H., Parekh A.C. A semi-micromethod for the determination of serum iron and iron-binding capacity without deproteinization. Am. J. Clin. Pathol. 1970; 54:813–817.

11. Wooton I.D.P. Micro-analysis in medical biochemistry 4th ed. J & A Churchill Ltd; London 1964.

12. Kivirikko K.I., Laitinen O., Prockp D.J. Modifications of a specific assay for hydroxyproline in urine. Annal Biochem. 1967; 19:249–255.

13. World Health Organization. Measuring change in nutritional status. WHO: Geneva 1983.

14. Frisancho A. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am. J. Clin. Nutr. 1981; 34:2540–2545.

15. Chong Y.H., Tee E.S., Ng T.K.W. et al. Status of community nutrition in poverty kampungs. Bulletin No. 22, Institute for Medical Research; Kuala Lumpur 1984.

16. Chen S.T. The assessment of physical growtih and development from birth to two years of age in a selected group of Malay children from higher income families. Doc. of Medicine, University Malaya 1983.

17. Chen P.C.Y., Chan M.K.C., Teoh S.T. et al. A nutrition study of the Interior, West Coast and Kudat Divisions of Sabah. Universiti Malaya: Kuala Lumpur 1981.

18. Dallman P.R. Diagnosis of anemia and iron deficiency: analytic and biological variations of laboratory tests. Am. J. Clin. Nutr. 1984; 39:937–941.

19. Dugdale A.E., Edkins E. Urinary urea/creatinine ratio in healthy and malnourished children. Lancet 1964; (i) : 1062.

20. Chandrasekharan N., Candlish J.K. The urinary hydroxyproline index in hospitalised and normal Malaysian children. Trop. Geog. Med. 1973; 25:71–74.

21. Teoh S.T. Recommended daily dietary intakes for Peninsular Malaysia. Med. J. Malaysia 1975; 30 : 38–42.

22. Okuda T., Kajiwara N., Date C. et al. Nutritional status of Papua New Guinea highlanders. J. Nutr. Sci. Vitaminol 1981; 27:319–322.

23. Martorell R. Nutrition and health status indicators: suggestions for surveys of the standard of living in developing countries. LSMS Working Ppaer No. 13. The World Bank Development Research Center: Washington 198g.

24. Hipsley E.H. Concerning the adaptation of Papua New Guineans to low protein diets. In: Porc. 10th International Congress of Nutrition, Kyoto, Japan, 1975.

25. Oomen H.A.P.C. Interrelationship of the human intestinal flora and protein utilization. Proc. Nutr. Soc. 1970; 29:197–206.

26. World Health Organization. Energy and protein requirement. Report of a Joint FAO/WHO/UNU Expert Consultation. Technical Report Series No. 724, WHO: Geneva 1985.

27. Viteri F.E., Torun B. Nutrition, physical activity and growth In: Ritzen M (ed) Biology of normal human growth. Raven Press: New York 1981.

28. Kano K., Chung C.S. Do American born Japanese children still grow faster than native Japanese? Am. J. Phys. Anthropol. 1975; 43 : 187–194.