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Energy and Nutrient Intakes: Findings from the Malaysian Adult Nutrition Survey (MANS)

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ABSTRACT

Nutrition surveys based on a representative sample of the Malaysian adult population have hitherto not been reported. In 2003, the Ministry of Health, Malaysia, conducted the Malaysian Adult Nutrition Survey (MANS), the first and largest nutrition survey in the country which aimed to provide detailed quantitative information on nutritional status, food and nutrient intakes, and physical activity pattern on a nationwide representative sample of adult subjects between the ages of 18 and 59 years. The survey covered four zones in Peninsular Malaysia (Central, Southern, Northern and East Coast), Sabah and Sarawak. This paper presents the mean and selected percentiles of energy and nutrient intake of 6886 subjects by selected demographic and socioeconomic characteristics. Energy contributions by macronutrients and dietary adequacy in relation to the Recommended Nutrient Intake for Malaysians are also described. Information on dietary intake was collected by trained nutritionists using a one day 24-hour diet recall. Dietary data were analysed using Nutritionist Pro, a diet analysis software and statistical analysis was carried out using the SPSS ver. 13.0. In most of the demographic and socioeconomic groups, males had higher mean energy (1776 kcal) and nutrient intake and percent achievement of RNI than females (1447 kcal). The proportions of calories derived from macronutrients were within the recommendations for a healthy diet. Intake of micronutrients such as iron, calcium and vitamin A was about 50% of RNI particularly in women. Sodium intake of Malaysians, not reported in earlier studies, is also made available. Under-reporting using the EI/BMR ratio was found in half of the population studied. The present study provides the first national estimates of energy and nutrient intake of the Malaysian adult population. Regular nutrition surveys are needed at the national level to provide valuable information on trends in food and nutrient intake, particularly among age and ethnically diverse subgroups of the population.

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INTRODUCTION

The stable economic growth and political climate in Malaysia during the last three decades have greatly contributed to improved socio-economic status of its population and has led to significant lifestyle and dietary changes. Food disappearance data of the last three decades show marked upward shifts in the availability of dietary energy, total fat and protein, refined carbohydrate and animal products (Tee, 1999). These changes and a high rate of physical inactivity (MOH, 2006) have been implicated as factors contributing to the increasing rate of obesity and other nutrition-related non-communicable diseases among Malaysian adults (Ng, Tee & Rosman, 1995; MOH, 1999; Khor *et al*., 1999; Lim *et al*., 2000). Consequently, there is a need for comprehensive information on the actual dietary intake of Malaysian adults.

Information on the diet of the population is essential for the formulation, implementation and monitoring of effective policies and programmes designed to improve overall nutritional well-being and health status. Between 2002 and 2003, the Ministry of Health carried out the Malaysian Adult Nutrition Survey, a cross-sectional survey that was conducted for the first time on a representative sample of the Malaysian adult population. This landmark survey covered four zones in Peninsular Malaysia and included Sabah and Sarawak. The main objective of this survey was to determine the nutritional status, food and nutrient consumption and physical activity pattern of Malaysian adults.

The 24-hour diet recall (24-HDR) a quantitative estimate of all foods and beverages an individual consumes the previous day covering 24-hour duration has been the method of choice in many national dietary surveys such as the New Zealand National Nutrition Survey (Russell *et al*., 1999), National Nutrition Survey of Japan (Yoshiike *et al*.,1996), the US National Health and Nutrition Examination Survey (NHANES) (NCHS, 1994), and the Continuing Survey of Food Intakes by Individuals (CSFI II/DHSK, 1997). This interviewer or telephone administered dietary assessment method provides complete self–reported information for group intake for a given day and has been recognised as being accurate (Gibson, 2005; Subar, 2004). The 24-HDR was used to obtain dietary data in the Malaysian Adults Nutrition Survey (MANS). The purpose of this paper is to report the intake of energy and nutrients, energy contribution from macronutrients and dietary adequacy of Malaysians by demographic and socio-economic characteristics of the population.

MATERIALS AND METHODS

Survey design and sampling

The MANS survey utilised stratified random sampling which covered Sabah, Sarawak and four zones in Peninsular Malaysia (Southern, Central, East Coast and Northern). The eligible respondents of this survey were Malaysian adults aged 18 to 59 years old. Sample size was determined using three factors which were: the estimated prevalence of obesity and overweight (21%) from the Second National Health and Morbidity Survey (NHMS 11, 1996), 95% as the desired level of confidence and a 5% margin of error. The minimum sample size required was 5,780. The sampling frame was provided by the Department of Statistics and comprised Enumeration Blocks (EB) and Living Quarters (LQ) which were sampled proportionate to the population size. To account for a non-response rate of 50%, the required sample size was increased to 8,670.

A pre-survey of the selected LQs was carried out to scout and locate the selected houses, and to obtain information on the household members such as age, sex and ethnic group. Information on the status of houses which were demolished, destroyed, did not exist or changed status was used to determine the actual number of eligible respondents. Eligibility was defined as being aged between 18 and 59 years and not pregnant or breastfeeding at the time of the interview. Where there was more than one adult in this group living in the same household, only one was selected at random to take part in the survey.

Subjects

A total sample of 7349 adults (51% men and 49% women) corresponding to the total estimated population of 14,178,135 were interviewed at their homes.

Measurements

Socio-demographic variables

A pre-tested questionnaire was used to obtain socio-demographic information which included gender, ethnicity (Malay, Chinese, Indian including Punjabi, Orang Asli of Peninsular. Malaysia, Sabah Bumiputra, Sarawak Bumiputra, and other Bumiputra), age group (18-19, 20-39, 40-49, 50-59), educational level (primary school, lower secondary school, higher secondary school, matriculation/form six, college/ university and others: no formal education e.g. religious schooling), strata (rural: small towns, villages /urban: metropolitans, cities) and four zones in Peninsular Malaysia (Southern: Negeri Sembilan, Melaka, Johor; Central: Perak, Selangor, Wilayah Persekutuan; East-Coast: Kelantan, Terengganu, Pahang; Northern: Perlis, Kedah, Pulau Pinang), Sabah and Sarawak.

Dietary assessment

Dietary data were obtained from an interactive 24-hour dietary recall method that was adapted from Gibson and Ferguson (1999) and the Continuing Survey of Food Intakes by Individuals (CSFI II/DHSK, 1997). This is an improved approach for collecting dietary intake wherein respondents are asked to recall all foods and beverages consumed over the previous 24-hr time period (midnight to midnight) in an uninterrupted manner (the *quick* list). Respondents are then probed for the types of foods and preparation method, ingredients and amounts for each food item mentioned in the quick list. To help the respondent in recalling foods that are frequently forgotten, the interviewer reads out a list of foods that include alcoholic and non-alcoholic beverages, fruit, and snack items. After all foods and fluids consumed are specified, the interviewer reviews the entire recall with the respondent as a final check for completeness and accuracy. The 24-HDR was interviewer-administered by nutritionists trained in interviewing and probing skills, quantification of portion sizes of foods and who are also familiar with local food customs. In addition, data entry clerks who were trained to identify, describe foods and recipes and carry out quality control checks were used. Dietary assessment aids such as the album of food pictures (MOH, 2004) and household measures were used to facilitate identi-fication of foods and quantification of portion sizes consumed. The album consists of actual size photographs of individual foods which were useful in helping subjects estimate amounts

eaten as fractions or multiples of the illustrated reference portions.

Dietary data analysis

Questionnaires were sent to the Family Health Development Division, MOH for centralised data entry to ensure standardisation of the data management process. Data cleaning and quality control checks were carried out before dietary intake analysis was performed. Complete information on diet and socio-economic characteristics was obtained from 6886 adults (93.6% response rate). A dietary analysis software, Nutritionist Pro™ Nutrition Analysis Software (First Data Bank, USA, 2003)*, was used for energy and nutrient analysis. This software contains several food databases including the USDA Food Database, Canadian Food Database, Mexico Food Database and the Malaysian Food Composition Tables along with other hundreds of international food items. For food items not available in Nutritionist Pro, other food databases such as the Singapore Food Composition Guide (Singapore Ministry of Health, 2001), ASEAN Food Composition Tables (Puwastien, Burlingame & Raroenwichit, 2000) and The China Food Composition Tables (Institute of Nutrition and Food Safety, China, 2002) were sought for energy and nutrient content. The information was then entered into the Nutritionist Pro for analyses. For local complex mixed cooked dishes that were not available in any of the food databases, local recipe books were used to identify at least two recipes for each dish. For each recipe, it was ensured that the quantitative information on oils, fats and salt were available. Energy and nutrient content of these recipes were analysed using the Malaysian Food Composition Tables (Tee *et al.*, 1997) and the average of these values was entered into the Nutritionist Pro software. For example, two recipes of fish curry (gravy) were obtained and the ingredients were analysed for energy and nutrient values (per 100 gram). The average values of the two recipes were then used as the standard for nutrient content of fish curry. For processed and packaged foods, information on energy and nutrient content on their labels was entered into the software directly for analysis. For all foods consumed by the subjects, steps were taken to ensure that oils, fats and salt were accounted for. The macro- and micro-nutrient intakes reported in the present paper are based exclusively on the contribution of food and fluids consumed and do not include contribution from vitamin and mineral supplements.

Dietary adequacy

Dietary adequacy was assessed by comparison of energy and nutrient intake with the Recommended Nutrient Intakes (RNIs) for Malaysians (NCFFN, 2005). For macro-nutrients, adequacy was considered achieved if the person's mean intake met, at a minimum, the following guidelines: 20-30% of energy from total fat, 55% to 70% carbohydrate and 10-15% proteins. For micro-nutrients (vitamins A, C, thiamine, iron, and calcium), adequacy was considered achieved if the individual's mean intake met or exceeded 100% of the RNI.

Evaluation of under-reporting

Under-reporting of energy is a major concern in dietary assessment (Black *et al.*, 1991). The

* The license for Nutritionist Pro™ Nutrition Analysis Software was taken over by Axxya Systems in the United States, a developer of nutrition and fitness products, in 2005.

ratio between reported total energy intake (EI) and basal metabolic rate (BMR) was used to examine the prevalence of under-reporting of energy. BMR was calculated using the equation of Ismail *et al.* (1998). An EI/BMR ratio below 1.2 was considered as inadequate for the maintenance of body weight to identify low energy reporters (Goldberg *et al.*, 1991). In this population, it was found to be 1.212 and half (54.8%) of the population were under-reporters. Women's EI/BMR ratio was lower than that of men (1.178 vs 1.243) and more women (58%) than men (51%) were under-reporters. However, this paper does not exclude under-reporters from the data set as the aim of this paper is to present the energy and nutrient intakes of the whole sample.

Statistical analysis

Data on energy and nutrient intakes were transferred from the Nutritionist Pro to the Statistical Package for Social Sciences (SPSS) version 13.0 for statistical analysis. A sampling weight was added to account for complex survey design, non-response and post stratification for stratum, age and sex in the analysis for extrapolation of the findings to the Malaysian population. Intake distributions are presented as mean±SE, median, 25^{th} and 75^{th} percentiles to characterise population intake levels for gender, and socio-demographic characteristics (zone, strata, ethnicity, age and education level).

RESULTS

Socio-demographic profile

About 54% and 46% of the population was from the urban (metropolitans and cities) and rural (towns, villages) areas, respectively (Table 1). By ethnic distribution Malays constituted the majority (54%), followed by the Chinese (23%), and Indians (9.2%). Bumiputera Sarawak and Bumiputera Sabah (Bumiputra groups other than Malays) together comprised 11.2%, Other Bumiputra, 2.2% (Bumiputra groups other than Malays, Bumiputra Sabah, Bumiputra Sarawak) and Orang Asli of Peninsular Malaysia comprised 0.4%. Young adults between the ages of 18 and 29 years formed the biggest group (35.8%) while the smallest group was the oldest adults (13.2%). About 75% of the population have achieved about six to 11 years of education while a small minority did not receive any formal education.

Energy

Table 2 presents the distribution of energy intake of Malaysian adults. The mean energy intake of men was higher (1776 kcal or 74.5% of RNI) than that of women (1447 kcal or 71.0% of RNI). In general, energy intake and percent RNI achievement in both sexes declined gradually with age with women in all age groups having lower achievements than men. By strata, rural and urban respondents had similar mean energy intakes. By zones, Sabah achieved the highest mean energy intake while the Central zone had the lowest. Among the three major ethnic groups in Malaysia, Malays had the highest intake of energy (1653 kcal). When all ethnic groups were considered, the mean energy intake of Bumiputra Sabah was the highest (1790 kcal) and Orang Asli, the lowest (1066 kcal). Energy intake increased with educational level, being lowest in the Others group (1319 kcal) and highest in the group with college/university education.

Table 1. Socio-demograhic characteristics of the survey population (N=6886)

Characteristics	*Total (N=6886)*		*Men (n=3327)*		*Women (n=3559)*	
	n	*(%)*	*n*	*(%)*	*n*	*(%)*
Zone						
South	1,324	19.2	623	18.7	701	19.7
Central	2,312	33.6	1,154	34.7	1,158	32.5
East Coast	940	13.7	451	13.6	489	13.7
North	891	12.9	415	12.5	476	13.3
Sabah	721	10.5	355	10.7	366	10.3
Sarawak	698	10.1	329	9.9	369	10.4
Strata						
Urban	3,682	53.5	1,800	54.1	1,882	52.9
Rural	3,204	46.5	1,527	45.9	1,677	47.1
Age group (years)						
18-19	427	6.2	208	6.3	219	6.2
20-29	2,039	29.6	989	29.7	1,050	29.5
30-39	1,974	28.7	907	27.3	1,067	30.0
40-49	1,537	22.3	767	23.1	770	21.6
50-59	909	13.2	456	13.6	453	12.7
Ethnic Group						
Malay	3,709	53.9	1,812	54.5	1,897	53.3
Chinese	1,590	23.1	756	22.7	834	23.4
Indian	632	9.2	299	9.0	333	9.4
Orang Asli SM	29	0.4	12	0.4	17	0.5
Bumiputera Sabah	389	5.7	187	5.6	202	5.7
Bumiputera Sarawak	384	5.5	189	5.7	195	5.4
Other Bumiputera	153	2.2	72	2.2	81	2.3
Educational Level						
Primary school	1,427	20.7	622	18.7	805	22.6
Lower secondary school	1,472	21.4	791	23.8	681	19.1
Upper secondary school	2,296	33.3	1,129	33.9	1,167	32.8
Matriculation/Form 6	359	5.2	139	4.2	220	6.2
College/University	970	14.1	548	16.5	422	11.9
Others	355	5.2	97	2.9	258	7.2

Table 2. Energy intake (kcal) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*% RNI*				*25*	*75*	*% RNI*
Malaysia Zone	1,615	9	1,540	1,188	1,959	1,776	14	1,722	1,348	2,116		1,447	11	1,400	1,071	1,759	
Southern	1,571	20	1,488	1,152	1,880	1,732	29	1,696	1,321	2,058		1,401	23	1,359	1,034	1,677	
Central	1,577	16	1,484	1,152	1,866	1,746	22	1,634	1,312	2,051		1,400	20	1,339	1,020	1,692	
East Coast	1,686	27	1,654	1,227	2,072	1,833	42	1,833	1,415	2,271		1,530	34	1,476	1,129	1,912	
Northern	1,570	23	1,504	1,175	1,875	1,711	32	1,666	1,326	2,038		1,436	31	1,382	1,081	1,707	
Sabah	1,776	35	1,679	1,307	2,212	1,915	58	1,795	1,422	2,335		1,629	40	1,543	1,209	2,011	
Sarawak	1,716	33	1,652	1,276	2,094	1,910	56	1,866	1,472	2,244		1,513	32	1,476	1,144	1,919	
Strata																	
Urban	1,601	12	1,512	1,171	1,931	1,760	18	1,671	1,322	2,080		1,437	15	1,379	1,051	1,739	
Rural	1,635	14	1,575	1,211	1,985	1,800	22	1,755	1,385	2,167		1,463	17	1,423	1,097	1,786	
Age Group (years)																	
18-19	1,621	51	1,571	1,161	2,050	1,817	82	1,802	1,369	2,257	74.5	1,419	55	1,355	994	1,941	71.0
20-29	1,665	16	1,595	1,221	2,005	1,805	23	1,759	1,370	2,142	74.0	1,519	22	1,461	1,100	1,819	76.0
30-39	1,660	16	1,567	1,237	1,995	1,847	24	1,773	1,409	2,218	75.1	1,468	18	1,415	1,105	1,776	67.3
40-49	1,555	16	1,501	1,148	1,890	1,716	23	1,657	1,314	2,050	69.8	1,387	21	1,356	1,026	1,716	63.6
50-59	1,503	21	1,443	1,152	1,795	1,638	30	1,576	1,253	1,983	66.6	1,360	28	1,351	1,033	1,634	62.4
Ethnic Group																	
Malay	1,653	13	1,579	1,203	1,999	1,817	18	1,757	1,375	2,141		1,479	17	1,416	1,082	1,807	
Chinese	1,567	16	1,492	1,182	1,856	1,729	24	1,648	1,345	2,048		1,403	20	1,359	1,061	1,668	
Indian	1,431	30	1,370	1,057	1,759	1,589	49	1,512	1,175	1,917		1,281	33	1,256	949	1,591	
Orang Asli PM	1,066	152	1,014	618	1,653	1,119	275	1,369	652	2,055		1,000	120	987	495	1,294	
Sabah Bumiputera	1,790	44	1,705	1,278	2,250	2,009	62	1,837	1,466	2,353		1,580	53	1,540	1,115	2,012	
Sarawak Bumiputera	1,692	38	1,641	1,299	2,122	1,813	58	1,809	1,434	2,185		1,567	48	1,484	1,157	1,972	
Others Bumiputera	1,661	85	1,557	1,300	2,010	1,737	155	1,663	1,309	2,238		1,575	60	1,492	1,278	1,743	
Educational Level																	
Primary School	1,522	18	1,439	1,119	1,855	1,692	29	1,617	1,252	2,083		1,382	20	1,346	1,040	1,682	
Lower Secondary School	1,615	18	1,539	1,190	1,942	1,751	24	1,688	1,330	2,098		1,430	26	1,395	1,053	1,737	
Higher Secondary School	1,672	17	1,616	1,251	2,015	1,824	24	1,776	1,401	2,160		1,512	21	1,476	1,119	1,845	
Matriculation/Form 6	1,627	44	1,564	1,205	2,094	1,848	66	1,815	1,394	2,271		1,483	54	1,437	1,102	1,894	
College/Universiti	1,693	26	1,600	1,248	2,006	1,846	37	1,773	1,413	2,144		1,473	30	1,395	1,105	1,754	
Others	1,319	38	1,348	993	1,668	1,353	88	1,428	1,106	1,768		1,303	38	1,314	955	1,621	

Table 3. Carbohydrate intake (g) of Malaysian adults by socio-demographic characteristics

Characteristics	*All (N=6886)*					*Men (n=3327)*					*Women (n=3559)*				
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*	
				25	*75*				*25*	*75*				*25*	*75*
Malaysia Zone	232	1.4	221	169	284	256	2.0	246	193	310	206	1.67	198	153	253
Southern	224	2.9	210	162	270	246	4.2	239	185	300	201	3.52	190	147	242
Central	225	2.4	212	163	273	251	3.3	236	188	299	198	2.88	188	145	244
East Coast	250	3.9	242	185	308	274	5.8	270	207	341	224	5.00	218	165	277
Northern	226	3.4	215	164	273	249	4.9	242	189	298	205	4.52	194	152	245
Sabah	258	5.0	243	189	310	282	8.5	270	213	341	232	4.95	222	174	277
Sarawak	239	4.4	229	177	289	268	6.7	253	203	319	209	4.54	205	157	258
Strata															
Urban	226	1.8	213	163	274	250	2.6	239	188	302	201	2.21	191	147	245
Rural	240	2.1	231	176	294	266	3.2	254	200	322	214	2.50	209	159	262
Age Group (years)															
18-19	232	7.2	220	159	301	263	11.0	252	184	328	199	8.41	185	139	254
20-29	238	2.4	228	171	289	259	3.4	250	197	313	215	3.10	204	154	263
30-39	239	2.4	228	176	290	268	3.6	256	203	323	210	2.68	204	159	256
40-49	223	2.3	214	168	276	248	3.3	238	188	304	198	2.91	192	146	245
50-59	217	3.1	208	163	261	237	4.3	229	182	294	197	4.16	185	151	239
Ethnic Group															
Malay	242	1.9	232	176	295	268	2.7	256	203	321	215	2.48	207	156	263
Chinese	209	2.2	197	157	250	232	3.3	222	178	277	186	2.65	177	143	219
Indian	212	4.5	207	155	262	234	7.1	223	174	291	190	4.96	188	142	239
Orang Asli PM	196	20.9	215	134	284	198	32.8	255	146	308	193	25.12	162	93	248
Sabah Bumiputera	263	6.7	253	195	317	296	10.2	287	218	347	231	7.17	227	172	281
Sarawak Bumiputera	241	5.3	231	185	287	261	7.9	249	200	316	221	6.63	221	177	269
Others Bumiputera	244	11.7	234	186	291	260	21.7	257	196	314	226	8.46	216	182	254
Educational Level															
Primary School	223	2.7	211	163	274	252	4.4	239	185	308	200	2.99	194	149	247
Lower Secondary School	231	2.7	220	169	284	251	3.7	243	189	310	204	3.70	196	147	253
Higher Secondary School	240	2.5	230	177	292	264	3.6	252	202	318	216	3.09	207	158	263
Matriculation/ Form 6	231	6.7	223	171	293	267	10.6	253	202	331	207	7.74	197	155	257
College/Universiti	233	3.6	221	167	285	257	4.9	245	191	306	200	4.38	191	151	247
Others	203	5.1	203	156	249	215	10.3	217	175	272	197	5.82	199	152	242

Macronutrients

The mean carbohydrate intake of Malaysian adults was approximately 232g (Table 3) which contributed to 59% of the total energy intake. By strata, rural adults had a higher mean carbohydrate intake (240g) than their urban counterparts (226g). Mean carbohydrate intake was highest in Sabah (258g) and lowest in the Southern zone (224g). The Orang Asli had the lowest carbohydrate intake (196g) among all the ethnic groups. Carbohydrate intake declined with age and a similar trend was observed for educational level.

Malaysian adults recorded a mean protein intake of 59g (14% of total energy intake) and men's intake was higher by 10g over that of women (Table 4). Rural and urban adults were similar in their intake of protein. However, by zone, mean protein intake ranged from lowest in Southern and Central (57g) to highest in Sarawak (68g). RNI achievement for protein intake in both men and women was high, being above the 75th percentile. Ethnic differences were observed with protein intake being highest in Bumiputra Sarawak (67g) and lowest in the Orang Asli (27g). By educational level, the lowest intake of protein was observed in the Others group.

Mean fat intake was estimated to be about 50g for the whole population while a difference of 9g was noted between men and women. A similarity in fat intake was noted for rural and urban residents (Table 5). By zone, fat intake was lowest in Northern zone (47g) and highest in Sabah and Sarawak (53g). The youngest age group recorded the highest intake (49g) while the lowest intake was in the oldest age group (41g). By ethnic groups, Chinese had the highest fat intake (53g) while the Orang Asli had the lowest (18g), recording a difference of 35g. By age group, a decline in fat intake was observed with advancing age but it increased with educational level.

Micronutrients

Calcium

Malaysian adults recorded a mean intake of about 397mg for calcium (Table 6) with rural and urban adults having a similar intake. Calcium consumption was lowest for the youngest age group in both sexes with RNI achievement ranging from 40-48% in women and from 48-54% in men. By zone, mean calcium intake ranged from 384mg in Sabah to 425mg in Sarawak. Across ethnic groups, Orang Asli had the lowest intake of calcium (274mg) while Bumiputra Sarawak had the highest intake (394mg) followed by the Chinese (362mg). An increase in calcium intake was observed with higher levels of education.

Iron

The mean intake of iron among Malaysian adults was about 10.7mg with men having a higher intake (12mg) than women (9.5mg) (Table 7). By age group and gender, RNI achievement was lower in women than in men in all age groups with the exception of the oldest group, being <36%. RNI achievement in men exceeded 75% of intake. By zone, intake varied on average by about 1mg. By ethnic group, Orang Asli had the least iron intake (5.5mg) followed by Indians and Other Bumiputras. Iron intake appeared to increase with educational level.

Vitamin C

The mean intake of vitamin C of the respondents was about 61mg with women's intake being higher than that of men (Table 8). Percentage RNI achievement for vitamin C was higher in men in all age groups (80 - 105%) compared to that of women (63-95%).

Table 4. Protein intake (g) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*% RNI*				*25*	*75*	*% RNI*
Malaysia Zone	59	0.4	55	41	74	64	0.6	60	46	78		54	0.5	50	37	68	
Southern	57	1.0	53	39	70	61	1.6	57	44	75		52	1.1	48	36	65	
Central	57	0.7	52	39	69	62	0.9	57	44	75		51	1.0	46	34	63	
East Coast	61	1.1	57	42	76	66	1.8	63	48	80		56	1.4	53	38	72	
Northern	60	1.0	56	43	74	65	1.4	60	46	77		56	1.4	53	40	68	
Sabah	65	1.4	61	44	81	70	2.3	65	48	85		61	1.7	57	41	77	
Sarawak	68	1.6	63	46	84	75	2.6	70	52	92		61	1.6	56	42	76	
Strata																	
Urban	59	0.6	55	40	72	64	0.8	59	45	77		54	0.7	50	37	68	
Rural	60	0.6	56	42	75	65	1.0	62	47	80		54	0.7	51	38	69	
Age Group (years)																	
18-19	59	2.3	56	39	74	65	3.7	62	46	81	104.8	53	2.6	49	34	69	96.4
20-29	61	0.7	56	41	75	64	1.0	60	46	79	103.3	57	1.0	52	38	71	103.6
30-39	61	0.7	57	42	75	67	1.1	63	48	81	108.1	55	0.9	52	38	68	100.0
40-49	58	0.7	54	40	73	63	1.0	59	45	76	101.6	53	1.0	49	36	68	96.4
50-59	56	0.9	52	40	68	61	1.3	57	44	73	98.4	51	1.3	49	36	64	92.7
Ethnic Group																	
Malay	59	0.6	55	41	73	64	0.8	59	46	77		54	0.7	51	37	68	
Chinese	62	0.8	57	44	75	67	1.1	62	49	81		57	1.2	52	39	70	
Indian	48	1.2	45	33	59	53	2.0	49	37	67		43	1.2	41	30	52	
Orang Asli PM	27	6.1	18	7	48	31	11.5	45	8	83		22	4.7	17	6	39	
Sabah Bumiputera	64	1.7	61	44	81	72	2.5	69	50	89		57	2.2	53	39	74	
Sarawak Bumiputera	67	1.9	63	45	84	71	2.9	67	49	89		63	2.5	61	39	78	
Others Bumiputera	63	3.2	58	42	78	63	5.5	64	39	79		62	3.1	55	42	75	
Educational Level																	
Primary School	57	0.8	53	39	71	62	1.2	58	43	76		52	1.0	49	37	65	
Lower Secondary School	59	0.8	55	41	73	63	1.1	59	45	78		54	1.2	50	36	67	
Higher Secondary School	61	0.7	57	42	75	65	1.1	61	48	78		56	0.9	53	38	72	
Matriculation/Form 6	59	1.6	58	40	78	64	2.5	62	45	86		56	2.1	55	35	74	
College/Universiti	64	1.4	57	44	76	69	1.9	63	47	82		57	1.8	51	38	66	
Others	46	1.9	45	32	61	45	4.6	48	37	64		47	1.8	44	31	61	

Table 5. Fat intake (g) of Malaysian adults by socio-demographic characteristics

Characteristics	*All (N=6886)*					*Men (n=3327)*					*Women (n=3559)*				
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*	
				25	*75*				*25*	*75*				*25*	*75*
Malaysia Zone	50	0.4	46	31	63	54	0.6	50	35	68	45	0.5	41	28	58
Southern	50	0.8	45	32	64	55	1.2	53	37	69	43	0.9	39	27	55
Central	50	0.6	45	31	61	54	0.9	49	35	67	45	0.8	41	28	57
East Coast	49	1.1	46	31	64	52	1.7	50	35	67	45	1.4	42	28	58
Northern	47	0.9	44	30	60	51	1.3	47	34	63	44	1.3	41	28	56
Sabah	53	1.5	47	31	67	55	2.3	49	32	69	50	2.0	45	30	64
Sarawak	53	1.6	49	32	69	58	2.9	55	36	77	48	1.5	45	30	64
Strata															
Urban	51	0.5	47	32	65	56	0.8	51	36	69	46	0.6	42	30	60
Rural	48	0.6	45	30	62	52	0.9	50	34	68	43	0.7	40	27	56
Age Group (years)															
18-19	51	2.1	49	32	69	56	3.7	57	35	74	46	1.9	42	27	65
20-29	52	0.7	48	33	67	56	0.9	52	37	71	48	0.9	45	30	61
30-39	51	0.6	45	32	64	56	1.0	51	37	70	45	0.8	42	30	59
40-49	48	0.7	43	30	60	53	1.1	48	35	65	43	1.0	39	26	54
50-59	45	1.0	41	29	58	49	1.4	46	31	63	41	1.2	38	26	54
Ethnic Group															
Malay	49	0.5	45	31	63	54	0.8	50	35	67	45	0.6	41	28	58
Chinese	53	0.8	49	34	67	58	1.2	54	39	72	48	1.0	44	32	62
Indian	44	1.3	40	27	56	48	2.1	44	30	60	39	1.5	36	24	50
Orang Asli PM	18	6.1	14	2	32	21	11.4	16	2	71	15	3.5	14	2	26
Sabah Bumiputera	52	1.8	46	28	68	57	2.4	52	32	73	47	2.5	43	26	63
Sarawak Bumiputera	50	1.7	45	30	63	51	2.5	48	32	67	48	2.1	43	26	62
Others Bumiputera	48	3.3	43	29	61	49	5.7	43	28	68	47	2.9	42	32	57
Educational Level															
Primary School	44	0.8	40	27	57	48	1.3	44	29	63	41	0.9	38	26	52
Lower Secondary School	50	0.8	45	31	63	54	1.1	49	34	69	44	1.1	40	28	57
Higher Secondary School	52	0.7	48	34	65	56	1.0	52	38	69	47	0.8	44	31	60
Matriculation/Form 6	52	1.8	50	32	69	58	2.6	56	40	72	48	2.4	46	27	66
College/Universiti	56	1.1	50	35	68	60	1.6	56	39	73	50	1.3	45	32	61
Others	36	1.7	33	22	51	34	4.1	33	22	52	36	1.6	33	21	51

Table 6. Calcium intake (mg) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*% RNI*				*25*	*75*	*% RNI*
Malaysia Zone	397.2	3.5	353	233	514	418.4	5.0	374	252	538		375.3	4.8	334	217	485	
Southern	408.6	8.8	364	246	527	420.2	11.6	383	268	545		396.2	13.3	338	226	513	
Central	387.8	5.5	344	228	502	416.0	7.9	370	247	533		358.1	7.4	324	212	456	
East Coast	413.8	9.4	367	231	548	435.7	13.5	408	258	588		390.8	13.2	335	210	511	
Northern	382.4	9.1	331	225	483	406.5	13.3	346	239	507		359.7	12.1	318	208	451	
Sabah	383.6	9.8	339	217	487	398.4	14.3	342	217	503		367.9	13.0	338	216	474	
Sarawak	425.4	12.8	389	261	548	437.0	21.3	413	275	554		413.3	13.6	369	236	536	
Strata																	
Urban	398.9	4.6	351	234	511	418.9	6.7	373	249	532		378.3	6.2	334	223	482	
Rural	394.7	5.3	355	230	518	417.6	7.5	377	255	544		370.9	7.4	333	214	491	
Age Group (years)																	
18-19	358.8	15.7	332	207	473	390.5	24.9	368	241	522	48.8	326.0	18.7	294	180	416	40.8
20-29	406.4	6.5	353	236	525	424.6	8.9	367	251	558	53.1	387.4	9.3	338	224	493	48.4
30-39	407.8	5.7	367	237	526	429.5	8.7	393	255	553	53.7	385.8	7.1	342	224	505	48.2
40-49	384.7	6.0	347	236	491	401.6	8.0	361	252	511	50.2	366.9	9.0	329	220	463	45.9
50-59	405.0	10.2	353	222	512	429.9	12.9	375	256	525	53.7	378.7	15.9	326	191	483	47.3
Ethnic Group																	
Malay	399.8	4.9	349	225	519	422.1	6.8	373	245	550		376.2	7.0	329	208	489	
Chinese	401.7	6.6	362	254	503	424.2	9.6	391	278	525		378.7	9.0	335	236	468	
Indian	377.6	11.4	342	229	506	402.2	17.5	360	250	518		354.2	14.5	323	216	475	
Orang Asli PM	288.2	57.9	274	145	506	286.4	97.4	311	145	545		290.3	46.5	263	145	492	
Sabah Bumiputera	374.3	11.9	339	220	492	396.7	17.8	344	238	527		352.9	15.6	337	215	471	
Sarawak Bumiputera	422.5	13.7	394	261	571	415.7	19.9	383	265	555		429.6	18.7	406	261	581	
Others Bumiputera	383.6	22.3	338	195	483	401.3	34.6	353	184	498		363.4	24.9	335	216	483	
Educational Level																	
Primary School	375.8	7.2	334	215	473	398.1	9.7	356	235	510		357.5	10.4	311	202	450	
Lower Secondary School	392.9	7.1	349	227	514	403.1	9.6	360	238	522		379.1	10.5	336	215	497	
Higher Secondary School	409.0	6.1	368	246	536	426.3	9.2	379	257	556		390.7	7.8	353	234	512	
Matriculation/ Form 6	386.3	13.4	352	247	524	432.7	19.7	412	267	580		356.3	17.3	332	234	489	
College/Universiti	429.4	10.0	383	257	540	458.2	12.2	418	278	579		387.6	16.6	336	225	485	
Others	329.6	15.5	309	177	438	301.2	31.2	309	179	411		342.7	16.9	309	175	452	

Table 7. Iron intake (mg) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*% RNI*				*25*	*75*	*% RNI*
Malaysia Zone	10.7	0.2	9	6	13	12.0	0.3	9	7	14		9.5	0.1	8	6	12	
Southern	10.3	0.3	9	6	12	11.6	0.6	9	7	13		8.9	0.2	8	6	11	
Central	10.6	0.2	9	6	12	11.6	0.3	9	7	13		9.5	0.2	8	6	11	
East Coast	10.8	0.3	9	6	13	11.6	0.6	10	6	14		10.0	0.4	8	6	12	
Northern	10.7	0.3	9	6	13	11.7	0.4	9	7	13		9.8	0.3	8	6	12	
Sabah	11.5	0.9	9	6	13	13.1	1.8	9	6	14		9.7	0.4	8	6	12	
Sarawak	12.0	0.9	9	7	13	14.5	1.7	10	8	14		9.3	0.3	8	6	12	
Strata																	
Urban	11.0	0.2	9	6	13	12.4	0.4	10	7	14		9.5	0.2	8	6	12	
Rural	10.4	0.2	9	6	12	11.2	0.3	9	6	14		9.5	0.2	8	6	11	
Age Group (years)																	
18-19	9.9	0.5	8	6	13	11.1	0.8	9	6	14	79.3	8.8	0.5	8	5	12	30.3
20-29	11.5	0.4	9	6	13	12.8	0.7	10	7	14	91.4	10.2	0.3	8	6	12	35.3
30-39	11.0	0.2	9	6	13	12.0	0.3	10	7	14	85.7	9.9	0.2	8	6	12	34.1
40-49	10.4	0.3	8	6	12	11.8	0.5	9	7	13	84.3	8.9	0.2	8	6	11	30.7
50-59	9.8	0.3	8	6	11	10.9	0.6	9	6	13	77.9	8.7	0.3	8	5	11	79.1
Ethnic Group																	
Malay	11.0	0.2	9	6	13	12.0	0.3	10	7	14		9.9	0.2	8	6	12	
Chinese	10.7	0.3	9	6	12	12.2	0.5	10	7	14		9.3	0.2	8	6	11	
Indian	9.1	0.3	8	6	11	9.7	0.5	8	6	12		8.5	0.4	8	5	11	
Orang Asli PM	5.5	0.8	5	2	9	6.3	1.6	9	4	15		4.6	0.8	4	2	7	
Sabah Bumiputera	12.2	1.6	9	6	14	15.3	3.3	9	6	15		9.2	0.5	8	6	12	
Sarawak Bumiputera	11.6	1.5	9	6	12	13.9	2.8	9	6	13		9.1	0.4	8	6	12	
Others Bumiputera	9.4	0.6	8	6	12	9.5	1.1	8	5	13		9.4	0.7	8	6	10	
Educational Level																	
Primary School	9.3	0.2	8	6	11	10.0	0.3	8	6	12		8.7	0.2	8	6	10	
Lower Secondary Schoo1	10.6	0.2	9	6	12	11.6	0.4	9	6	14		9.2	0.3	8	6	11	
Higher Secondary School	11.3	0.3	9	6	13	12.3	0.5	10	7	14		10.2	0.2	9	6	13	
Matriculation/ Form 6	10.6	0.6	9	6	13	12.4	1.2	10	7	15		9.4	0.6	8	5	12	
College/Universiti	12.6	0.7	10	7	14	14.1	1.1	10	7	15		10.5	0.4	9	6	13	
Others	7.9	0.4	7	5	10	7.9	0.9	7	5	10		7.9	0.4	7	5	10	

Table 8. Vitamin C intake (mg) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*% RNI*				*25*	*75*	*% RNI*
Malaysia Zone	60.6	1.0	39	17	83	60.0	1.4	37	16	81		61.2	1.4	41	18	84	
Southern	55.9	1.8	41	18	78	53.4	2.6	37	17	73		58.6	2.5	42	19	83	
Central	58.1	1.7	34	15	76	56.7	2.2	32	14	73		59.5	2.6	35	17	77	
East Coast	48.1	1.9	32	15	60	48.7	2.7	33	16	61		47.4	2.8	32	14	59	
Northern	56.1	2.2	37	16	80	56.5	3.5	35	15	80		55.7	2.7	39	16	81	
Sabah	75.1	3.8	44	17	107	79.6	5.9	43	15	103		70.3	4.4	45	19	110	
Sarawak	94.5	4.5	74	34	128	94.4	6.7	74	35	134		94.6	5.9	76	34	125	
Strata																	
Urban	60.0	1.3	39	17	82	59.0	1.8	37	16	81		61.0	1.9	41	18	83	
Rural	61.4	1.4	38	17	84	61.5	2.2	37	16	82		61.3	1.9	40	17	85	
Age Group (years)																	
18-19	50.0	3.5	32	14	69	55.9	5.8	34	16	74	79.9	44.0	3.7	29	13	68	62.9
20-29	58.6	1.8	37	16	77	57.1	2.4	36	15	73	81.6	60.2	2.7	38	17	79	86.0
30-39	61.7	1.6	41	18	84	57.9	2.3	36	17	79	82.7	65.5	2.3	43	20	89	93.6
40-49	63.5	2.1	40	17	88	60.5	2.6	37	15	85	86.4	66.7	3.2	43	18	90	95.3
50-59	66.4	2.8	42	19	88	72.8	4.2	43	19	93	104.0	59.6	3.6	41	18	82	85.1
Ethnic Group																	
Malay	51.2	1.1	33	15	68	50.5	1.6	31	14	65		52.0	1.6	34	15	69	
Chinese	77.1	2.3	57	28	102	74.4	3.1	57	27	103		79.8	3.4	58	29	100	
Indian	44.5	2.4	27	12	57	46.1	3.9	25	11	57		43.0	3.0	28	14	57	
Orang Asli PM	103.0	19.5	54	16	167	90.6	14.5	72	20	152		118.4	37.7	49	7	196	
Sabah Bumiputera	75.9	4.5	48	18	112	82.6	7.1	44	15	112		69.6	5.5	53	21	114	
Sarawak Bumiputera	92.5	5.1	75	30	131	93.1	7.6	69	28	132		91.8	6.7	83	33	131	
Others Bumiputera	77.8	10.0	40	15	93	87.3	15.7	35	14	91		66.9	9.2	41	17	101	
Educational Level																	
Primary School	59.9	1.8	39	17	84	60.3	2.6	41	16	87		59.5	2.5	38	18	83	
Lower Secondary School	60.0	2.0	38	16	83	58.3	2.7	36	15	82		62.4	3.1	43	17	85	
Higher Secondary School	60.2	1.7	38	18	82	61.1	2.6	36	16	80		59.3	2.1	40	19	84	
Matriculation/ Form 6	52.8	2.8	39	20	78	51.3	4.7	35	19	66		53.7	3.4	42	21	81	
College/Universiti	63.6	2.9	39	18	82	60.9	3.5	39	19	79		67.5	4.9	39	18	84	
Others	68.8	5.9	42	14	93	68.0	7.9	38	13	98		69.1	7.8	45	14	92	

Vitamin C intake of rural and urban adults was similar but by zone, a difference of almost 43mg was recorded between the highest (Sarawak) and the lowest (East Coast). Among ethnic groups, Indians showed the lowest intake of vitamin C (45mg). By age group, vitamin C intake increased by about 10mg from the 18-19 years group to 42mg in the 50-59 years group. Increasing intake of vitamin C was observed with increasing educational levels.

Vitamin A

Vitamin A intake of Malaysian adults was around 517μg (Table 9). By gender, it was higher in men (564μg) than in women (468μg). Intake of both men and women exceeded the 75th percentile with RNI achievements ranging from 72-102%. In terms of strata, the rural adults' intake (556μg) of vitamin A was higher than that of urban adults (490μg). Sarawak had the highest intake of vitamin A (733μg) while Central zone had the lowest intake (486μg). Ethnic group difference was observed where intake ranged from lowest in Orang Asli (196μg) to highest in Bumiputra Sarawak (753μg). By educational groups Vitamin A intake was lowest in the Others group (486μg).

Thiamin

The mean thiamin intake of the respondents was 0.8mg (Table 10). Men and women had similar achievements of RNI across all age groups. Similar intakes of thiamin were seen in all zones and by strata. The Orang Asli consumed the least amount of thiamin (0.5mg) while the Chinese had the highest (0.9mg). A progressive increase in thiamin intake was noted with increasing educational status.

Sodium

Malaysian adults' mean intake of sodium was about 2575mg. By gender, Malaysian men consumed about 500mg more than women while intake was similar in rural and urban respondents. Sarawak and Sabah populations consumed the highest amount of sodium while the Southern zone had the least intake. By ethnic group, Orang Asli had the lowest intake of sodium (945mg) while the Sabah Bumiputra followed by the Chinese had the highest intake. By age group, sodium intake ranged from the highest in the 30-39 years group to the lowest in the 50-59 years group. A difference of 761 mg in mean intake of sodium was noted from highest in the college/university group (2734mg) to lowest in the Others group (1973mg).

DISCUSSION

The reported energy intake of Malaysian adults from several sporadic surveys carried out in various communities in the last 20 years ranged from 1600 kcals to about 2300 kcals (Chong *et al*., 1984, Zanariah *et al*., 1986, Chee *et al*., 1997). The MANS found a mean intake of energy that was lower than the values reported in these studies. However these studies, while being reference points, may not be comparable to the present study as the dietary assessment methods used in the latter were different, sample sizes were relatively small and were not representative of the total population.

Distinct differences in energy intake were seen among geographic and socio-demographic characteristics. The intake of energy by Malaysian men was found to be higher than that of women by about 300 kcal. The estimates of mean energy intake

Table 9. *V*itamin A intake (*μg*) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*%RNI*				*25*	*75*	*% RNI*
Malaysia Zone	516.5	9.0	379	211	639	563.8	13.6	419	246	700		467.5	11.8	345	190	580	
Southern	454.2	12.2	358	218	612	498.5	17.8	412	263	681		407.1	16.4	318	189	543	
Central	486.3	14.2	348	200	577	537.3	21.1	385	221	644		432.8	18.7	321	177	517	
East Coast	535.8	29.6	378	206	648	597.0	51.9	434	253	689		471.2	25.9	338	184	613	
Northern	523.7	23.2	415	231	667	557.6	26.9	445	275	719		491.6	37.3	374	200	613	
Sabah	559.0	34.9	399	199	700	593.4	46.7	399	202	723		522.6	51.6	397	193	676	
Sarawak	732.7	49.6	498	276	870	785.2	79.1	545	306	900		677.9	59.2	465	239	820	
Strata																	
Urban	490.1	11.2	364	205	607	543.7	17.3	399	241	675		434.6	14.0	332	184	548	
Rural	555.5	15.0	400	218	686	593.3	21.9	438	253	729		516.1	20.4	356	195	629	
Age Group (years)																	
18-19	420.4	26.1	335	168	572	478.9	43.4	386	203	681	79.8	360.3	27.2	291	129	511	72.1
20-29	535.7	19.9	383	206	646	561.5	27.9	423	244	718	93.6	508.8	28.5	350	188	583	101.8
30-39	560.6	18.7	389	220	657	613.5	28.3	434	253	717	102.3	506.6	24.2	358	204	616	101.3
40-49	495.9	14.5	372	218	627	542.1	23.7	391	244	669	90.4	447.5	16.2	348	193	583	89.5
50-59	494.3	18.7	379	213	619	572.0	30.6	431	254	689	95.3	412.0	19.3	316	175	560	82.4
Ethnic Group																	
Malay	529.7	13.1	372	211	642	584.4	19.4	422	251	713		471.4	17.4	332	188	574	
Chinese	487.2	14.4	396	226	623	526.3	20.8	438	254	679		447.4	19.8	358	201	572	
Indian	407.3	23.3	313	183	492	448.7	42.1	347	205	527		368.0	21.5	285	166	467	
Orang Asli PM	196.2	58.9	184	0	466	210.4	102.3	408	5	591		178.7	53.2	56	0	379	
Sabah Bumiputera	577.9	50.2	429	215	739	585.4	38.7	435	236	740		570.8	90.9	418	202	736	
Sarawak Bumiputera	752.9	62.4	508	274	900	807.0	109.8	508	287	900		696.5	55.9	509	263	922	
Others Bumiputera	499.6	45.6	338	170	607	521.5	68.4	346	128	748		474.6	54.4	338	180	590	
Educational Level																	
Primary School	493.9	17.4	367	207	609	569.2	32.8	413	253	684		432.4	16.3	329	186	565	
Lower Secondary School	514.3	16.8	393	210	660	539.7	18.2	434	237	713		479.6	30.7	353	192	602	
Higher Secondary School	532.5	16.6	385	223	649	598.0	27.8	421	258	722		463.5	17.2	351	201	583	
Matriculation/ Form 6	475.1	33.5	381	215	605	474.3	33.0	438	241	635		475.7	50.8	363	202	577	
College/Universiti	537.5	27.5	380	204	654	566.0	35.3	417	245	695		496.1	44.4	331	175	573	
Others	486.0	48.4	333	154	624	437.2	69.8	314	154	622		508.7	62.5	341	157	624	

Table 10. Thiamin intake (μg) of Malaysian adults by socio-demographic characteristics and percent RNI

Characteristics	*All (N=6886)*					*Men (n=3327)*						*Women (n=3559)*					
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*
				25	*75*				*25*	*75*	*% RNI*				*25*	*75*	*% RNI*
Malaysia Zone	0.8	0.0	0.6	0.4	1.0	0.9	0.0	0.7	0.5	1.0		0.7	0.0	0.6	0.4	0.9	
Southern	0.9	0.1	0.7	0.5	1.0	1.0	0.1	0.7	0.5	1.0		0.7	0.0	0.7	0.4	1.0	
Central	0.8	0.0	0.7	0.4	1.0	0.9	0.0	0.7	0.5	1.0		0.8	0.0	0.6	0.4	0.9	
East Coast	0.8	0.0	0.6	0.4	1.0	0.8	0.0	0.7	0.4	1.0		0.8	0.1	0.6	0.4	0.9	
Northern	0.7	0.0	0.6	0.4	0.9	0.8	0.0	0.7	0.4	1.0		0.7	0.0	0.6	0.4	0.9	
Sabah	0.7	0.0	0.6	0.4	0.8	0.7	0.0	0.6	0.4	0.8		0.7	0.0	0.6	0.4	0.8	
Sarawak	0.8	0.0	0.7	0.4	1.1	0.9	0.1	0.7	0.5	1.1		0.8	0.0	0.6	0.4	1.0	
Strata																	
Urban	0.8	0.0	0.7	0.4	1.0	0.9	0.0	0.7	0.5	1.0		0.8	0.0	0.6	0.4	1.0	
Rural	0.8	0.0	0.6	0.4	0.9	0.9	0.1	0.7	0.4	1.0		0.7	0.0	0.6	0.4	0.9	
Age Group (years)																	
18-19	0.7	0.0	0.6	0.3	1.0	0.8	0.1	0.7	0.4	1.0	66.7	0.7	0.1	0.6	0.3	0.9	63.6
20-29	0.8	0.0	0.6	0.4	1.0	0.9	0.1	0.7	0.5	1.0	75.0	0.8	0.0	0.6	0.4	0.9	72.7
30-39	0.8	0.0	0.7	0.4	1.0	0.9	0.1	0.7	0.5	1.0	75.0	0.8	0.0	0.6	0.4	1.0	72.7
40-49	0.8	0.0	0.7	0.4	0.9	0.8	0.0	0.7	0.5	1.0	66.7	0.8	0.1	0.6	0.4	0.9	72.7
50-59	0.8	0.0	0.6	0.4	1.0	0.8	0.0	0.7	0.5	1.0	66.7	0.7	0.0	0.6	0.4	0.9	63.6
Ethnic Group																	
Malay	0.8	0.0	0.6	0.4	0.9	0.8	0.0	0.7	0.5	1.0		0.7	0.0	0.6	0.4	0.9	
Chinese	0.9	0.0	0.7	0.5	1.1	1.0	0.0	0.8	0.5	1.2		0.8	0.0	0.7	0.4	1.1	
Indian	0.8	0.0	0.7	0.5	1.0	0.9	0.1	0.7	0.5	1.0		0.7	0.0	0.7	0.4	0.9	
Orang Asli PM	0.5	0.1	0.5	0.2	0.9	0.5	0.2	0.5	0.2	1.0		0.5	0.1	0.4	0.1	0.9	
Sabah Bumiputera	0.7	0.0	0.6	0.4	0.8	0.8	0.0	0.6	0.5	0.8		0.6	0.0	0.6	0.4	0.8	
Sarawak Bumiputera	0.8	0.0	0.6	0.4	1.0	0.8	0.0	0.7	0.4	1.0		0.8	0.0	0.6	0.4	1.0	
Others Bumiputera	0.6	0.0	0.6	0.4	0.8	0.6	0.0	0.5	0.4	0.8		0.6	0.0	0.6	0.4	0.8	
Educational Level																	
Primary School	0.7	0.0	0.6	0.4	0.9	0.8	0.0	0.6	0.4	0.9		0.7	0.1	0.6	0.4	0.9	
Lower Secondary School	0.8	0.0	0.6	0.4	1.0	0.9	0.1	0.7	0.4	1.0		0.7	0.0	0.6	0.4	1.0	
Higher Secondary School	0.8	0.0	0.7	0.5	1.0	0.9	0.1	0.7	0.5	1.0		0.7	0.0	0.6	0.4	1.0	
Matriculation/Form 6	0.9	0.1	0.7	0.5	1.0	0.8	0.0	0.8	0.5	1.1		0.9	0.1	0.6	0.4	1.0	
College/Universiti	0.8	0.0	0.7	0.5	1.0	0.9	0.0	0.8	0.5	1.1		0.8	0.0	0.6	0.4	0.9	
Others	0.6	0.0	0.5	0.3	0.8	0.6	0.1	0.5	0.3	0.8		0.6	0.0	0.5	0.3	0.8	

reported here for men and women are below the recommended intakes for Malaysian adults. The differences observed between reported and average recommendations may be due to under-reporting of food intake by some subjects and/or may reflect lower levels of activity in the population. The higher energy intake in men compared with women is to be expected and can be attributed to the higher proportion of lean body mass in men who may also be more physically active. It could also be due to the fact that women tend to under-report their food intake (Pryer *et al*.,1997). However, when strata was taken into consideration, gender difference disappears which then concurs with the study of Chee *et al.* (1997) that men and women in rural and urban areas were not different in their energy intakes.

The decline in energy intake with age is compatible with the reduction in energy requirement with aging, a consequence of reduction in basal metabolic rate due to the loss of fat-free mass and a possible reduction in physical activity. By ethnic group, the Orang Asli community had the lowest intake of energy, a finding that reflects the poor socio-economic status of this community. There appears to be no improvement in energy intake by the Orang Asli community from that reported by Khor (1988) and Ismail, Wong & Zawiah (1988) on Orang Asli Semai population. The Bumiputra Sabah and Sarawak appear to consume the largest amount of energy. However comparable studies are not available. Lower average energy intakes were reported for Malay and Indian women estate workers (1538 kcal) and urban office workers (1527 kcal) (Chee *et al*., 1996; Fatimah *et al*., 1996). A recent study on the dietary intake of women in rural areas of Selangor found mean energy intakes ranging from 1550 to 1581 kcal (Zalilah & Khor, 2005).

Percentage of energy from macro-nutrients

The proportion of energy derived from macro-nutrients has been used to assess the quality of diet and distribution of macro-nutrient intake of individuals (Mattison *et al*., 2001). In this survey, the relative contribution of macro-nutrients to the total energy intake of respondents by all demographic characteristics were well within dietary guidelines for a healthy diet and met the population nutrient goals recommended by WHO (2003). However, in comparison to the study by Chee *et al.* (1997), Malaysian adults in general appear to have increased their fat derived energy intake from 23 to 27% (+4%) while energy intake from carbohydrate decreased during the same period from 63 to 59%. Energy contribution from protein intake, however, has remained unchanged.

Differences in the proportion of energy from macro-nutrients particularly from carbohydrate and fat were observed among ethnic groups. The highest proportion of energy from carbohydrate was seen in the Orang Asli (70%) while the lowest was in the Chinese community (55%). Fat percent energy in the Chinese was twice (30%) that of the Indian group which could be due the differences in cooking methods.

The distribution of energy from macrnutrients in the diets of Malaysians as found in this study is also comparable to that of Singaporeans (carbohydrate: 55%, protein: 15%, fat: 30%) and the Hong Kong Chinese (carbohydrate: 53%, protein 18%, fat: 29%) but proportionately less carbohydrate and more fat than the Japanese (carbohydrate: 59%, protein: 25%, fat: 16%) (25). In comparison to their Western counterparts, however, Malaysians consume proportionately more carbohydrate but less fat compared to the British (carbohydrate: 45%, protein: 16%, fat: 39%), Australians

Table 11. Sodium intake (μg) of Malaysian adults by socio-demographic characteristics

Characteristics	*All (N=6886)*					*Men (n=3327)*					*Women (n=3559)*				
	Mean	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*		*Mean*	*±SE*	*Median*	*Percentiles*	
				25	*75*				*25*	*75*				*25*	*75*
Malaysia Zone	2575	23.0	2293	1476	3383	2819	34.4	2584	1710	3675	2322	29.2	2072	1317	3106
Southern	2425	50.0	2172	1437	3188	2697	81.2	2454	1639	3499	2136	50.1	1971	1289	2778
Central	2525	38.1	2191	1442	3237	2782	55.0	2469	1706	3603	2254	50.0	1965	1233	3006
East Coast	2706	68.3	2472	1542	3509	2854	103.1	2705	1757	3648	2550	89.4	2242	1427	3360
Northern	2480	53.1	2229	1440	3202	2682	75.4	2467	1678	3416	2289	72.7	1968	1315	3077
Sabah	2923	99.0	2533	1495	3788	3072	137.6	2743	1646	3922	2766	144.7	2364	1396	3719
Sarawak	2831	75.1	2585	1653	3773	3219	119.2	3039	1971	4252	2427	83.3	2232	1478	3239
Strata															
Urban	2601	31.5	2321	1485	3383	2847	46.8	2585	1724	3696	2346	40.2	2095	1330	3111
Rural	2538	33.1	2283	1461	3382	2778	50.6	2578	1702	3648	2286	41.6	2053	1315	3101
Age Group (years)															
18-19	2494	116.4	2266	1454	3385	2793	197.3	2708	1640	3777	2186	114.3	2036	1244	3076
20-29	2645	40.1	2363	1532	3446	2844	52.1	2616	1775	3699	2438	60.2	2165	1345	3239
30-39	2671	39.3	2376	1524	3454	2937	59.9	2702	1744	3854	2399	48.8	2140	1403	3167
40-49	2500	42.4	2249	1407	3257	2765	61.0	2545	1657	3577	2222	56.1	1973	1250	2942
50-59	2414	59.0	2131	1357	3254	2645	87.8	2322	1529	3518	2169	75.4	1850	1229	2952
Ethnic Group															
Malay	2507	30.0	2251	1457	3304	2749	45.4	2494	1670	3537	2249	36.5	2030	1315	3068
Chinese	2916	49.0	2668	1808	3733	3189	67.9	2936	2089	4158	2638	69.0	2342	1581	3355
Indian	1965	61.9	1725	1101	2486	2137	96.1	1940	1232	2763	1801	77.3	1492	1009	2193
Orang Asli PM	945	334.8	752	37	2099	933	535.7	1139	29	2572	959	342.2	752	37	1156
Sabah Bumiputera	2929	107.8	2594	1554	3787	3328	167.9	3018	1761	4016	2548	118.8	2365	1364	3648
Sarawak Bumiputera	2707	96.1	2395	1495	3566	2891	140.3	2852	1651	3967	2515	126.0	2115	1426	3187
Others Bumiputera	2518	179.8	2268	1297	3271	2682	291.9	2355	1391	4009	2332	208.7	2144	1168	3102
Educational Level															
Primary School	2429	46.2	2143	1339	3201	2697	73.9	2328	1454	3516	2208	56.6	1945	1274	2987
Lower Secondary School	2588	46.7	2338	1463	3410	2770	64.2	2586	1657	3657	2342	66.0	2023	1263	3126
Higher Secondary School	2663	39.2	2371	1589	3477	2893	56.2	2667	1780	3770	2421	53.4	2178	1420	3202
Matriculation/Form 6	2605	101.7	2349	1481	3577	3022	167.7	2668	1837	3997	2336	120.8	2088	1305	3365
College/Universiti	2734	70.1	2529	1662	3416	2964	101.5	2732	1874	3702	2400	86.3	2246	1446	3086
Others	1973	98.4	1778	1155	2693	1900	228.9	1863	1025	3030	2008	95.2	1763	1171	2619

(carbohydrate: 45%, protein: 17%, fat: 32%) and New Zealanders (Russell *et al*., 1999).

Intake of micro-nutrients

Iron intake as a percentage of RNI in Malaysian women was below 50% and fell to as low as 30% in the youngest age group. Various studies in the country have reported that iron deficiency and anemia continue to be significant problems. Tee *et al*. (1998) documented that 25% of women aged 18 to <60 years in rural areas and estates had anemia while a survey in remote communities in Sarawak found a high prevalence of anemia in men >40 years and in young women. However, true iron deficiency cannot be ascertained from dietary intake alone as individuals generally adapt to poor dietary intake by increasing their rate of absorption and by using body stores to maintain equilibrium while individual rates of absorption and losses may differ greatly from predicted values (Hallberg & Hulthen, 2000). Thus, true iron status as determined by biochemical measures is necessary to determine the extent of prevalence of deficiency.

Calcium intake in both men and women across socio-demographic groups did not meet the recommended intake. Low calcium intake poses a public health concern as it is increasingly recognised that inadequate calcium intake during the pre-menopausal years reduces bone density and increases risk of osteoporosis after menopause (Heany, 2000). Low calcium intake has also been implicated as a risk factor for colorectal cancer and hypertension (Wu *et al*., 2002), the incidence of which is increasing in the Malaysian population.

Chronic inadequacy of thiamin in the early part of the 20th century led to beri-beri in migrant workers in tin mines and estates. Today, this nutritional deficiency has been practically eliminated. Yet this study found Malaysian adults' intake of thiamin to be below the recommended intake. The generally low intake of this vitamin could be due to the lower energy intakes reported here.

Sodium intake has been consistently associated with blood pressure which is a major risk factor for coronary heart disease and stroke (WHO, 2003). An estimated sodium intake >2300 mg has been shown to be significantly related to the slope of blood pressure increase with increasing age (INTERSALT Cooperative Research Group,1988). The mean intake of sodium was higher in men than women by about 500mg while its consumption declined with age. Although rural-urban differences in sodium intake were not obvious, it was found to be highest in the group with the highest educational level and in the Chinese. Culturally, the latter group is well known for its excessive use of soy based sauces which are noted to be high in sodium. It is recommended that dietary intake of sodium, from all sources should be limited so as to reduce the risk of coronary heart disease and stroke (Sacks *et al*., 2001).

Comparison of intakes of other micronutrients such as vitamin A, vitamin C and thiamine with RNI were all found to be less than adequate in all age groups in both men and women. With lower energy intake, the intake of many micro-nutrients will be expected to decrease. Hence the lower intake of all these nutrients particularly in women and with increasing age (with the exception of vitamin C).

Strengths and limitations of the study

The strength of this study is the large representative sample of the Malaysian adult population from a wide range of socio-demographic backgrounds. The main

limitation of our study is the use of a single 24-hour recall. Multiple 24-hour recalls would have provided better estimates of intake, but would have also increased respondent burden, which in turn may have contributed to decreased participation in this study not withstanding the cost that it may have incurred. A limitation that cannot be overlooked in self-reported dietary intakes is that food and nutrient intakes are often under-estimated. Black & Cole (2001) estimated under-reporting in dietary assessment methods to be 64%, 88% and 25% of the results using diet records, diet recall and diet history, respectively. Yet, this study utilised well-trained nutritionists and the interactive approach in which repeated and skillful probing was done to help the respondents recall as accurately as possible all food and fluids consumed. Even so, a high degree of under-reporting was found in this survey. Low energy reporters, however, were not excluded from the present analysis as exclusion would have biased the data towards higher intakes. Nonetheless, actual energy intake and hence nutrient intakes are likely to be under-estimated.

CONCLUSION

Acknowledging the caveats of under-reporting and limitations of the dietary method used, the MANS provides unique new data on the energy and selected nutrient intakes of the Malaysian adult population. The study found an intake of energy that falls short of the recommended intake in both men and women, although intake of macro-nutrients met the recommendations for a healthy diet. Intakes of micro-nutrients studied were below the RNI with calcium and iron being the most inadequate, particularly in women. Regular nutrition surveys should be carried out to provide valuable information on trends in food and nutrient intake, particularly among age and ethnically diverse subgroups of the population. Future studies are needed to explore the associations between diet and chronic diseases among Malaysians and finally, continued nutrition monitoring is needed to assess public adherence to dietary recommendations.

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