

Dietary Intake of Adolescents in a Rural Fishing Community in Tuaran District, Sabah

Foo Leng Huat¹, Khor Geok Lin¹, Tee E Siong² & Dhanaraj Prabakaran³

¹ Department of Nutrition and Health Sciences, Faculty of Medicine and Health Sciences, UPM, Selangor, Malaysia

² Former Head, Centre for Cardiovascular, Diabetes and Nutrition Research Centre, Institute for Medical Research, Kuala Lumpur, Malaysia

³ District Health Office of Lahad Datu, Lahad Latu, Sabah

ABSTRACT

Dietary intakes and lifestyle habits during adolescence may predict the occurrence of obesity and other diet-related chronic diseases later in life. The purpose of this study was to determine dietary intake of adolescents in a fishing community in Tuaran District, Sabah. A total of 199 apparently healthy adolescents comprising 94 male and 105 female subjects were purposively selected for the study. The mean age of the subjects was 15.2 ± 2.2 years with female subjects having a higher mean age of 15.7 ± 2.4 years compared to the males (14.6 ± 1.8 years). The mean BMI of the subjects was 18.4 ± 2.9 kg/m² with females having a significantly higher BMI (18.9 ± 2.8 kg/m²) than the males (17.8 ± 3.0 kg/m²). Based on the WHO classification (WHO, 1995), 19.6% of the subjects could be classified as thin while 4.5% were at risk of overweight. Overall for both sexes, intake of energy and most nutrients were below the Malaysian recommended nutrient intake (RNI) levels for adolescents, with the exception of vitamin C and niacin. The male subjects showed higher mean intake for vitamin A, thiamine, niacin and vitamin C than the females. Calcium and iron intake ranked among the lowest levels, at 33.4% and 47.2% respectively of the RNI values for both sexes. The main sources of energy were rice, flour products and tubers while fish and seafood were the chief sources of protein. Majority of the subjects (84%) reported taking breakfast daily, which often consisted of fried noodles, fried banana, doughnuts and coffee. Consumption of snacks was popular and commonly consumed snacks were bread, biscuits, and fried banana. The present study revealed that 25.5% and 14.3% of the male and female adolescents respectively were thin, with majority of them consuming inadequate levels of energy and several key nutrients. The results underscore the need for adolescents to be targeted for nutrition and health education as they go through a period of marked physical, physiological and psychological changes.

INTRODUCTION

Food choices during childhood and adolescence are important as it influences health, growth and development throughout the lifespan. Eating practices established in childhood and adolescence could determine the diet and health in adulthood (Nicklas *et al.*, 2001). Unhealthy dietary practices during the early growing periods increases the risk of developing obesity and various lifestyle-related chronic diseases including coronary artery disease, diabetes mellitus and certain types of cancer later in life (Mikkila *et al.*, 2004; Sinaiko *et al.*, 1999). Eating practices established during adolescence may be difficult to change in later years. It is therefore important to establish healthy dietary and lifestyle practices among adolescents. In Malaysia, dietary studies on adolescents are fewer compared with those on young children, pregnant women and the elderly, who are normally deemed as vulnerable groups. The aim of the study was to determine the dietary intake of male and female adolescents in a fishing community in Tuaran District, Sabah.

METHODS

Subjects

Six fishing villages namely, Kg. Serusop, Kg. Penimbawan, Kg. Tajau, Kg. Kindu, Kg. Betutai and Kg. Sambah, located in the northwest of the Tuaran district, Sabah were purposively selected as a cluster for the study, based on the homogenous nature of the population with respect to ethnicity, socio-cultural and daily economic activities. Out of a total of 225 adolescents aged 12 to 19 years in the selected villages, 199, comprising 94 males and 105 females, agreed to participate in the study. The subjects were apparently in good health. The subjects were interviewed using a pre-tested structured

questionnaire, which consisted of questions on socio-demographic background, food intake and dietary practices. The study was approved by the State Health Department of Sabah and written consent was obtained from both parents and the subjects prior to the interview.

Weight and height measurements

Measurements of height and body weight were taken by the first author, either in the community clinic, community hall or during home visits. Anthropometric measurements were performed according to standard procedures of the World Health Organization (WHO, 1995). Body weight was measured using an electronic digital scale (TANITA Corporation, Tokyo, Japan) with an accuracy of 0.1 kg, calibrated with a 5 kg calibrator daily. Height was measured using a microtoise tape (Seca bodymeter 208, Hamburg, Germany), calibrated for an error of measurement of ± 0.1 cm. The average of at least two measurements was calculated. The body mass index (BMI) was computed by dividing the weight (kg) by the square of the height (m).

Dietary intake assessment

The subjects were asked to record each type of food and beverage taken for three days including a weekend. They had to estimate the amount of every food item using food models and household measures in the form of standardised plastic cups and spoons. Details such as brand names for processed foods and the method of food preparation were also recorded. For composite dishes, the amount of each ingredient used in the recipe was estimated. The principal investigator obtained local recipes of commonly eaten foods in the present community to verify dishes recorded by the subjects. The subjects were also asked the frequency and types of food taken during breakfast and as snacks

(defined here as foods eaten between main meals). At the end of the 3 days, the subjects returned their intake records, which were checked for completeness. Each estimated amount consumed was then converted into grams, using a list of commonly consumed foods with known weight for each portion size.

Data analysis

Statistical analyses were performed using the SPSS software (version 12.0; SPSS Inc., Chicago, US). All the variables were tested for normality by the Kolmogorov-Smirnov test and test of homogeneity of variance before any statistical comparisons were made. Data transformation was carried out for variables whose distributions did not appear to be normally distributed. The nutritional status of the subjects, based on the percentiles of BMI-for-age (WHO, 1995), was classified as follows; (i) thinness (<5th percentile of BMI-for-age), (ii) normal (5th to 84.9th percentile of BMI-for-age) and (iii) at risk of overweight (\geq 85th percentile of BMI-for-age). The energy and nutrient content of each food and beverage consumed were determined using the Nutrient Composition of Malaysian Foods (Tee *et al.*, 1997). Computation of the total energy and nutrients for each day's intake was performed using the nutrient conversion computer programme "Diet 4". The average energy and nutrient intake for the 3 days was then compared with The Recommended Nutrient Intakes for Malaysians (RNI) (NCCFN, 2005) to determine intake adequacy. The results are presented either as means and standard deviations (SD) or as proportions (%). For variables that were not normally distributed, median values and the 5-95th percentiles were given. The chi-square (χ^2)

test was used to determine independence between categorical variables, whereas the student's independence t-test for non-paired data was used to test mean differences between male and female adolescents for various continuous measurements indices. Statistical significance for all the tests was defined at P -value < 0.05.

RESULTS

The overall mean age of the subjects was 15.2 ± 2.2 years with the females having a significantly higher mean age (15.7 ± 2.4 years) than the males (14.6 ± 1.8 years) (Table 1). The majority (82.9%) had attended at least secondary school and the average number of years of schooling was 8.6. About half of the subjects (51.8%) were from households with 5 to 8 members. Almost three quarters of the households were living below the Poverty Income Line (PLI)* out of which, 36.7% and 38.2% could be categorised as poor and hard-core poor respectively.

Nutritional status

The mean height (\pm SD) of the male and female adolescents was 1.52 ± 0.11 m and 1.49 ± 0.06 m respectively. The mean body weight (\pm SD) was 41.8 ± 10.6 kg for the male subjects and 42.1 ± 7.5 kg for the females. There was no significant difference in the mean height and body weight between the male and female subjects. The average female BMI value of 18.9 ± 2.8 kg/m² differed significantly from that of the males at 17.9 ± 3.0 kg/m² ($t=2.677$, $P<0.01$). Based on the criteria of WHO (1995), 68.1% and 82.9% of the male and female adolescents respectively possessed normal BMI. While 25.5% and 14.3% of the

* In 1995, the PLI for Sabah was RM601 for household size of 4.9; thus, the PLI per capita was RM122.65, while the hard-core PLI per capita was RM61.33.

Table 1. Socio-economic background and nutritional status of subjects (n=199)

	Male (n=94)	Female (n=105)	Sexes combined (n=199)
	% (N)		
Age (years) ^a	(14.6 ± 1.8)	(15.7 ± 2.4) ^{b***}	(15.2 ± 2.2)
12 to 15	69.1 (65)	44.8 (47)	56.3 (112)
16 to 19	30.9 (29)	55.2 (58)	43.7 (87)
Educational attainment (years) ^a	(8.1 ± 0.2)	(9.0 ± 1.9) ^{b***}	(8.6 ± 2.0)
Primary school	21 (22.3)	13 (12.4)	34 (17.1)
Lower secondary	48 (51.1)	44 (41.9)	92 (46.2)
Upper secondary & above	25 (26.6)	48 (45.7)	73 (36.7)
Household size ^a	(8.4 ± 2.6)	(7.8 ± 2.7)	(8.1 ± 2.7)
1 - 4 persons	7.4 (7)	10.5 (11)	9.0 (13)
5 - 8 persons	46.8 (44)	56.2 (59)	51.8 (103)
≥ 9 persons)	45.7 (43)	33.3 (35)	39.2 (78)
Monthly household income per capita			
≤ RM61 (Hard-core poor)	30.9 (29)	44.8 (47)	38.2 (76)
RM62 - RM123 (Poor)	44.7 (42)	29.5 (31)	36.7 (73)
RM124 and above	24.4 (23)	25.7 (27)	25.2 (50)
Body weight (kg) ^a	(41.8 ± 10.6)	(42.1 ± 7.5)	(41.9 ± 9.1)
Height (m) ^a	(1.52 ± 0.11)	(1.49 ± 0.06)	(1.50 ± 0.09)
Body mass index (kg/m ²) ^a	(17.8 ± 3.0)	(18.9 ± 2.8) ^{b**}	(18.4 ± 2.9)
Thinness (BMI < 5 th percentile)	25.5 (24)	14.3 (15)	19.6 (39)
Normal (5 th to 84.9 th percentile)	68.1 (64)	82.9 (87)	75.9 (151)
At risk of overweight (BMI ≥ 85 th percentile)	6.4 (6)	2.9 (3)	4.5 (9)

^aMean ± SD in parenthesis

^bSignificantly different between male and female subjects (Student's *t*-test; **P*<0.05 and ***P*<0.01)

male and female subjects respectively had BMI in the "thinness" category, a relatively smaller proportion (6.4% male and 2.9% female) was at risk of overweight.

Dietary intake

The mean intake of energy and nutrients according to sex and age groups are presented in Table 2. Overall, the male subjects had intake of dietary energy amounting to about 1710 ± 228 kcal compared to 1468 ± 250 kcal for the females. Two-thirds of the total energy was from carbohydrates, about 14% from

protein and just under 20% from fat sources for both sexes.

The male adolescents had a significantly higher mean intake than the females for all nutrients with the exception of vitamin A, calcium and iron. Within the male group, the older adolescents aged 16 to 19 years showed significantly higher mean intake of energy and most nutrients than the younger males (12-15 years). However, the energy and nutrient intake of the older and younger female adolescents showed no significant differences.

When compared with the recommended intake levels for Malaysians

Table 2. Energy and nutrient intakes according to sex and age groups (n=199)

	Male			Female		
	12 - 19 years (n=94)	12 - 15 years (n=65)	16 - 19 years (n=29)	12 - 19 years (n=105)	12 - 15 years (n=47)	16 - 19 years (n=58)
Energy, kcal	1709.5 ± 228.0 ^{c***}	1649.6	1843.7 ^{d***}	1468.4 ± 250.0	1442.7	1489.3
Carbohydrate, g	266.8 ± 14.4 ^{c*}	268.4	263.0	261.1 ± 17.6	261.6	260.6
% kcal ^a	66.6 ± 3.7 ^{c*}	67.1	65.8	65.3 ± 4.4	65.4	65.2
Protein, g	59.7 ± 9.4 ^{c***}	57.8	64.2 ^{d**}	53.2 ± 11.1	52.5	53.7
% kcal ^a	14.1 ± 1.7	14.1	14.0	14.5 ± 1.8	14.5	14.5
Fat, g	36.8 ± 8.3 ^{c**}	34.7	41.8 ^{d***}	33.4 ± 8.9	32.9	33.9
% kcal ^a	19.3 ± 3.1	18.8	20.3	20.2 ± 3.6	20.1	20.3
Vitamin A ^b , µg RE	532.5 ± 204.0	497.7	610.5 ^{d*}	606.3 ± 184.6	472.2	533.9
Thiamine, mg	0.7 ± 0.2 ^{c*}	0.6	0.8 ^{d***}	0.6 ± 0.2	0.6	0.6
Riboflavin ^b , mg	1.1 ± 0.3 ^{c**}	1.0	1.2 ^{d**}	1.0 ± 0.3	1.0	1.0
Niacin, mg NE	19.9 ± 3.6 ^{c***}	19.1	21.8 ^{d**}	17.3 ± 3.7	16.9	17.6
Vitamin C, mg	85.0 ± 31.9 ^{c**}	81.0	93.9	69.6 ± 30.7	66.6	72.0
Calcium, mg	337.8 ± 106.8	322.0	373.2 ^{d*}	315.8 ± 123.9	313.8	317.4
Iron, mg	10.7 ± 2.6	10.1	11.9 ^{d**}	10.0 ± 2.9	9.5	10.3

Note: Values in table are mean ± SD

^a The amount of energy calculated by using the following conversion factors: Carbohydrate 4 kcal/g (17 kJ), Protein 4 kcal/g (17 kJ) and Fat 9 kcal/g (37 kJ)

^b Analyses were based on transformed data

^c Significantly different between male and female subjects at **P* < 0.05, ***P* < 0.01 and ****P* < 0.001

^d Significantly different between the age groups of 12-15 years and 16-19 years among the male subjects at **P* < 0.05, ***P* < 0.01 and ****P* < 0.001

(NCCFN, 2005), the energy intake of the subjects reached on average only 67.4% of the RNI level (Table 3). Lower RNI levels were attained for the intake of calcium (33.4%), iron (47.2%) and thiamine (56.6%). In contrast, intake of niacin, vitamin C, protein and riboflavin showed high attainment, achieving the RNI levels of 87-117%.

In comparing dietary intake adequacy between the sexes, significant differences showed up for intake of riboflavin, niacin and vitamin C, whereby a lower percentage of the female subjects had intake less than the RNI levels. No significant differences were found between the two age groups of 12 to 15 years and 16 to 19 years with respect to intake adequacy. The younger and older subjects had intakes that were similar, in that the majority of them did not meet the RNI levels for energy, calcium, iron and thiamine.

The main sources of energy were rice, flour products and tubers whilst fish and seafood were the principal sources of protein for the subjects. It was observed that a typical meal taken for lunch or dinner usually consisted of one plate of cooked rice (approximately 175g) eaten with only one portion of steamed fish (*Ikan kukus*) (about 42g) or a whole egg. The year-round consumption of raw local fruits and vegetables and tuber products may contribute to the adequate intake of vitamin C and a high level intake of vitamin A.

Breakfast consumption pattern

The majority of the subjects (83.9%) reported taking breakfast daily. Significantly more males (89.4%) than females (79%) had breakfast daily ($\chi^2=3.91$; $P<0.05$) (Table 4). Almost all the subjects (96%) took breakfast at home, usually prepared by their parents. Only a small proportion had breakfast outside the home, e.g. in the school canteen or coffee shop. As for the types of food taken for breakfast, there was a similar pattern between the males

and females. Foods that were often taken for breakfast included fried noodles (56.2%), fried banana (47.9%) and doughnuts (33.0%). Coffee is the favourite beverage for breakfast (42.8%) by both male and female subjects. Younger and older adolescents appear to have a rather similar breakfast consumption pattern.

Snacks consumption pattern

The most frequently mentioned snacks taken in between main meals were bread and biscuits (69.8%), crackers/chips (56.3%) and fried banana (*pisang goreng*) (48.7%) (Table 5). Fruits (34.2%), ice cream (26.1%), local cakes (*kuih-muih*) (24.1%) and fried noodles (20.6%) were also taken as snacks. Less frequently taken snacks are fried rice (4.0%) and carbonated drinks (3.5%). No significant differences were found in the types of snacks consumed between younger and older male subjects. However, younger females tended to choose ice-cream as a snack, while older female subjects consumed more fruits (40.4%) than their younger subjects and the male subjects, suggesting that older females aged 16-19 years seemed to be more "health conscious". Other studies have reported female adolescents generally tend to choose more healthy diets compared to the males, probably out of body image concerns (Warwick, McIlveen & Strugnell, 1999).

DISCUSSION AND CONCLUSION

The subjects were from poor and hard-core poor households in fishing villages in the Tuaran district of Sabah. A key finding is their low intake of energy and several essential nutrients. Almost all the subjects had total energy intake below the Malaysian RNI level. It is not surprising to find nearly 20% of them were thin. Besides dietary energy, their intake levels of several essential nutrients including calcium and iron were insufficient. An

Table 3. Energy and nutrient intake adequacy among male and female adolescents (n=199)

Energy/Nutrients	Sex	% of RNI attained Mean (SD)	% (n) subjects with intake less than RNI		
			12 - 15 years	16 - 19 years	12 - 19 years
Energy, Kcal	M	63.8 (8.8)	100.0 (65)	100.0 (29)	100.0 (94)
	F	70.7 (12.3)	100.0 (47)	98.3 (57)	99.0 (104)
Protein, g	M & F	67.4 (11.3)	100.0 (112)	98.9 (86)	99.5 (198)
	M	97.3 (17.5)	63.1 (41)	55.2 (16)	60.6 (57)
Vitamin A, mg RE ^a	F	99.3 (19.9)	55.3 (26)	53.4 (31)	54.3 (57)
	M & F	98.3 (18.8)	59.8 (67)	54.0 (47)	57.3 (114)
Thiamine, mg	M	88.5 (82.0 - 96.0)	70.8 (46)	58.6 (17)	67.0 (63)
	F	83.3 (80.3 - 93.6)	76.6 (36)	67.2 (39)	71.4 (75)
Riboflavin, mg ^a	M & F	86.7 (83.2 - 92.7)	73.2 (82)	64.4 (56)	69.3 (138)
	M	57.0 (14.5)	100.0 (65)	96.6 (28)	98.9 (93)
Niacin, mg NE	F	56.2 (17.8)	97.9 (46)	100.0 (58)	99.0 (104)
	M & F	56.6 (16.3)	99.1 (111)	98.9 (86)	99.0 (197)
Vitamin C, mg	M	83.1 (80.1 - 89.2)	81.5 (53)	58.6 (17)	74.5 (70) ^{b**}
	F	95.3 (91.7 - 103.7)	59.6 (28)	48.3 (28)	53.3 (56)
Calcium, mg	M & F	87.0 (83.2 - 92.7)	72.3 (81)	51.7 (45)	63.3 (126)
	M	124.5 (22.6)	18.5 (12)	3.4 (1)	13.8 (13) ^{b**}
Iron, mg	F	110.3 (25.1)	44.7 (21)	27.6 (16)	35.2 (37)
	M & F	117.0 (25.0)	29.5 (33)	19.5 (17)	25.1 (50)
Energy, Kcal	M	129.8 (49.1)	29.2 (19)	17.2 (5)	25.5 (24) ^{b***}
	F	105.7 (46.0)	57.4 (27)	44.8 (26)	50.5 (53)
Protein, g	M & F	117.1 (48.9)	41.1 (46)	35.6 (31)	38.7 (77)
	M	34.1 (11.0)	100.0 (65)	100.0 (29)	100.0 (94)
Vitamin A, mg RE ^a	F	32.8 (13.7)	100.0 (47)	100.0 (58)	100.0 (105)
	M & F	33.4 (12.5)	100.0 (112)	100.0 (87)	100.0 (199)
Thiamine, mg	M	64.5 (15.8)	98.5 (64)	100.0 (29)	98.9 (93)
	F	31.8 (9.6)	100.0 (47)	100.0 (58)	100.0 (105)
Riboflavin, mg ^a	M & F	47.2 (20.8)	99.1 (111)	100.0 (87)	99.5 (198)

^a Median (95% CI)

^b Significantly different between male and female subjects (χ^2 test at ** $P < 0.01$; *** $P < 0.001$)

Table 4. Breakfast consumption patterns among male and female adolescents

	Male			Female		
	12-15 yrs (n=65)	16-19 yrs (n=29)	All ages (n=94)	12-15 yrs (n=47)	16-19 yrs (n=58)	All ages (n=105)
Frequency of taking breakfast						
Daily ^a	90.8 (58)	86.2 (25)	89.4 (84)	68.1 (32)	87.9 (51)	79.0 (83)
A few times a week	7.7 (5)	13.8 (4)	9.6 (9)	21.3 (10)	10.3 (6)	15.3 (16)
Seldom take breakfast	1.5 (1)	0	1.1 (1)	10.7 (5)	1.7 (1)	5.9 (6)
Place of breakfast ^b						
At home	98.4 (63)	93.1 (27)	96.8 (90)	97.8 (43)	91.2 (52)	94.1 (95)
School canteen/coffee shop	1.6 (1)	6.9 (2)	3.2 (3)	2.2 (1)	8.8 (5)	5.9 (6)
Food taken for breakfast ^c						
Fried noodles	51.6 (33)	72.4 (21)	58.1 (54)	61.4 (27)	49.1 (28)	54.5 (55)
Fried banana	50.0 (32)	41.4 (12)	47.3 (44)	50.0 (22)	47.4 (27)	48.5 (49)
Doughnuts	37.5 (24)	20.7 (6)	32.3 (30)	40.9 (18)	28.1 (16)	33.7 (34)
Bread and/or biscuits	12.5 (8)	24.1 (7)	16.1 (15)	6.8 (3)	12.3 (7)	9.9 (10)
Other foods	28.1 (18)	69.0 (20)	40.9 (38)	25.0 (11)	31.6 (18)	28.7 (29)
Coffee	43.8 (28)	48.3 (14)	45.2 (42)	38.6 (17)	42.1 (24)	40.6 (41)
Chocolate drinks	35.9 (23)	21.4 (7)	32.3 (30)	56.8 (25)	38.6 (22)	46.5 (47)
Milk	4.7 (3)	6.9 (2)	5.4 (5)	11.4 (5)	10.5 (6)	10.9 (11)
Other drinks	17.2 (11)	20.7 (6)	18.3 (17)	6.8 (3)	12.3 (7)	9.9 (10)

Note: values in table are % of subjects, with number of subjects in parenthesis

^aSignificantly different between male and female subjects ($\chi^2=3.91$; $P<0.05$)

^bOnly subjects who reported to have breakfast (n=194)

^cSubjects may name more than one type of food (n=194)

Table 5. Snacks consumption among male and female adolescents (n=199)

	Male (n=94)	Female (n=105)	Sexes combined (n=199)
Food taken for snacks ^a			
Bread and/or biscuits	75.5 (71)	64.8 (68)	69.8 (139)
Crackers/chips	62.8 (59)	50.5 (53)	56.3 (112)
Fried banana	52.1 (49)	45.7 (48)	48.7 (97)
Fruits	24.5 (23)	42.9 (45)	34.2 (68)
Ice cream	24.5 (23)	27.6 (29)	26.1 (52)
Local cakes	24.5 (23)	23.8 (25)	24.1 (48)
Fried noodles	13.8 (13)	26.7 (28)	20.6 (41)
Fried rice	3.2 (3)	4.8 (5)	4.0 (8)
Carbonated drinks	5.3 (5)	1.9 (2)	3.5 (7)
Other foods	23.4 (22)	13.3 (14)	18.1 (36)

Note: values in table are % of subjects, with number of subjects in parenthesis

^aSubjects may name more than one type of snack

adequate intake of calcium is critical not only for the rapid growth and development during adolescence, but also for reducing the risk of osteoporosis later in life (Heaney *et al.*, 2000). Iron intake was also poor, placing them at high risk of iron deficiency anaemia (Foo *et al.*, 2004a). Almost 26% of the male subjects and 50% of the females had deficient levels of ferritin (Foo *et al.*, 2004b).

Being from fishing villages, the subjects were fortunate to have access to fish and seafood that were probably more affordable than other protein sources such as meat and dairy products. Their protein intake was found to be adequate in meeting the Malaysian RNI.

There are limited reports on the dietary intake of adolescents in Malaysia. The mean intake of nutrients of this rural group was comparable with that of adolescents from urban areas in Peninsular Malaysia (Poh *et al.*, 1996). The latter study reported subjects aged 10-12 years consuming 282 mg of calcium and 12 mg iron daily, compared with 338 mg and 10 mg respectively in this study.

Taking breakfast is known to be

important for such effects as improving overall school academic and cognitive performances of schoolchildren (Rampersaud *et al.*, 2005). In this study, while the majority take breakfast daily, it is the type of food taken that may pose a health challenge. The majority of subjects usually consumed fried foods for breakfast. While these foods may not necessarily be healthy to be taken on a daily basis, they are relatively cheap to purchase or easy to prepare at home. Only few prefer or could afford to take milk or other dairy products for breakfast. It is therefore challenging to encourage adolescents to take a healthy breakfast that is balanced in terms of energy and nutrients, has variety and yet is affordable and culturally acceptable.

The overall nutritional problem is low dietary intake generally leading to thinness in rapidly growing children. There is less concern for overweight as the proportion of those at risk of overweight is still small, compared to similar age groups in urban areas of Malaysia (Kasmini *et al.*, 1997) and other developed countries (Ogden *et al.*, 2002; McCarthy, Ellis & Cole, 2003).

RECOMMENDATIONS

An adequate intake of energy and essential nutrients during adolescence is crucial in order to meet the high nutritional demands of rapid growth and growth spurts during this period. The adolescents need to be targeted for nutrition and health education, as their intake may not only be dictated by economic factors, but also by the media that portray "thin" role models. Nutrition road shows, public forums and nutrition education campaigns in schools and in the community should be held to promote balanced nutrient intake and healthy lifestyles. Co-operation of all relevant agencies is needed to achieve these goals. In addition, further studies are needed to address the underlying mechanism of inadequate energy intake and its long-term consequences on the general health and well-being of adolescents.

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