Original Article

Dual forms of malnutrition in the same households in Malaysia – a case study among Malay rural households

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This report is a part of a multi-centre study in Asia on the problem of dual forms of malnutrition in the same households. In Malaysia, the prevalence of underweight and stunting persist among young children from poor rural areas. Overweight in adults, especially women from poor rural areas has been reported in recent years. Thus, this study was undertaken in order to assess the presence of the dual burden of underweight child-overweight mother pairs in a poor rural community. Out of 140 Malay households identified to have at least one child aged 1-6 years and mother aged above 20 years, 52.1% of the mothers were overweight, 15.7% of the children were underweight, 27.1% stunted and 5% wasted. Socio-economic background and food intake frequency data were collected from 54 underweight child/overweight mother pairs (UW/OW) and 41 normal weight child/normal weight mother pairs (NW/NW). Compared with the overweight mothers, a higher percentage of the normal weight mothers had received secondary education, were employed and with a higher household monthly income, although these differences were not significant. Patterns of food intake of the mothers and children appeared to have more similarities than differences between the UW/OW and NW/NW groups. Quantitative dietary intakes for 2 days using 24-hr recall and physical activity energy expenditure over the same period were assessed in a sub-group of UW/OW and NW/NW mothers and children. The NW/NW children showed significantly higher intake of total calories, fat and riboflavin than the UW/OW counterparts. Mean energy and nutrient intake of mothers from both groups were not significantly different, although the NW/NW mothers showed higher intake adequacy for total calories and most nutrients. While most of the mothers from both groups reported having no chronic illnesses, about half of the children in both groups had infections, especially gastrointestinal infections, over a 2-week period. Energy expenditure from physical activity for both UW/OW and NW/NW mothers and children did not differ significantly. This study confirmed inadequate intake of total energy and nutrients as the major factor for underweight in Malay children from rural aras. However, assessing intake and physical activity by interview methods were not sensitive enough to overcome perceived problems of under-reporting of energy intake and over-estimation of energy expenditure, especially by overweight subjects. Further investigations on a larger sample are necessary to understand the family dynamics leading to the double burden of malnutrition within the same household.

Key Words: underweight child/overweight mother, food intake, energy balance, malnutrition, Malaysia

Introduction

Several studies have reported on the co-existence of under- and over-nutrition in countries that are undergoing rapid socio-economic development.[1,2] These countries are described as being in a state of nutrition transition, showing shifts in consumption patterns from a high-carbohydrate and low-fat diet based on cereals, starchy roots, vegetables and fish toward higher consumption of refined grains, meat, dairy products and edible oils. Nutrition transition is also accompanied by reduced physical activity with a shift away from walking and cycling to use of cars, and from work in the fields to sedentary jobs in factories and offices. These changes in consumption and physical activity lead to rising prevalence of overweight and obesity in men and women. However, at the same time, problems related to under-nutrition, including protein-energy malnutrition and micronutrient deficiency, particularly iron, vitamin A, iodine and folic acid, continue to have detrimental effects on vulnerable groups in many countries that are undergoing the nutrition transition.

Whilst the manifestation of dual forms of malnutrition namely, underweight and overweight in different population groups has been the subject of several studies in the past decades, the phenomenon of underweight and overweight coexisting in the same household is receiving attention only in recent years. Based on data from national surveys, the prevalence of such households ranged from 8% in China and Russia to 11% in Brazil.[3] This study was initiated toward gathering information on the burden of dual forms of malnutrition in six countries namely, Japan, Korea, the Philippines, Thailand, Indonesia and Malaysia

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with funding from Japan Ministry of Education and Welfare. In Malaysia, the nutrition situation has improved substantially over the decades. Clinical symptoms of overt protein-energy malnutrition are rarely encountered in field surveys. Nonetheless, underweight and stunting in young children persist in poor communities such as those in rural villages, estates and among the Aborigines.[4] Anaemia in children, female subjects and the elderly also poses as another "old" nutrition problem.[5] Meanwhile, overweight prevails not only in the urban population[6], but also has emerged as a matter of concern in adults from poor rural communities.[7] Given that childhood mal-nutrition prevails primarily in poor rural communities, the research interest here is to assess the extent and factors contributing to the burden of the dual forms of mal-nutrition in a poor rural community.

Methods

Selection of study location

The district of Sabak Bernam, situated approximately 150km north of the capital city of Kuala Lumpur, was purposively chosen for its high percentage of poor rural households. According to the Ministry of Rural Develop-ment Malaysia, Sabak Bernam district had 1150 families or 62% of the total welfare recipients in Selangor state in the year 2000. Monthly welfare allowance is given to families earning below the government Poverty Income Line (PLI) (based on PLI of RM510 for a household size of 4.6 or RM110.87 per capita PLI[8]). The rural population of Sabak Bernam can be found in 12 villages and one oil palm plantation. Based on information from the District Office, 7 of the largest villages in terms of population size were purposively selected for the study.

Selection of child-mother pairs

There were a total of 840 households in the villages and plantation in Sabak Bernam. The enumerators visited each of them in order to identify only Malay households with at least one child aged between 1-6 years and the mother aged above 20 years. A total of 140 such Malay households were identified. In households with more than one child aged 1-6 years, the youngest of the children was selected for the child-mother pair.

Weight and height of the mothers and children were measured. Weight was taken with light clothings (to the nearest 0.1 kg) on a TANITA weighing scale (Tanita Corporation, Tokyo, Japan). Height was measured with a SECA bodymeter (Vogel & Halke Gmgh & Co., Hamburg, Germany) to a precision of 0.1 cm. The same researcher took all the measurements throughout the study. The Z scores for weight-for-age, height-for-age, and weight-for-length of the children were calculated using the US National Center for Health Statistics (NCHS) reference data by using "Anthro" software version 1.02 (CDC/WHO, 1999).

The mothers were categorized according to body mass index (BMI) and overweight was when BMI was ≥ 25 kg/m^2 (WHO 1998). Children were categorized according to weight-for-age Z scores (WAZ). As the number of underweight children defined by WAZ <-2SD (WHO, 1983) was small (only 21), it was decided that for this study, the underweight children group would include all children whose WAZ < -1SD. Based on these definitions, a household is said to have dual forms of malnutrition when there is an underweight child and an overweight mother. This child-mother pair is denoted as underweight child/overweight mother or abbreviated as UW/OW. Meanwhile, households with a child having normal WAZ (neither underweight nor overweight that is, WAZ ≥ -1SD and < 2SD) and his/her mother with normal BMI (neither underweight nor overweight that is, BMI ≥ 18.5 and < 25.0 kg/m^2) were termed as normal weight child/normal weight mother pairs or abbreviated as NW/NW. Out of the 140 child-mother pairs measured, a total of 95 pairs were included in the study, comprising 54 (26%) UW/OW cases and 41 (19.7%) NW/NW cases (Table 1). The remaining 45 child-mother pairs did not fit into either of these combination types.

Data collection analysis

Household socio-demographic information and dietary intake of the child-mother pairs were obtained from all the 95 households. A food frequency questionnaire (FFQ) was used to record the usual dietary intake of the mothers and children over a month period. The FFQ data were classified using a 5-point scale ranging from 5 = daily intake, 4 = 2-3 times a week, 3 = once a week, 2 = once a month and 1 = rarely or never. Based on this, a score was calculated for each of the food items using the equation originally reported by Reaburn *et al.*,[9] and adapted by Chee *et al.*[10] The higher the score for a particular food item, the more frequent is the intake of that food.

Due to limited resources available for this study, a sub-sample of 30 child-mother pairs was randomly selected from each group (UW/OW and NW/NW) for assessing quantitative food intake (using 24-hour dietary recall for 2 days), physical activity and health status. The mothers were asked to recollect all the types and amounts of food eaten for the 24 hours prior to the interview. The enumerator guided the mothers on the estimation of food amounts using a set of household cups and spoons. The weights (g) of commonly consumed food according to

Table 1. Anthropometric characteristics of child-mother pairs

Variables	Underweight/ overweight (UW/OW) (*N*=54) Mean ± SD	Normal weight/ normal weight (NW/NW) (*N*=41) Mean ± SD
Mother		
Weight (kg)**	70.96 ± 10.30	52.40 ± 7.10
Height (cm)	151.68 ± 9.64	153.83 ± 8.33
BMI (kg/m^2)*	31.31 ± 8.11	22.10 ± 1.93
Child		
Weight (kg)*	12.99 ± 1.96	16.51 ± 2.28
Height (cm)	95.24 ± 12.60	97.05 ± 13.24
WAZ**	-1.77 ± 0.43	0.30 ± 0.69
HAZ*	-1.78 ± 1.16	-1.25 ± 1.21
WHZ**	-0.90 ± 1.05	1.40 ± 1.17

Significant difference between the two groups by t-test, *P < 0.05; **P < 0.01

these household measures have been established previously. The mean data for energy and nutrient intake for the two days were calculated.

Physical activity for both child-mother pairs was recorded using a 24-hour activity recall list. The mothers were asked to elaborate their activities and corresponding time spent for each activity, for the day (24 hours) prior to the interview. The interview for the 24-hour dietary recall and physical activity was carried out on the same day so that the data for dietary recall and physical activity were for the same 24 hours prior to the interview.

Resting energy expenditure (REE) was calculated using the Schofield's Equation and total energy expenditure was determined by multiplying the BMR by a metabolic constant.[11] The same 2 days for the 24-hour dietary recall and physical activity were used for each subject.

Health status of mothers was obtained by asking the mothers whether they currently experienced health and medical problems based on a prepared list of conditions. Health status of the children was obtained by asking the mothers if their children had experienced illnesses identified by symptoms (e.g. running nose, cough, stomach ache) during a two week period prior to the interview date. The data were analyzed using SPSS Version 10.0. Descriptive statistics were used to describe the sample. Exploratory data analysis was carried out to

Table 2. Socio-demographic characteristics of households

	Total (*N*=95)		UW/OW (*N*=54)		NW/NW (*N*=41)	
	N (%)	Mean ± SD	*N* (%)	Mean ± SD	*N* (%)	Mean ± SD
Mothers						
Age (years)		35.2 ± 7.9		35.9 ± 7.9		34.3 ± 7.8
<39	69 (72.6)		37 (68.5)		32 (78.0)	
40-49	22 (23.2)		14 (25.9)		- (0.0)	
50-59	3 (3.2)		3 (5.6)		8 (19.5)	
>60	1 (1.1)		- (0.0)		1 (2.4)	
Education		8.1 ± 2.9 yrs		8.2 ± 3.1 yrs		7.9 ± 2.5 yrs
None	1 (1.1)		0 0.0		1 (2.4)	
Primary	49 (51.6)		30 55.6		19 (46.3)	
Secondary	36 (37.9)		16 29.6		20 (48.8)	
Tertiary	9 (9.5)		8 14.8		1(2.4)	
Age of children (yrs)		3.9 ± 1.2		3.9 ± 1.17		3.8 ± 1.1
1 to 3 years	46 (48.4)		26 (48.1)		20 (48.8)	
4 to 6 years	49 (51.6)		28 (51.9)		21 (51.2)	
No. of children per household		3.55 ± 1.75		3.65 ± 1.76		3.41 ± 1.75
1 to 4	72 (75.8)		41 (75.9)		31 (75.6)	
5 to 9	23 (24.2)		13 (24.1)		10 (24.4)	
Employment status[1]						
Housewife	74 (77.9)		46 (85.2)		28 (68.3)	
Employee	21 (22.1)		8 (14.8)		13 (31.7)	
Household income (RM)		877.8 ± 678.9		819.4 ± 569.9		954.8 ± 801.3
≤ 500	42 (44.2)		26 (48.1)		16 (39.0)	
500 – 1000	30 (31.6)		15 (27.8)		15 (36.6)	
1001 – 2000	15 (15.8)		11 (20.4)		4 (9.7)	
> 2000	8 (8.4)		2 (3.7)		6 (14.6)	
Household size		5.8 ± 1.8		5.7 ± 1.8		5.8 ± 1.9
1 to 5	47 (49.5)		25 (46.3)		22 (53.7)	
6 to 10	47 (49.5)		28 (51.9)		19 (46.3)	
>10	1 (1.1)		1 (1.9)			
Household income per capita per month (RM)[2]		171.4 ± 155.6		168.16 ± 166.0		175.6 ± 142.6
< 55.44	7 (7.4)		2 (3.7)		5 (12.2)	
55.44 – 110.87	38 (40.0)		28 (51.9)		10 (24.4)	
> 110.87	50 (52.6)		24 (44.4)		26 (63.4)	

[1] including manual workers, factory workers, teachers, clerks

[2] less than RM110.87 per capital per month is classified as household living in poverty according to the government Poverty Income Line[8]

Table 3. Food intake frequency score of mothers (*N*=95)

Under/over (*N*=54)		Normal/normal (*N*=41)	
Food	Score	Food	Score
A. Highly consumed foods (Score: 80.0 – 100.0)			
Rice	100.0	Rice	100.0
Anchovy	85.2	Anchovy	84.8
Fresh marine fish	82.9		
B. Moderately consumed foods (Score: 60.0 – 79.9)			
Egg	78.8	Egg	79.3
Traditional Malay cakes	74.5	Fresh marine fish	78.7
Green leafy vegetables	74.1	Chicken	76.3
Chicken	73.6	Green leafy vegetables	74.4
Cucumber	72.8	Noodles	73.2
Nuts	72.7	Bread	73.2
Canned fish	71.8	Nuts	73.2
Cabbage	71.8	Cabbage	72.6
Brinjal	71.8	Traditional Malay cakes	72.6
Carrot	71.3	Biscuit	72.0
Noodles	70.8	Cucumber	70.7
Tomato	69.9	Local salad “Ulam”	70.1
Bread	69.1	Brinjal	68.9
Biscuit	68.5	Sweet porridge	68.9
Sweet porridge	68.1	Carrot	68.8
Local salad “Ulam”	66.3	Beef	67.7
Cooking oil	64.9	Tomato	67.0
Banana	64.4	Canned fish	66.5
Pumpkin	64.0	Bitter gourd	66.5
Fermented soya bean cake “Tempeh”	63.9	Salted egg	65.9
Watermelon	62.0	Wheat flour pancake “Roti canai”	65.8
Full cream milk	61.1	Pumpkin	64.1
Papaya	60.7	Prawns	64.0
Beef	60.7	Banana	64.0
Bitter gourd	60.2	Fermented soya bean cake “Tempeh”	63.5
		Cakes / pastries	63.4
		Full cream milk	62.9
		Cuttlefish	62.2
		Watermelon	62.2
		Nuts	61.0
		Papaya	61.0
C. Less consumed foods (Score: 20.0 – 59.9)			
Cuttlefish	59.8	Guava	57.9
Prawns	58.9	Jackfruit	57.3
Cakes / pastries	58.8	Clam / cockles	56.8
Wheat flour pancake “Roti canai”	57.4	Pineapple	56.7
Nuts	56.4	Fish / Cuttlefish / Prawn ball	54.9
Salted egg	56.0	Cooking oil	52.4
Guava	54.2	Potato	49.4
Jackfruit	52.8	Low fat milk	49.4
Pineapple	51.4	Jam	48.8
Soya bean curd	50.9	Soya bean milk	48.2
Clam / cockles	50.5	Soya bean curd	47.0
Soya bean milk	49.2	Butter	45.1
Potato	45.9	Peanut butter	41.5
Jam	45.9	Ghee	40.3
Fish / Cuttlefish / Prawn ball	45.4	Cow’s internal organ	37.2
Butter	44.0	Mutton	28.7
Low fat milk	42.6	Cheese	28.1
Peanut butter	40.3	Traditional Indian cakes	28.0
Ghee	39.4	Yogurt	27.4
Cow’s internal organ	36.6	Black gram dhal & rice flour pancake “Dosai”	26.8
Traditional Indian cakes	34.8	Wheat flour cake “Puri”	26.2
Yogurt	31.0	Black gram dhal & rice cake “Idli”	26.2
Cheese	30.2	Wheat flour pancake “Capati”	26.2
Rice flour string hopper “Putu mayam”	28.7	Rice flour string hopper “Putu mayam”	26.2
Wheat flour pancake “Capati”	27.8	Duck meat	25.6
Mutton	27.8		
Black gram dhal & rice flour pancake “Dosai”	27.8		
Duck meat	26.0		
Wheat flour cake “Puri”	25.9		
Black gram dhal & rice cake “Idli”	25.9		

check the normality and homogeneity of the data before conducting the analysis to make comparison between the two groups. The t-test was used to compare mean values between the UW/OW and NW/NW groups. The Mann Whitney test was applied for non-parametric variables. Significance was set at $P<0.05$ in each test.

Results

Anthropometric characteristics

Due to the selection criteria, the mean body weight of the overweight (UW/OW) mothers was significantly higher (70.96 ± 10.30 kg) than that of the normal weight (NW/NW) mothers (Table 1). The mean BMI value for the two groups also differed significantly, 31.31 ± 8.11 kg/m^2 compared to 22.1 ± 1.93 kg/m^2 respectively for overweight and normal weight mothers.

The mean body weight of the underweight (UW/OW) children was significantly lower (12.99 ± 1.96 kg) than that of the normal weight (NW/NW) children (16.51 ± 2.28 kg). This result also reflects the pre-determined selection criteria. The normal weight group also showed a significantly better mean WAZ of 0.30 ± 0.69 than that of the underweight children (-1.77 ± 0.43). Both groups have a low HAZ, but the difference was not significant. Given their higher mean weight, the normal weight group showed a significantly higher mean WHZ value (1.40 ± 1.17) than the underweight children (-0.90 ± 1.05). The normal weight group may run a risk of becoming overweight should they put on weight since they are short for their age.

Socio-demographic characteristics

The average age of all the mothers (N=95) was 35.2 ± 7.9 years with the majority (72.6%) aged below 39 years (Table 2). Overweight and normal weight mothers had almost similar mean age, 35.9 ± 7.9 and 34.3 ± 7.8 years respectively. Approximately, 52% of all mothers had primary education only. The mean number of years of education was 8.2 ± 3.1 and 7.9 ± 2.5 years respectively for the overweight and normal weight groups. More of the normal weight mothers had at least secondary education (51.2%) compared to the overweight group (44.4%).

While the majority of the mothers were housewives, a higher proportion of the normal weight mothers were employed (31.7%) compared with 14.8% among the overweight mothers. The women were employed as factory operators, manual workers, clerks and teachers. This leads to the normal weight mothers to have a higher mean household monthly income (RM 955 ± 801) than the overweight group (RM 819 ± 570), but the difference was not significant. The mean household income per capita for the UW/OW and NW/NW households was RM168 ± 166 and RM 176 ± 143 respectively. When compared with the National Poverty Line Income for Peninsular Malaysia of RM110.87 per capita, it is seen that there was a higher percentage of the households with overweight mothers living in poverty (55.6%) compared with 36.6% in the normal weight group.

Both groups had almost similar mean household size of about 6 members. On average, the overweight mothers had 3.65 ± 1.8 children while the normal weight mothers had 3.41 ±1.8. Each group had about half of their children aged 1-3 years and half aged 4-6 years. The mean age of all the children in the study was 3.9 ± 1.2 years.

Table 4a. Mean energy and nutrient intake of mothers[1]

	UW/OW (N=29)	NW/NW (N=28)
	Mean ± SD	Mean ± SD
Energy (kcal)	1310 ± 435	1473 ± 645
Protein (g)	41.2 ± 12.3	51.3 ± 21.4
Fat (g)	40.6 ± 15.2	45.9 ± 23.5
Carbohydrate (g)	190.3 ± 73.3	211.7 ± 94.7
Calcium (mg)	231.6 ± 125.9	257.3 ± 147.1
Iron (mg)	10.5 ± 8.0	12.0 ± 9.2
Vitamin A Eq(µg)	466.9 ± 299.4	645.7 ± 441.4
Thiamin (mg)	0.6 ± 0.3	0.7 ± 0.3
Riboflavin (mg)	0.9 ± 0.4	1.0 ± 0.5
Niacin (mg)	7.4 ± 3.3	8.9 ± 5.4
Vitamin C (mg)	22.5 ± 17.0	26.2 ± 17.5

[1]mean values of 24–hour dietary recall data for two days

The socio-economic description of the mothers indicated that households with dual forms of malnutrition

Table 4b. Adequacy of energy and nutrient intake of mothers

	RDA	UW/OW (*N* = 29) Intake as % of RDA		NW/NW (*N* = 28) Intake as % of RDA	
	Malaysia	Mean	Median	Mean	Median
Energy (kcal)	2000	65.5	60.1	73.7	67.6
Protein (g)	41	100.5	100.0	125.1	122.0
Calcium (mg)	450	51.5	48.4	57.1	50.2
Iron (mg)	28	37.5	28.1	42.8	27.4
Vitamin A Eq (µg)	750	62.2	57.3	86.1	78.4
Thiamin (mg)	0.8	75.0	67.5	87.3	78.8
Riboflavin (mg)	1.2	72.9	70.8	80.0	73.8
Niacin (mg)	13.0	56.7	64.5	68.5	56.9
Vitamin C (mg)	30	75.1	60.0	89.7	63.3

Table 5a. Food intake frequency score of children (1-3 years) (*N*=46)

Under/over (*N* = 6)		Normal/normal (*N* = 20)	
Food	Score	Food	Score
A. Highly consumed foods (Score: 80.0 – 100.0)			
Rice	100.0	Rice	100.0
Fresh marine fish	86.6	Anchovy	87.5
Anchovy	85.6		
B. Moderately consumed foods (Score: 60.0 – 79.9)			
Egg	77.9	Fish	78.8
Bread	73.0	Chicken	75.0
Biscuit	72.1	Egg	75.0
Chicken	72.1	Bread	73.8
Canned fish	71.1	Biscuit	71.3
Traditional Malay cakes	71.1	Green leafy vegetables	68.8
Green leafy vegetables	70.2	Traditional Malay cakes	68.8
Noodles	69.2	Noodles	67.5
Watermelon	69.2	Beef	66.3
Full cream milk	66.4	Sweet porridge	65.0
Nuts	66.4	Full cream milk	63.8
Sweet porridge	66.3	Cuttlefish	62.5
Banana	66.3	Prawns	62.5
Carrot	65.5	Cakes/pastries	62.5
Papaya	64.4	Wheat flour pancake “Roti canai”	61.3
Cabbage	64.4	Cucumber	61.3
Fermented soya bean cake “Tempeh”	63.5	Cabbage	61.3
Cakes/pastries	62.5	Canned fish	60.0
Cucumber	61.6	Nuts	60.0
		Banana	60.0
		Watermelon	60.0
C. Less consumed foods (Score: 20.0 – 59.9)			
Guava	59.6	Papaya	58.8
Cuttlefish	58.7	Nuts	58.8
Oil	58.7	Fermented soya bean cake “Tempeh”	57.5
Brinjal	58.6	Local salad “Ulam”	57.5
Wheat flour pancake “Roti canai”	58.6	Guava	56.3
Tomato	57.8	Salted egg	55.0
Jackfruit	57.7	Fish / Cuttlefish / Prawn ball	55.0
Prawns	57.7	Carrot	55.0
Beef	56.8	Jackfruit	52.5
Soya bean milk	56.7	Brinjal	52.5
Nuts	54.8	Tomato	52.5
Salted egg	53.9	Pineapple	51.3
Soya bean curd	52.9	Pumpkin	51.3
Local salad “Ulam”	51.0	Low fat milk	50.0
Clam / cockles	50.9	Clam / cockles	48.8
Pumpkin	50.0	Bitter gourd	47.5
Pineapple	48.1	Jam	41.3
Fish / Cuttlefish / Prawn ball	48.1	Oil	41.3
Low fat milk	47.1	Soya bean milk	40.0
Jam	46.2	Potato	37.5
Potato	41.3	Butter	37.5
Bitter gourd	41.3	Peanut butter	36.3
Butter	38.4	Cow’s internal organ	35.0
Peanut butter	31.7	Ghee	35.0
Cow’s internal organ	30.8	Soya bean curd	33.8
Yogurt	30.8	Mutton	27.5
Ghee	29.8	Duck meat	27.5
Cheese	28.9	Black gram dhal & rice flour pancake “Dosai”	25.0
Traditional Indian cakes	27.8	Wheat flour cake “Puri”	25.0
Black gram dhal & rice flour pancake “Dosai”	26.9	Black gram dhal & rice flour cake “Idli”	25.0
Mutton	26.9	Wheat flour pancake ‘Capati”	25.0
Rice flour string hoppers “Putu mayam”	26.0	Rice flour string hoppers “Putu mayam”	25.0
Wheat flour cake “Puri”	25.0	Cheese	25.0
Black gram dhal & rice flour cake “Idli”	25.0	Yogurt	25.0
Wheat flour pancake “Capati”	25.0	Traditional Indian cakes	25.0
Duck meat	25.0		

Table 5b. Food intake frequency score of children (4-6 years) (*N*=49)

Under/over (*N* =28)		Normal/normal (*N* =21)	
Food	Score	Food	Score
A. Highly consumed foods (Score: 80.0 – 100.0)			
Rice	100.0	Rice	100.0
Egg	81.3	Anchovy	84.5
Anchovy	80.4	Fresh marine fish	84.5
Fresh marine fish	80.4		
B. Moderately consumed foods (Score: 60.0 – 79.9)			
Chicken	72.3	Egg	76.3
Noodles	70.5	Traditional Malay cakes	75.0
Full cream milk	70.5	Chicken	73.8
Traditional Malay cakes	69.7	Bread	73.8
Biscuit	67.9	Noodles	72.6
Bread	67.0	Full cream milk	70.2
Green leafy vegetables	66.1	Biscuit	67.9
Canned fish	66.1	Beef	66.7
Prawns	64.4	Green leafy vegetables	65.5
Watermelon	63.5	Sweet porridge	65.5
Cabbage	63.4	Watermelon	64.3
Banana	63.4	Canned fish	64.3
Cuttlefish	62.6	Cakes/pastries	63.1
Carrot	61.6	Banana	63.0
Sweet porridge	61.6	Wheat flour pancake “Roti canai”	62.0
Oil	61.6	Papaya	61.9
Cakes/pastries	60.8	Cucumber	61.9
Papaya	60.8	Cuttlefish	60.7
C. Less consumed foods (Score: 20.0 – 59.9)			
Beef	59.0	Prawns	59.5
Cucumber	59.0	Fermented soya bean cake	59.5
Brinjal	56.3	Salted egg	58.4
Nuts	56.2	Pineapple	57.2
Fermented soya bean cake	55.4	Cabbage	57.2
Guava	55.4	Brinjal	57.1
Salted egg	54.5	Carrot	56.0
Tomato	53.6	Low fat milk	56.0
Soya bean milk	53.5	Nuts	54.8
Nuts	52.7	Guava	54.8
Clam / cockles	50.9	Tomato	53.6
Pumpkin	50.9	Nuts	53.5
Jackfruit	50.1	Oil	52.5
Wheat flour pancake “Roti canai”	48.2	Local salad “Ulam”	52.4
Local salad “Ulam”	48.2	Jackfruit	52.3
Fish / Cuttlefish / Prawn ball	47.3	Soya bean milk	52.3
Pineapple	47.3	Fish / Cuttlefish / Prawn ball	51.2
Jam	45.6	Clam / cockles	51.2
Soya bean curd	45.5	Pumpkin	50.0
Low fat milk	44.6	Jam	50.0
Bitter gourd	41.1	Bitter gourd	48.8
Potato	41.1	Potato	45.3
Coe’s internal organ	39.3	Soya bean curd	44.1
Butter	38.4	Butter	40.5
Peanut butter	37.5	Peanut butter	35.7
Ghee	34.0	Ghee	34.6
Traditional Indian cakes	32.2	Cow’s internal organ	32.2
Mutton	30.4	Cheese	31.0
Black gram dhal & rice flour pancake “Dosai”	28.6	Yogurt/dadih	29.8
Wheat flour pancake “Capati”	28.6	Traditional Indian cakes	27.4
Yogurt	28.6	Black gram dhal & rice flour pancake “Dosai	27.4
Rice flour string hoppers “Putu mayam”	27.7	Wheat flour cake “Puri”	27.4
Duck meat	27.7	Black gram dhal & rice flour cake “Idli”	26.2
Cheese	26.8	Wheat flour pancake “Capati”	26.2
Wheat flour cake “Puri”	25.9	Rice flour string hoppers “Putu mayam”	26.2
Black gram dhal & rice flour cake “Idli”	25.9	Mutton	26.2
		Duck meat	25.0

tend to have slightly older and less educated mothers, who were mainly housewives, and more of their households have income below the national poverty income level.

Dietary intake - mothers

Food consumption patterns

The FFQ score showed that rice is the most frequently consumed food by all mothers (Table 3). Rice is the staple food of Malaysians and it is usually eaten for lunch and dinner, and sometimes for breakfast as well. Thus 100% of the subjects consume rice daily. Following rice, anchovy and fresh fish are the next highest frequently consumed foods by both UW/OW and NW/NW mothers. Foods like eggs, chicken and green vegetables are consumed with moderate frequency. Examples of least frequently consumed foods include lamb, cheese and yoghurt. Generally, the FFQ data showed several similarities in the food consumption patterns between the overweight and normal weight mothers.

Mean intake of energy and nutrients

Based on the 24-hour dietary recall for 2 days, the mean energy and nutrient intakes for the mothers are shown in Table 4a. Mean energy intake of the normal weight mothers was higher at 1473 ± 645 kcal than that of the overweight mothers at 1310 ± 435 kcal, but the difference was not significant. The normal weight mothers also showed higher intake of almost all the nutrients studied, although the differences were not significant.

When compared to the recommended daily allowances (RDA) for Malaysians, it is noted that, with the exception of protein, the mean intake of energy and nutrients by both groups were below the recommended levels (Table 4b). For example, the energy intake of the UW/OW and NW/NW mothers met only 69% and 76% respectively of the RDA value. Iron intake was the lowest among the nutrients for both groups, meeting only 37.5% of the RDA level among the overweight and 42.8% for the normal weight mothers. Table 4b also shows that the median energy and nutrient consumption, as percentage of the RDAs were lower than the mean intake levels, indicative of a wide intake range for both groups.

Dietary intake – children

Food consumption patterns

Highly consumed food items of the children aged 1-3 years are rice and anchovy, while fresh fish, egg, bread, biscuit and chicken meat are moderately consumed (Table 5a). Foods less consumed by this age group include cheese, yoghurt, peanut butter and margarine. A similar intake pattern prevails for both the underweight and normal weight children. Table 5b shows that the intake frequency pattern of children aged 4-6 years is quite similar to that of children aged 1-3 years. Highly consumed foods are rice, anchovy and fresh fish, while moderately consumed food includes egg, chicken meat, bread, noodles, and local cakes. Less frequently consumed foods by children from both age groups are cheese and yoghurt, showing that dairy products, among

Table 6a. Mean energy and nutrient intake of children[1]

Energy & nutrients	Children (1 - 6 years old)		Children (1 - 3 years old)		Children (4 - 6 years old)	
	UW/OW (*N*=29) Mean ± SD	NW/NW (*N*=28) Mean ± SD	UW/OW (*N*=16) Mean ± SD	NW/NW (*N*=13) Mean ± SD	UW/OW (*N*=13) Mean ± SD	NW/NW (*N*=15) Mean ± SD
Energy (kcal)	1204 ± 398	1423 ± 320*	1194 ± 382	1435 ± 363	1216 ± 433	1414 ± 292
Protein (g)	22.9 ± 9.3	27.0 ± 7.6	21.7 ± 8.1	28.8 ± 8.7*	24.5 ± 10.7	25.5 ± 6.4
Fat (g)	37.1 ± 16.3	45.8 ± 13.0*	35.5 ± 12.5	45.7 ± 16.7	39.2 ± 20.3	45.9 ± 9.3
Calcium (mg)	229.0 ± 98.7	279.8 ± 112.7	231.1 ± 97.7	272.5 ± 130.7	226.5 ± 103.9	286.2 ± 98.8
Iron (mg)	10.5 ± 9.4	11.5 ± 7.3	10.5 ± 8.6	11.8 ± 8.9	10.6 ± 10.7	11.3 ± 5.7
Vitamin A (µg)	197.1 ± 121.7	201.6 ± 101.8	192.0 ± 118.6	205.2 ± 103.0	203.3 ± 130.0	198.6 ± 104.3
Thiamin (mg)	0.4 ± 0.2	0.5 ± 0.3	0.4 ± 0.2	0.5 ± 0.3	0.4 ± 0.2	0.5 ± 0.2
Riboflavin (mg)	0.8 ± 0.3	1.0 ± 0.3*	0.8 ± 0.3	1.0 ± 0.4	0.8 ± 0.3	1.0 ± 0.3*
Niacin (mg)	6.6 ± 3.4	8.1 ± 4.0	6.5 ± 2.9	8.6 ± 3.6	6.7 ± 4.0	7.6 ± 4.3
Vitamin C (mg)	13.5 ± 9.5	14.0 ± 11.2	12.6 ± 10.2	12.8 ± 10.4	14.6 ± 8.9	15.0 ± 12.0

[1]mean values of 24–hour dietary recall data for two days; * Intake levels between UW/OW and NW/NW children within age group are significantly different at $P<0.05$

Table 6b. Adequacy of energy and nutrient intake of children

Energy & nutrients	Children 1 – 3 years old		Children 4 – 6 years old	
	UW/OW (*N*=16)	NW/NW (*N*=13)	UW/OW (*N*=13)	NW/NW (*N*=15)
	Mean intake as percentage of RDA for Malaysian children			
Energy	87.8	105.5	66.5	77.3
Protein	94.3	125.2	84.5	87.9
Calcium	51.3	60.6	50.3	63.6
Iron	105.0	118.0	106	113.0
Vitamin A	76.8	82.0	67.7	66.2
Thiamin	80.0	100.0	57.1	71.5
Riboflavin	100	125.0	72.7	90.9
Niacin	72.2	95.6	55.4	62.8
Vitamin C	63.0	64.0	73.0	75.0

other food items, are not part of the diet of Malaysian children from poor rural areas.

Mean intake of energy and nutrients

The mean energy intake of the normal weight children aged 1 to 6 years was significantly higher at 1423 ± 320 kcal than the level taken by the underweight children at 1204 ± 398 kcal (Table 6a). Fat intake was also significantly higher for the normal weight children with mean intake of 45.8 ± 13.0g compared to 37.1 ± 16.3g for the underweight group. Riboflavin intake levels also differed significantly between these two groups of children. The normal weight children showed higher intake of the other nutrients than the underweight children but the differences were not significant.

A similar trend was found when the mean intake levels for energy and nutrients were shown separately for the children aged 1-3 years and 4-6 years. In the 1-3 years age group, the normal weight children showed a significantly higher mean protein intake level (28.8 ± 8.7g) than that of the underweight counterparts (21.7 ± 8.1g). Based on the data from food intake frequency, rice, fish and anchovy are the major sources of energy, protein, iron and calcium for the children. As for the 4-6 year olds, mean intake of energy and nutrients were also higher for the normal weight compared to the underweight children, with significant differences shown for riboflavin consumption.

When consumption was expressed as percent of the RDA levels, the normal weight children showed higher attainment of the recommended levels for energy and nutrients as listed in Table 6b. The data were shown separately for ages 1-3 years and 4-6 years as the RDA values differ for these two age groups. In general, the younger children showed better dietary adequacy than the older children. For example, the normal weight children aged 1-3 years had intakes of energy, protein, iron, thiamin and riboflavin that equalled or exceeded the respective RDA values, whereas the older normal weight children showed consumption levels that were below the RDA, except for iron. Comparing between the UW/OW and NW/NW groups, the normal weight children showed better adequacy than the underweight children, regardless of age. The underweight group had intake levels that were below the RDA values for energy and all the nutrients, except for iron, for either 1-3 or 4-6 year olds.

Energy balance - mothers

Due to their higher body weight, the mean resting energy expenditure (REE) of the overweight mothers at 1472.05 ± 137.78 kcal/day was significantly higher than that for the normal weight mothers at 1276.23 ± 67.60 kcal/day (Table 7). The mean level of energy expenditure in physical activity was not significantly different between the two groups, 168.39 ± 42.42 kcal/day for normal weight mothers and 161.73 ± 31.91 kcal/day for overweight mothers. The mean total energy expenditure of the overweight mothers was significantly higher at 1731.71 ± 137.61 kcal/day than that of the normal weight mothers (1542.66±. 83.38 kcal/day). Compared to their energy intake, both the overweight and normal weight mothers showed a negative energy balance (minus 421.34 ± 491.15 kcal/day and minus 69.61 ± 640.26 kcal/day respectively). The energy balance difference between the two groups was significant. It is noted that the standard deviation of the energy balance value in each group is large relative to the mean value, indicating a wide spread of values, from negative to positive, for energy balance. A negative energy balance over a prolonged period would lead to weight loss. However, it was noted that some

Table 7. Energy balance of mothers[1]

kcal/day	UW/OW (*N*=29) Mean ± SD	NW/NW (*N*=28) Mean ± SD
Resting energy expenditure**	1472.05 ± 137.78	1276.23 ± 67.60
Energy expenditure in physical activity	161 .74 ± 31.91	168.39 ± 42.42
Thermogenic effect of food (5% of energy requirement)	Depending on age: 90 - 100	Depending on age: 90 - 100
Total energy expenditure **	1731.71 ± 137.61	1542.66 ± 83.38
Energy intake	1310.37 ± 434.46	1473.04 ± 644.53
Energy balance *	- 421.34 ± 491.16	- 69.61 ± 640.26

[1]energy balance = energy intake - total energy expenditure; Significant difference between the two groups by t-test at *P<0.05 and at **P<0.01

Table 8. Energy balance of children[1]

kcal/day	UW/OW (*N*=29) Mean ± SD	NW/NW (*N*=28) Mean ± SD
Resting energy expenditure**	719.46 ± 113.34	877.45 ± 82.96**
Energy expenditure in physical activity	146.64 ± 25.62	139.26 ± 25.98
Thermogenic effect of food (5% of energy requirement)	Depending on age: 68 - 92	Depending on age: 68 – 92
Total energy expenditure **	944.64 ± 128.37	1097.30 ± 91.51
Energy intake*	1204.05 ± 398.02	1423.19 ± 320.40
Energy balance	259.41 ± 406.51	325.90 ± 332.42

[1] energy balance = energy intake - total energy expenditure; Significant difference between the two groups by t-test at *P<0.05 and at **P<0.01

Table 9. Illnesses experienced by children during 2 weeks prior to interview as recollected by the mothers

Illness	UW/OW (*N*=29) *N* (%)	NW/NW (*N*=28) *N* (%)
Upper respiratory infections (running nose, cough, sore throat with/without fever)	2 (15.4)	1 (6.7)
Gastrointestinal infections (diarrhoea, stomach ache, vomiting)	9 (69.2))	11 (73.3)
Other infections (ear, skin) and allergies (food and non-food)	2 (15.4)	3 (20.0)
Total	13 (100.0)	15 (100.0)

No significance differences for the prevalence of illnesses between the UW/OW and NW/NW groups by λ^2 test at $P< 0.05$

subjects reported very low intake, and it is believed that they were under-reporting or under-estimating their food intake.

Energy balance - children

The mean REE of the children was significantly lower for the underweight children at 719.46 ± 113.34 kcal/day than for the normal weight children at 877.45 ± 82.96 kcal/day (Table 8). The mean energy expenditure in physical activity was not significantly different for the two groups (146.64 ± 25.62 kcal/day for underweight children and 139.26 ± 25.98 kcal/day for normal weight children). Mean total energy expenditure of the underweight children was significantly lower at 944.64 ± 128.37 kcal/day than that (1097.30 ± 91.51 kcal/day) for the normal weight children. As shown previously, the normal weight children also showed significantly higher energy intake than the underweight counterparts (1423.19 ± 321.40 kcal and 1204.05 ± 398.02 kcal respectively). Thus, the normal weight children were consuming and expending more energy than the underweight group. The normal weight children had a higher energy balance (325.90 ± 332.42 kcal/day) than the underweight children (259.41 ± 406.51 kcal/day) but the difference was not significant. It is noted that as in the case for the mothers, the standard deviation for the mean value in each group is large, reflecting a wide range of values for energy balance, from negative to positive, among these children.

Health status

The mothers were asked if they had current medical problems that had been medically diagnosed. Overweight and normal weight groups each reported 2 cases of hypertension, 1 case each with breathing problems and 1 case each with arthritis. None reported having diabetes, kidney problems or cancer. The limited information provided by the mothers appear to show few medical problems amongst these women, but without clinical assessment, one does not know the actual total number of cases with health problems, as not all the mothers have had a medical examination. Based on the recollection of the mothers, about half of the children in each group were not well during a 2-week period (Table 9). Out of these, the most common illness was gastrointestinal infections followed by upper respiratory and other infections. There were no significant differences with respect to the episodes of infections between the UW/OW and NW/NW children.

Discussion

Almost half of the Malay households (47.4%) in the rural community of Sabak Bernam live in poverty, according to the Malaysian government criteria. In this poor community, 52.1% of the women with at least one child aged 1-6 years were found to be overweight with BMI ≥ 25.0 kg/m^2. Meanwhile, 15.7% of these children aged 1-6 years had WAZ < -2SD and 37.9% had WAZ between -2SD and < -1SD. This poor community showed the co-existence of the dual burden of mal-nutrition namely, underweight children and overweight adults.

Overweight and obesity have multi-causal aetiology, including metabolic disorders and genetic susceptibility. In apparently healthy subjects, overweight is normally linked to excess energy intake and/or a lack of physical activity. In this study, the overweight mothers showed a negative energy balance that could be due to over-estimation of energy expenditure in physical activity and/or under-estimation of energy intake. The mothers could have under-reported their food intake, partly due to poor recollection of the types and quantities of the foods eaten, and partly due to under-estimation of the amounts consumed. The latter might be due to a conscious effort not to reveal actual consumption, especially intake of fatty foods. Baiotis and Lino (2002)[12] suggested that overweight women in food insufficient households could be engaged in binge eating when food is available. Women from poor households may be consuming cheaper and less nutritious (more calorie dense) food that leads to being overweight. Future studies should repeat quantitative dietary intake, and also include qualitative approaches such as home-stay observations and informal interviews, in order to capture more closely actual intake of overweight women.

The underweight children consumed significantly less macronutrients, including energy, fat and protein than their normal weight counterparts. Energy expenditure in physical activity did not differ significantly between the two groups. Thus, the underweight children are too thin for their age because they are not eating enough energy-dense food for putting on weight. Besides adequate energy and nutrient intake, the health status of the child is also critical in contributing toward growth and development. In this study, several cases of illnesses were found in both underweight and normal weight children during a two-week period of assessment. Frequent bouts of infection can aggravate poor nutritional status and this in turn, lowers the child's immunity to infections. Thus the interaction of nutrition and infection become a cycle that is well-established.[13]

Conclusion

The presence of dual forms of malnutrition in a poor community poses unique challenges to the health promotion authorities. Intervention messages and activities need to be tailored to meet the needs of the socio-cultural and

economic characteristics of the community. Most of the mothers are housewives with low purchasing power and probably lacking in choices with respect to availability of food. It is not evidently clear from this study whether overweight in the mothers is due primarily to the level of physical activity not being in balance with energy intake, as the dietary data seems to be under-reported. Underweight in the children is evidently due to insufficient food intake and frequent infections. In this respect, hygiene in child care, food preparation and feeding, and the general living surroundings need to be emphasized. More studies should be carried out on a larger sample to ascertain the prevalence and aetiology of the dual forms of malnutrition among the poor in Malaysia.

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