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Anthropometry, dietary patterns and nutrient intakes of Malaysian estate workers

Chee SS[1], Zawiah H[1], Ismail MN[1], and Ng KK[2]

[1] *Department of Nutrition and Dietetics, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur.*
[2] *Amway (Malaysia) Sdn. Bhd., Petaling Jaya, Selangor.*

ABSTRACT

Studies were carried out in two estates in Kedah and Johor to characterize the anthropometry and dietary patterns of 334 (169 females, 165 males) Malaysian estate workers. Subjects were Malay and Indian adults (aged 18 to 60 years) engaged in various work activities including rubber tappers, palm fruit harvesters, field supervisors and workers in the estate factories. Anthropometric results showed that the prevalence of overweight (26% in men, 25% in women) and obesity (5% in men, 11% in women) were higher compared to prevalence of underweight (11% in men, 9% in women) in these workers despite being engaged in moderate to heavy activities. The dietary intake pattern revealed that the main sources of calories in the diet were rice, cooking oil and sugar. Major sources of protein in the Malay diet were anchovies and fish whilst in the Indian diet protein was provided by salted fish, anchovies, eggs, fish, and pulses. The consumption of poultry, meat and dairy products were low for both ethnic groups. The dietary intakes of a subsampel of 108 normal weight subjects (56 females, 52 males) were recorded for 3 days. The results showed that the mean energy intake was 8.44 ± 2.12 MJ in males and 6.48 ± 1.29 MJ in females. The contribution of calories from protein, fat and carbohydrate were 13%, 22% and 60% in males and 12%, 23% and 65% in females, respectively. Alcohol intake was found to contribute five percent of energy in the diet of the Indian male subjects. Calcium, iron, vitamin A, thiamin, riboflavin and niacin intake were below 66% of the Malaysian RDA, particularly amongst the women. Income appeared to have a significant correlation with energy and iron intakes of the female workers as well as thiamin, niacin and riboflavin intakes of the male workers. There is a need for improving the quality of the dietary intakes of these workers as well as nutrition education on the prevention of obesity and its consequences.

INTRODUCTION

Oil palm and rubber are the main crops grown in Malaysia, covering a total land area of 1.8 million hectares for rubber and 13.47 million hectares for oil palm in 1990 (Department of Statistics, 1991). Some of these are planted in estates which employ workers who not only work but live in these plantations with their families.

In the early 1980's, the estate workers were generally regarded as being poorly paid and living in an environment without proper basic amenities and plaqued with problems of undernutrition and diseases (O'Holohan, 1994). High prevalence of protein-energy malnutrition, anemia, worm

infestations and vitamin deficiences have been reported amongst estate communities (Kandiah & Lim, 1977; Sinniah et al., 1992). The growth of estate children was found to be the poorest compared to children of the urban disadvantaged and rural sectors (Singh, 1992). Chandrasekharan and Marimuthu (1980) reported various nutrient inadequacies in the dietary intakes of estate families. However, to date there is a limited amount of data on dietary intakes of estates workers in Malaysia.

Presently, acts of Parliament such as the Workers Minimum Standards of Housing and Amenities Act, 1990 have been passed to ensure the safety and health of estate workers. Proper housing, basic amenities, hospital and medical treatment as well as schools will have to be provided by estate operators for the workers and their families (O'Holohan, 1994). The objectives of this study were to characterize the current status through anthropometry and dietary pattern evaluations and to examine the influence of the dietary patterns on nutrient intakes of the estate workers.

METHODS

The study was conducted in two estates located in Ladang Sungai Dingin, Karangan, Kedah and Ladang Ulu Remis, Layang-layang, Johor. This study was part of a larger study on the energy requirements of adults in Malaysia (Ismail et al., 1994).

Subjects

Subjects were obtained from volunteers who lived in the estates. They were adults (aged 18-60 years) and they comprised of rubber tappers, palm fruit harvesters, field supervisors and workers in the seed germinating and palm fruit processing factories. Those who held administrative or managerial positions and foreign workers were excluded from this study.

Anthropometric measurements were carried out in a total of 334 workers (169 females, 165 males) from the two estates. A subsample of 108 healthy subjects (57 females, 52 males) with normal Body Mass Index (BMI ; 18.5 -24.9 kg/in^2) WHO (1990) were then selected for the food intake study.

Method

Body weight was measured in light clothings, without shoes to the nearest 0.1 kg using a SECA beam balance (Model 713 Germany) calibrated with a known weight. Height was measured to the nearest 0.1 cm using the height attachment to the SECA beam balance. Body mass index (kg/in^2) was calculated for each individual. Skinfold measurements were taken at four sites; tricep, bicep, subscapular and suprailiac using the Harpenden calipers (British Indicators, UK), following the method of Durnin and Rahaman (1967). Body fat percentages were then calculated using the formula by Durnin and Womersley (1974).

A pre-tested questionnaire was used to assess dietary pattern. The questionnaire included socio-economic characteristics and a food frequency list consisting of 37 food items. Frequency of

food consumption was classified using a 5-point scale ranging from 5 = daily, 4 = 2-3 times a week, 3 = once a week, 2 = once a month, 1 = never. A score was calculated for each of the food items using an equation adapted from Reaburn, Krondl & Lau (1979) and Zaitun & Terry (1990)

$$\text{Score} = \frac{R_1S_1 + R_2S_2 + R_3S_3 + \ldots R_5S_5}{5}$$

where $S_1 \ldots S_5$ are the scale ratings and $R_1 \ldots R_5$ are the percent respondents selecting a rating, and 5 is the maximum scale rating.

Energy and nutrient intakes of 52 male and 56 female subsample individuals were measured using a 3-day food record method, as described by Marr (1971). Food intake was recorded in household measures. Field assistants were employed at various study sites to assist in home visits. Foods eaten were recorded and checked for completeness, portion sizes and ingredients used. The weight of the foods was estimated based on the portion sizes using a list of common weight of foods which was previously compiled. Intakes were calculated using the Malaysian Food Composition Table (Tee et al, 1988) and were compared with the Malaysian RDA (Teoh, 1975). The researchers lived in the community for an average of 60 days to complete the study.

Frequency distribution analysis, Student t-test and Pearson correlation coefficient test were performed on the data. A statistical probability of less than 0.05 was considered significant.

RESULTS AND DISCUSSION

Background information about the estates

The estates were located at a distance of less than 10 km from the small town of Karangan in Kedah and Layang-layang in Johor. Ladang Sungai Dingin in Kedah covered an area of 10,000 acres and cultivated mainly with rubber and oil palm while Ladang Ulu Remis in Johor covered an area of 6,000 acres and planted mainly with oil palm and cocoa. There were also seed germinating and palm fruit processing factories in both the estates.

Both estates provided single storey terrace houses with two bedrooms for the workers and their families, which were equipped with tap water and electricity. There were sundry shops in both estates which sell dry provisions as well as vegetables, fruits, fish, and other daily produce. Several food and beverage stalls are found in the estates operating from dawn until late night. Both the estates have a hospital along with other facilities such as creches and schools for the workers children.

Description of sample

Selected demographic characteristics of the 334 subjects are presented in Table 1. The subjects comprised of Indians (74% males, 73% females) and Malays (26% males, 27% females). Fifty-eight percent of the male subjects worked as rubber tappers and palm fruit harvesters, whilst another 23% were factory workers and 19% were field supervisors. Majority of the female

subjects (71%) were rubber tappers whilst the remainder 29% were factory workers. Majority of the subjects had only primary level education. The mean age of the subjects studied was 37 ± 9 years for females and 38 ± 7 years for males.

The mean household income of the subjects was RM 488 ± 190 per month for males and RM 430 ±176 per month for female subjects. Family size ranged from 3 to 6 with a mean of 3.6. Sixty percent of the monthly income was spent on food items and the rest on amenities and education expenses for the children.

Table 1. Selected demographic characteristics of subjects

Characteristics	Males n = 165	Females n = 169
Ethnicity		
Malay	43	45
Indian	122	124
Category of work		
Field workers (palm fruit harvesters and/or rubber tapppers)	95	120
Field supervisors	32	-
Factory workers (seed germinating and/or palm fruit processing)	38	49
Level of education		
None	4	39
Primary	95	91
Secondary	66	39
Mean age (years ± SD)	38 ± 7	37 ± 9
Mean household income ± SD	RM488 ± 190	RM430 ± 176

The frequency distribution of the subjects based on income is shown in Table 2. Among the Malay subjects, 46.4% of the males and 47.5% of the females were earning less than the Poverty Line Income of RM 370 (Government of Malaysia, 1990) whilst among the Indians, the figures were 28.7% and 38% for the males and females, respectively. However, no significant difference was found between mean household income and ethnicity.

In terms of household possessions, the subjects owned most of the basic necessities. Over 90% of the subjects had gas stove, radio and television while a lesser proportion had a refrigerator (74%), video recorder (39%), motorcycle (84%) and bicycle (30%). None of the subjects owned any land while 20% of them reared chickens for domestic consumption.

Anthropometry

The physical characteristics of the total sample of 334 subjects are shown in Table 3. The weight of the male subjects ranged from 38.4 kg - 93.9 kg with a mean of 62.2 ± 11.2 kg . As for the female, the weight ranged from 31.4 to 89.4 kg with a mean of 55.2 ± 10.8 kg. The mean heights of the males was 1.64 ± 0.06 m and 1.52 ± 0.05 in for the females. The mean BMI of the males

(23.1 ± 3.8 kg/m^2) and females (23.8 ± 4.4 kg/m^2) was within the range for normal individuals (WHO, 1990). Mean percent body fat values for the males (22.2 ± 5.7%) and the females (33.7% ± 5.6 %) indicated that the male and female subjects were generally not lean but fell within moderate body fat levels (Durnin and Womersley, 1974). No significant difference in anthropometric measurements was noted between the Malays and Indians.

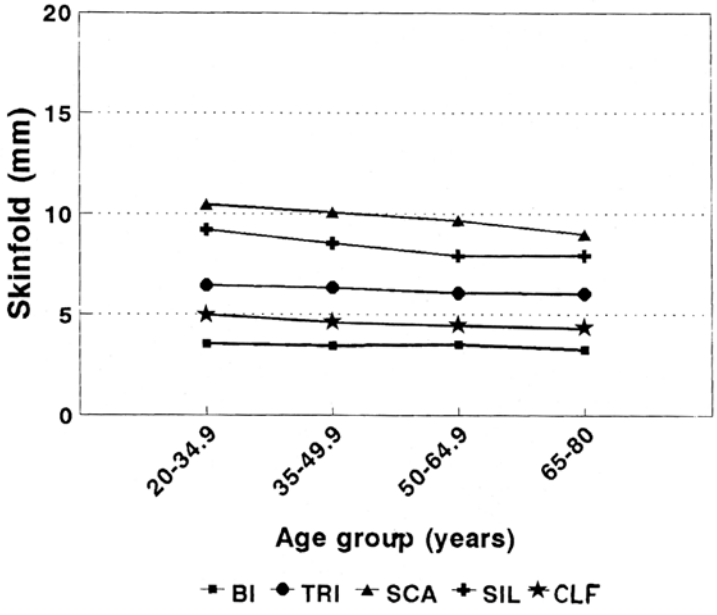

Figure 1. Geometric means for skinfold thicknesses by age group, males (skinfolds: bi: biceps; tri: triceps; sca: subscapular; sil: suprailiac; clf: medial calf).

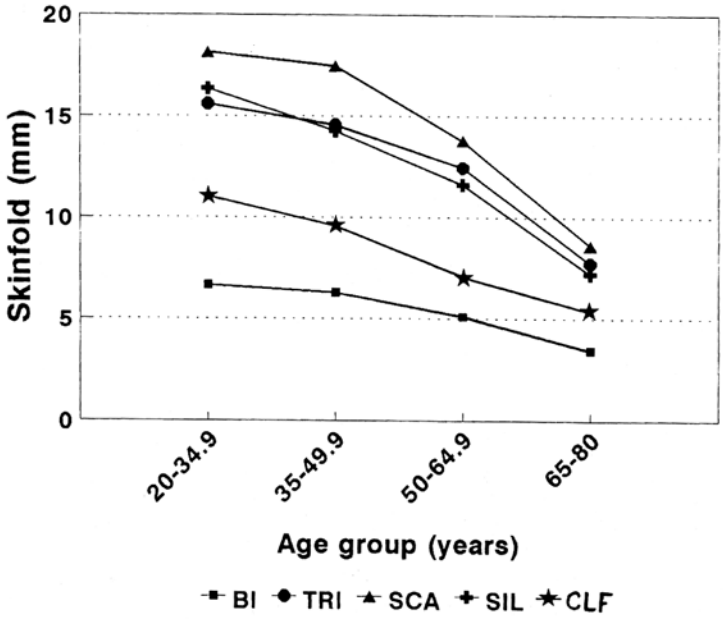

Figure 2. Geometric means for skinfold thicknesses by age group, females (skinfolds: bi: biceps; tri: triceps; sca: subscapular; sil: suprailiac; clf: medial calf).

Table 2. Income distribution of subjects

Income	Males (n = 165)		Females (n = 169)	
	Malay	Indian	Malay	Indian
Ethnic	n = 43	n = 122	n = 45	N = 124
Below RM370	46.4%	28.7%	47.5%	38.0%
RM371 - RM500	32.2%	46.7%	52.5%	33.7%
RM501 - RM1000	21.4%	24.6%	0%	28.3%
Mean ± SD	406 ± 119	500 ± 176	355 ± 111	426 ± 82
(range)	(200-700)	(200-905)	(140-600)	(310-500)

Table 3. Physical characteristics of 334 subjects (mean ± SD)*

	n	Age (years)	Weight (kg)	Height (m)	BMI (kg/m²)	Body fat (%)
Males						
Malay	43	37 ± 10	63.5 ± 13.7	1.63 ± 07	23.8 ± 4.4	22.3 ± 6.3
Indian	122	40 ± 9	61.7 ± 10.2	1.64 ± 0.06	22.8 ± 3.6	22.2 ± 5.6
Total	165	39 ± 9	62.2 ± 11.2	1.64±0.06	23.1 ± 3.8	22.2 ± 5.4
		(18-58)	(38.4-9.39)	(1.48-1.79)	(14.6-32.6)	(4.6-36.3)
Females						
Malay	45	36 ± 12	55.3 ± 11.2	1.51 ± 0.06	24.2 ± 4.7	34.1 ± 6.6
Indian	124	37 ± 8	54.9 ± 10.6	1.52 ± 0.05	23.6 ± 4.3	33.5 ± 5.4
Total	169	37 ± 9	55.2 ± 10.8	1.52 ± 0.05	23.8 ± 4.4	33.7 ± 5.7
		(18-57)	(31.4-89.4)	(1.37-1.67)	(15.6-38.2)	(18.7-46.7)

* Figures in parentheses indicate range

The BMI of these adults were divided into various categories as shown in Table 4. About 57.6% of the males could be classified as normal (BMI 18.5 - 24.9), 11% underweight (BMI below 18.5), 26% overweight (BMI 25.0-29.9) and 5% were obese (BMI 30.0 and above). In females, about 55.6% were normal, 8.9% underweight, 24.9% overweight and 10.6 % obese. Results also revealed that the prevalence of overweight and obesity were higher compared to prevalence of underweight amongst these estate workers. Overweight and obesity were most prevalent amongst those working in the factories who led a largely more sedentary lifestyle. However, in the men and women engaged in moderate to heavy work such as rubber tapping and fruit harvesting, overweight (20% in men, 25% in women) and obesity (4% in men, 8% in women) was still prevalent.

Dietary pattern

The food use frequency score of 37 food items is shown in Table 5. The higher scores indicate more frequent intake of these foods. The range of scores were divided arbitarily into three food frequency categories: highly consumed foods (score = 80.0 - 100.0), moderately consumed foods (score = 60.0 - 79.9), less consumed foods (score = 59.9 and below).

Table 4. Percentage subjects at various categories of BMI

	Underweight (BMI below 18.5 kg/m²)	Normal weight (BMI 18.5-24.9 kg/m²)	Overweight (BMI 25.0-29.9 kg/m²)	Obese (BMI >30.0 kg/m²)
Males				
Field workers (n=95)	9.5	66.3	20.0	4.2
Field supervisors (n=32)	21.0	50.0	21.0	8.0
Factory Workers (n=38)	3.1	40.6	50.0	6.3
Total (n=165)	10.9	57.6	26.1	5.4
Females				
Field worker (n=120)	9.2	57.5	25.0	8.3
Factory workers (n=49)	8.2	51.0	24.5	16.3
Total (n=169)	8.9	55.6	24.9	10.6

Table 5. Food use frequency score of subjects

Malay (n = 77)		Indian (n = 268)	
Food	Score	Food	Score
A. Highly consumed foods (Score: 80.0 - 100.0)			
Rice	100.0	Rice	100.0
Cooking oil	99.4	Cooking oil	98.2
Sugar	94.6	Ground/instant coffee	96.6
Ground/instant coffee	93.0	Salted fish	94.8
Dried anchovies	91.2	Sugar	88.0
Vegetables	87.6	Vegetables	82.8
Fresh fish	85.8	Full cream milk powder	80.8
B. Moderately consumed foods (Score: 60.0 — 79.9)			
Coconut milk	70.0	Anchovies	73.8
Eggs	68.0	Eggs	70.4
Flour products	65.2	Fresh fish	68.4
Bread	64.4	Bread	67.6
Fruits	63.2	Chocolate beverage	66.4
Soyabean products (tofu, tempe, fucuk)	62.4	Legumes & pulses	66.2
		Coconut milk	62.8
Cordial drinks	61.8	Noodles	62.6
Sweetened condensed milk	60.8	Fruits	60.2
C. Less consumed foods (Score: 20.0 - 59.9)			
Noodles	55.6	Fresh milk	59.2
Poultry	55.4	Yogurt	55.3

Canned sardines	50.0	Soyabean products	
Dried, salted fish	49.8	(tofu, tempe, fucuk)	55.6
Chocolate beverages	49.2	Canned sardines	52.4
Roots and tubers	47.8	Flour products	52.2
Carbonated drinks	43.0	Roots & tubers	47.2
Legumes & pulses	41.0	Poultry	46.4
Shellfish	39.0	Evaporated milk	45.6
Beef	38.2	Sweetened condensed milk	45.2
Organ meat	37.8	Carbonated drinks	41.0
Margarine/butter/jams/kaya	32.0	Shellfish	36.8
Full cream milk	30.8	Margarine/butter/jams/kaya	31.4
Evaporated milk	28.8	Cordial drinks	32.0
Fresh milk	24.0	Alcohol	32.3
Cheese	20.0	Organ meat	29.4
Yogurt	20.0	Mutton	23.8
Pork meat	20.0	Pork meat	23.2
Alcohol	20.0	Cheese	20.5

Rice, cooking oil and sugar were in the highly consumed food category for both the Malays and Indians, indicating these are the major sources of calories in the diet of these estate workers. Rice, being the staple diet in Malaysia, had the highest score of 100.0 and was consumed daily by 100% of these subjects. About 99% of the subjects use cooking oil daily and the major cooking oil used was palm oil. Sugar provided another source of calories as it was consumed daily by 85% of the Malay subjects and 81% of the Indian subjects. Sugar was mainly added into coffee, another highly consumed beverage. It was a habitual practice of the workers to bring along large tumblers of coffee with sugar to drink while at work in the fields. Other energy providing sources were flour products and bread in the Malay diet whilst among the Indians, bread and noodles were moderately consumed as sources of energy.

Dried anchovies provide a substantial source of protein in the Malay diet as it was categorized in the highly consumed food group with 88% of the population consuming it two to three times a week or daily. Anchovies were mostly added in vegetable dishes and it was a relatively affordable source of protein and calcium in the estate. Another major source of protein for the Malays was fish which was consumed by 90% of the subjects two to three times a week or on a daily basis. Among the Indians, major protein source reported was salted fish. Other sources of protein in the Indian diet were anchovies, eggs, fish and pulses but these were consumed moderately either once or two to three times a week.

It is interesting to note the low consumption of poultry, beef, mutton, pork and shellfish which had low scores both among the Malays and Indians. The frequency of poultry consumption was reported as once a month by a majority (41%) of the Malay respondents and 68% of the Indian respondents. Beef was considered sacred to the Indians and both beef and mutton were eaten by the Malays on special occasions such as during celebrations. The low availability of shellfish observed being sold in the estate provision shop was the likely reason for the low consumption amongst the subjects. Coconut milk was moderately consumed by the respondents, reportedly taken several times a week by 41% of the Malays and 22% of the Indians.

Vegetables were consumed once a week or more often by 90% of the Malay and Indian workers.

However, it should be noted that daily vegetable consumption was not practised by 71% of the Malay and 38% of the Indian workers. The subjects interviewed claimed that vegetables were costly and felt it was not economical to purchase as their children had a poor eating habit of avoiding vegetables. The type of vegetables frequently eaten were eggplant, okra, tomatoes and long beans which were added in dhall dishes by the Indians whilst the Malays consumed various types of green leafy vegetables. The consumption of fruits was moderate among the Malays and Indians with a score of 63.2 and 60.2, respectively. It was noted that consumption of fruits was seasonal and depended upon their availability.

It is important to note that the consumption of milk and milk products was low, particularly amongst the Malays. About 81% of the Malays and 51% of the Indians reportedly never consumed milk at all. When taken in moderation, the Malays would prefer sweetened condensed milk while the Indians would frequently consume full cream milk. Consumption of other sources of calcium (besides anchovies) such as soyabean products and sardines were also low.

Alcohol consumption was reported in the low use category. Only 16% of the Indian men and 5% of the Indian women reported that they consumed alcohol once a month or more often. This may well be under-reported due to the social stigma on alcohol consumption. Alcohol intake could contribute to excess energy and to the incidence of overweight observed among the Indian estate workers.

Energy and nutrient intakes

Table 6a and 6b show the mean energy and selected nutrient intake of 52 male and 56 female normal weight subjects. The mean energy intake was 8.44 ± 2.12 MJ (2032 ± 572 kcal) in males and 6.48 ± 1.29 MJ (1538 ± 384 kcal) in females. Fat provided an average of 22 ± 6 percent of the calories intake in men and 23 ± 8 percent in women. These figures are lower than the urban Malaysian diet which supplies 26% energy from fat as reported by Ng (1995). However, the contribution of energy from fat ranged from 15 to 55% among the females, and 14 to 34% in the male subjects indicating that there were individuals with high intakes of fat above the recommended levels of 15 - 30% by WHO (1990) for the prevention of chronic diseases. The mean percent contribution of carbohydrates to the daily energy intake was 60 ± 9 percent in male subjects and 65 ± 8 percent in female subjects. These figures are within the WHO (1990) recommendations of 50-70% kcal for total carbohydrate. The contribution of energy from protein was 13 ± 3 percent and 12 ± 3 percent in the men and women respectively, which were within the recommended level of 10-15 percent (WHO 1990). Alcohol was found to contribute about 5 percent of total energy intake in the diet of the Indian men.

Table 6a also showed that the Malay male subjects had significantly lower intake of protein but higher intakes of fat and carbohydrate compared to the Indian male subjects. The intake of other nutrients, however were not significantly different. As for the female subjects (Table 6b), the Malay subjects had significantly higher intakes of protein, calcium, iron and vitamin A than the Indians.

Table 6a. Energy and nutrient intakes of 52 male subjects (mean ± SD)

Nutrients	Indian (n=40)	Malay (n=12)	Total mean (n=52)
Energy (MJ)	8.11 ± 2.14	8.54 ± 1.88	8.44 ± 2.12
Protein (g)	58 ± 20	52 ± 26*	64 ± 23
% energy	12 ± 3	14 ± 3*	13 ± 3
Fat (g)	47 ± 21	60 ± 21*	51 ± 21
% energy	22 ± 7	24 ± 5	22 ± 6
Carbohydrate (g)	293 ± 71	352 ± 67*	307 ± 73
% energy	61 ± 11	62 ± 8	60 ± 9
Calcium (mg)	254 ± 115	333 ± 167	273 ± 130
Iron (mg)	10.9 ± 4.8	13.2 ± 6.9	11.5 ± 5.3
Vitamin A (µg RE)	480 ± 312	602 ± 277	503 ± 306
Thiamin (mg)	0.7 ± 0.3	0.8 ± 0.4	0.8 ± 0.3
Riboflavin (mg)	1.0 ± 0.6	1.0 ± 0.4	1.0 ± 0.5
Niacin (mg)	7.1 ± 2.7	7.6 ± 4.3	7.2 ± 3.1
Vitamin C (mg)	26 ± 19	38 ± 23	29 ± 20

* $p < 0.05$

Table 6b. Energy and nutrient intakes of 56 female subjects (mean ± SD)

Nutrients	Indian (n=46)	Malay (n=10)	Total mean (n=56)
Energy (MJ)	6.35 ± 1.16	6.82 ± 1.68	6.48 ± 1.29
Protein (g)	44 ± 14	57 ± 16**	47 ± 15
% energy	12 ± 2	14 ± 2**	12 ± 3
Fat (g)	38 ± 17	44 ± 16	40 ± 18
% energy	22 ± 8	24 ± 4	23 ± 8
Carbohydrate (g)	251 ± 45	251 ± 61	251 ± 47
% energy	66 ± 8	62 ± 5	65 ± 8
Calcium (mg)	178 ± 82	284 ± 117**	198 ± 96
Iron (mg)	9.1 ± 4.2	11.0 ± 3.9*	8.6 ± 4.2
Vitamin A (µg RE)	323 ± 215	711 ± 413*	399 ± 296
Thiamin (mg)	0.5 ± 0.2	0.5 ± 0.2	0.5 ± 0.3
Riboflavin (mg)	0.6 ± 0.3	0.8 ± 0.3	0.7 ± 0.3
Niacin (mg)	5.0 ± 2.7	5.8 ± 1.2	5.3 ± 2.6
Vitamin C (mg)	20 ± 15	40 ± 25	25 ± 19

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

Table 7 shows the percentage of subjects whose intake for various nutrients fall within selected RDA (Teoh, 1975) adequacy ranges. Energy intake was adequate in only 23% of the male subjects. However, more than 50% of the male subjects had intakes greater than 100% of the RDA for protein and iron. On the other hand, a high percentage of the male subjects had inadequate (less than 66% RDA) intake of riboflavin (58%), vitamin A (60%), calcium (62%) and in particular niacin (94%). These were reflected in the results of the dietary pattern survey where milk, milk products and meat consumption were reported to be low. Although the intake of vitamin C was adequate, 35% of the men had intakes of less than 66% of the RDA.

Table 7. Percentage of subjects with nutrient intakes at various level of adequacy

		Percentage RDA		
Nutrients	Mean percent RDA	(0-66)	(67-100)	(above 100)
Males (n=52)				
Energy	80		23% met RDA	
Protein	124	0	10	90
Calcium	61	62	26	12
Iron	128	12	36	52
Vitamin A	67	60	21	19
Thiamin	80	40	44	16
Riboflavin	67	58	29	13
Niacin	43	94	6	0
Vitamin C	97	35	25	40
Females (n=56)				
Energy	77		9% met RDA	
Protein	115	2	32	66
Calcium	44	86	11	3
Iron	31	96	4	0
Vitamin A	53	73	20	7
Thiamin	63	77	11	12
Riboflavin	58	66	27	7
Niacin	41	93	5	2
Vitamin C	83	56	21	23

Only 9% of the female subjects had adequate intake of energy. They had a much lower intake of micronutrients, including vitamin A, calcium, iron, thiamin, riboflavin and niacin intake which met less than 66% of the recommendation. Also, a high percentage of the subjects had intake of less than 66% of the RDA for these nutrients. This could also be attributed to the low energy intake and poor consumption of dairy products and meat including organ meat in the community as reported in the dietary pattern survey. Chandrasekharan and Marimuthu (1980) also reported a similar pattern of low intakes of iron, calcium and the B vitamins among plantation workers. The low intakes of iron could contribute to high prevalences of anemia amongst women in estates as reported by Tee (1992).

Chandrasekharan and Marimuthu (1980) reported that plantation workers had low consumption of meat, eggs and fish in the diet which led to low protein intakes. This study found that protein intakes were adequate and subjects were consuming fish and eggs moderately although meat consumption was also low.

The food intake of this study population was compared to several selected community based studies reported earlier (Table 8). Albeit the different methodology employed in obtaining the nutrient intake, estate workers in this study had a higher mean energy intake than the urban squatter community (Chee, 1989) and similar to the rural community as reported by Zawiah *et al.* (1984).

Education and income on selected nutrient intakes

Pearson correlation coefficient was used to assess the degree of association between the educational background and household income of the subjects on selected nutrients as shown in Table 9. The results revealed that household income showed a positive (significant) correlation with energy and iron intakes of the female subjects whilst in the male subjects, income had a significant correlation with the intakes of thiamin, riboflavin and niacin. Educational background was found to have a positive correlation with nutrient intakes although the r values were not significant.

CONCLUSION

Anthropometric results showed that the prevalence of overweight and obesity were higher compared to prevalence of underweight in these estate workers despite being engaged in moderate to heavy activities. The overall qualitative assessment of the dietary pattern showed that the consumption of poultry, meat and dairy products were low in this population. This could contribute to the inadequate consumption of calcium, iron, vitamin A, thiamine, riboflavin and niacin observed in the subsamples, particularly in the women 's diets. Income appeared to play a role in influencing the intake of certain nutrients of both the male and female subjects.

Table 8. Comparison of nutrient intakes of estate workers with other communities

References	Population	n	Sex	Energy (kcal)	Protein (g)	Fat (g)	Methodology
Zawiah et al. (1984)	Rural	60 44	Male Female	2065 1731	57 51	- -	24 hr diet recall
Chee HL (1989)	Urban squatters	138 125	Male Female	1575 1224	53 62	-	3 day diet recall
Fatimah et al. (1996)	Urban	186 199	Male Female	1825 1527	71 61	57 52	24 hr diet recall
This study	Estate workers	52 56	Male Female	2023 1538	64 47	51 40	3 day diet record

Despite the improved living conditions accorded to estate workers by their employers, the findings of this study appear to suggest that there is a need for improving the quality of their dietary intakes. Increased wages will lead to better socioeconomic status which will have an impact on the overall nutritional status of estate workers. However, measures such as encouraging cultivation of foodstuffs for domestic use would provide a more varied diet. Nutrition education on prevention of obesity and chronic diseases is also indicated. Such measures would contribute to better nutrition, health and increase productivity amongst estate workers.

Table 9. Correlation coefficient values of selected nutrient intakes with education and income

Nutrients	Males (n=52)		Females (n=56)	
	'r' values with education	'r' values with income	'r' values with education	'r' values with income
Energy	0.26	0.16	0.15	0.12
Protein	0.19	0.19	0.03	0.07
Calcium	0.10	0.22	0.16	0.09
Iron	0.13	0.05	0.04	0.20*
Vitamin A	0.16	0.05	0.05	0.06
Thiamin	0.15	0.11*	0.15	0.11
Riboflavin	0.04	0.14*	0.11	0.09
Niacin	0.08	0.18*	0.05	0.07
Vitamin C	0.03	0.11	0.29	0.07

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