

Patterns of fruits and vegetable consumption among adults of different ethnics in Selangor, Malaysia

¹Nurul Izzah, A., ²Aminah, A., ²Md Pauzi, A., ²Lee, Y. H., ¹Wan Rozita, W. M. and ¹Siti Fatimah, D.

¹Institute for Medical Research, Jalan Pahang 50588 Kuala Lumpur, Malaysia

²Universiti Kebangsaan Malaysia, 47100 Bangi, Selangor, Malaysia

Abstract: A survey was conducted to investigate patterns of fruits and vegetables consumption among Malaysian adults residing in Selangor, Malaysia. Two hundred forty two subjects comprises of male (28%) and female (72%) of major ethnics (Malays-52.3%; Chinese-30.5%; Indians-16.9%) with the mean age of 43.5±18 years were studied from July to November 2002. Consumption data for vegetables were collected using 24 hours duplicate samples method while for fruits 24-hour diet record was used. The results showed that most frequently consumed leafy, leguminous, root, brassica and fruits vegetables were celery (*Apium graveolens*), spinach (*Spinacia oleracea*), water spinach (*Ipomoea aquatic*), long beans (*Vigna sesquipedolis*), French beans (*Phaseolus vulgaris*), carrot (*Daucas carota*), potato (*Solanum tuberosum*), Chinese mustard (*Brassica juncea*), round cabbage (*Brassica reptans*), cauliflower (*Brassica oleracea var cauliflora*), chilies (red, green, small or dried) (*Capsicum sp.*), tomato (*Lycopersicum esculentum*), cucumber (*Cucumis sativus*), long eggplant (*Solanum melongena*) and okra (*Hibiscus esculentus*). While most consumed ulam and traditional vegetables were petai (*Parkia speciosa*), sweet leaves (*Sauropus andragynus*) and Indian pennywor (*Hydrocotyle asiatica*). Other vegetables inclusive spices and flavorings that were preferred by subjects were shallot (*Allium fistulosum*), garlic (*Allium sativum*), onion (*Alium cepa*), green bean sprout (*Phaseolus aureus*) and curry leaves (*Murraya koenigii*). The most preferred fruits were banana (*Musa spp.*) and apples (*Malus domestica*). A total consumption of fruits and vegetables among adults in Selangor was 173 g/day and the consumption among Malays (202 g/day) was significantly higher ($P<0.001$) compared to the Chinese or Indians. Individually, vegetables were consumed 133 g/day while fruits were 179 g/day. No significant differences ($P<0.05$) were shown for consumption of different vegetable categories among different ethnic groups. Study subjects consumed more brassica vegetables compared to other vegetable categories and the Malays preferred traditional vegetables compared to the other two ethnics. Most vegetables were consumed as soup and boiled, least was consumed as raw and salad form.

Key words: Fruits, vegetables, consumption pattern, Malaysian, ethnic

Introduction

Fruits and vegetables are important foods for health promotion because they contain essential nutrient such as vitamins, minerals, proteins, fibers and bio-functional components while also being low in fat, sodium and calories compared to many other foods (Devine *et al.*, 1998). Many studies had consistently linked a decreased risk of many cancers (such as cancer of the lung, esophagus, mouth, stomach, colon and pancreas (Hall *et al.*, 2009)) as well as cardiovascular disease, diabetes, stroke, obesity, diverticulosis and cataract (Bogers *et al.*, 2004) with a high consumption of fruits and vegetables.

A published report by World Health Organization (WHO) on diet, nutrition and the prevention of chronic diseases, recommends the intake of a minimum of 5 portions or 400g of fruits and vegetables per person per day but excluding potatoes and other

starchy tubers (WHO, 2003). This recommendation specify at least 2 daily servings of fruits (160 g) and 3 daily servings of vegetables (240 g) with at least one serving of vegetables involving dark green and leafy or orange vegetable (nutrient-rich vegetable) (Striegel-Moore *et al.*, 2006). A strong correlation between vegetable consumption and taste preference (Uglem *et al.*, 2007) was reported while bitterness was reported as a sensory deterrent for vegetable preference and consumption (Dinehart *et al.*, 2006).

In Malaysia, the Federation of Agricultural Malaysia (FAMA) reported the total vegetable consumption among Malaysian was 36 kg per capita for the year 1991 (FAMA, 1995) and the household expenditure survey (1985-1995) showed an increment of only 7.7% for fresh vegetables expenditure (Aminah and Huda, 2006). Aimed at promoting increasing vegetable consumption among Malaysian, in the year 1996, the Ministry of Agriculture of Malaysia had launched 'Eat more vegetables' campaign (Chin,

*Corresponding author.

Email: nurul@imr.gov.my

Tel: 603-26162735, Fax: 603-26926542

1999). The campaign seemed successful with daily calorie intake of vegetable among Malaysian increasing from 26.1 to 49.2 calories from the year 1990 to 2005 (Warr *et al.*, 2008). However, results from the World Health Survey in year 2002-2003 showed the prevalence of low fruit and vegetable consumption among men (85%) and women (85.5%) in Malaysia (Hall *et al.*, 2009). Findings from the Malaysian Adult Nutrition Survey (MANS) in year 2003 also showed similar results where only 40% of Malaysian adults consumed 1 cup (96 g) of green leafy vegetables daily (Norimah *et al.*, 2008) and this accounted for only 40% of the total recommendation of 240g per day by WHO (Striegel-Moore *et al.*, 2006).

It is interesting to determine the proportion of the population that met the fruits and vegetable recommendation because research has shown that diets rich in fruits and vegetables are associated with reduced risk of cancer, cardiovascular disease and other chronic diseases (Bogers *et al.*, 2004; Guenther *et al.*, 2006; 2004; Hall *et al.*, 2009). Although the exact mechanisms through which fruits and vegetables play a role in disease prevention have not been fully defined, the benefits are generally credited to the additive and synergistic effects of the phytochemicals found in these whole plant foods (Lui, 2003; Guenther *et al.*, 2006). Fruits and vegetables may also be important for weight management by promoting satiety and decrease energy intake as these foods are high in water and fiber and low in energy and energy density (Guenther *et al.*, 2006).

A database search was unsuccessful in identifying any study reporting on consumption of fruits and vegetable among Malaysian adults. Thus, the purpose of this study was to determine the consumption these food groups and to establish the patterns among adults of different ethnic residing in the Selangor, Malaysia. It is hope that the data reported will serve as invaluable baseline data for calculating and assessing risk on contaminants through vegetable consumption.

Material and Methods

Study location

Selangor State is situated at the west coast of Peninsular Malaysia, located at the 3° 35' North latitude and 101° 25' East longitude (Baharrudin, 2002) with an area of 7,960 km² (Statistical Department of Malaysia, 2003) (Figure 1). According to the 2000 census, Selangor has approximately 4 million residents which were the highest compared to other states or 18% of the total Malaysia population.

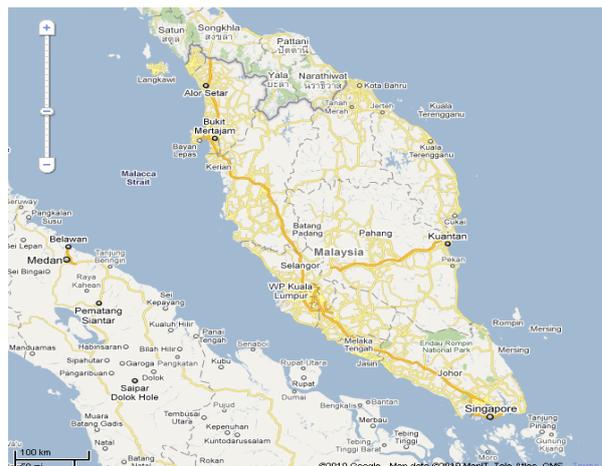


Figure 1. Map of Peninsular Malaysia showing the location of Selangor State at the 3° 35' North latitude and 101° 25' East longitude

Selection of subject

The study population involved was adults of three major ethnics namely Malay, Chinese and Indian with percentage of 54%, 31% and 15%, respectively. They resided in both urban and rural areas and their distribution is based on population density of Selangor (Statistical Department of Malaysia, 2001). The sampling frame was obtained from the National Household Sampling Frame (NHSF), Department of Statistics. The selection of subjects and detail addresses were obtained from the National Census Database, Year 2000 (Statistical Department of Malaysia, 2001). Subjects were selected among adults age from 18 and above, either male or female but excluding the pregnant women. They were among population staying in their own house. Others who stayed in institution such as hostel, hotel, hospital and prison were excluded.

The calculation of sample size was based on a prevalence of 16.4% of vegetable consumed by the Far-East population as reported by GEMS (2000). A number of 250 subjects were required in order to obtain 95% confidence interval and 5% margin of error. Based on 20% dropped-off rate, 300 subjects were identified, but at the final count, 279 participated. However, only 242 subjects completed the questionnaire and assigned the 24-hour duplicate samples of food containing vegetables.

Data collection

This was a cross-sectional study and a house-to-house survey was conducted during July – November 2002. The questionnaires which have been developed for use among subjects were adapted. The developed

questionnaires was pre-tested, improved and finally used in this study (Nurul Izzah, 2007). The eleven pages self-administered questionnaire include a socio-demographic information section as well as questions on knowledge, perception and practices towards vegetables consumption and a single 24-hour food record forms.

The enumerators were trained to review and understand the questionnaires. During training, they were taught on how to handle duplicate samples and to provide instructions to subjects. They were equipped with set of questionnaire tool to help the subjects recording the type of foods they consumed. The questionnaire tools included pictures of serving dishes, vegetables, fruits and common household measure like standard measuring cups, bowls, ladles and spoons. The self-administrated questionnaire was given between 9.00 am to 6.00 pm. Enumerators will assist by reading the questionnaires to some of the elderly or illiterate. They will also re-checked all food recorded in food record forms to verify types and amount of food consumed and the duplicate samples handed over by subjects. Second visits were made to the subjects if duplicate samples were not provided or survey was not completed during first visit. The height and weight of study subjects were measured using calibrated SECA digital weighing machine, while Body Mass Index (BMI) were calculated by using the formula of body weight (kg) divided by square roots of height (m²). The WHO criteria for obesity based on the BMI guidelines was used in this study (WHO 1995), commencing from underweight (BMI<18.5 Kg/m²), normal (BMI 18.5-24.9 Kg/m²), overweight (BMI 25.0-29.9 Kg/m²) and obese (BMI≥30 Kg/m²),

Food intake data

The duplicate portion of food containing vegetables was used for collecting data on vegetable consumption among study subjects. This method was chosen in order to deal with varieties of vegetable recipe that covered vegetable dishes and other food dishes that contained vegetables as ingredients such as noodles, fried rice, tom yam, fish curry, etc. Study subjects were requested to keep the duplicate of food containing vegetables consumed within 24 hours refrigerated. These food samples were kept in plastic bags, tighten with rubber band and properly labeled before being transported in the icebox to the laboratory. In the laboratory, food samples were weighed as a whole. The slurry or soup was separated using plastic colander and each type of vegetables was discrete before individual weight was taken. The discretion of different vegetables was only conducted if it is

possible. Food items such as vegetable porridge or wholly blended will be measured the whole weight.

Collection of fruits consumption data were conducted using a single 24-hour records method. Study subjects were requested to record fruits that they consumed within 24-hours. The portion weight of fruits was referred to the *Atlas Makanan: Saiz pertukaran dan Porsi*. (Suzana *et al.*, 2002). The collection of both duplicate food samples and the single 24-hour food record were conducted during weekdays and weekends.

Consent approval

The project was supported by the Division of Food Safety and Quality, Ministry of Health and informs consent was obtained from the subjects beforehand.

Data analysis

Results were tabulated using SPSS (version 11.5 for windows, 2002, SPSS Inc). The data included demographic characteristics, frequency types of consumed fruits and vegetables and consumption of vegetables at different categories, group and preparation. Data was clean and checked for discrepancies before analysis. Initially, analysis included descriptive statistics was conducted to assess data normality. The data was found not distributed in a normal bell-shaped curve, mainly because of the existing of the outliers. To test the differences between independent variables inclusive socio-demographic characteristics and fruits and vegetable consumption, non parametric tests were used. Data were presented as medians (with interquartile range) and the statistical significance of difference was assessed using Kruskal-Wallis's test, followed by Mann-Whitney's test. Significance was set a priory at P≤0.05.

Results

Subjects characteristics

There was a good response rate (87%), with 242 adults completing the questionnaire and handing over the duplicate samples of vegetables or food containing vegetables consumed within 24 hours. Table 1 showed the socio-demographic characteristics of subjects involved in the food consumption survey in Selangor. The subjects comprised of 127 (52.3%) Malays, 74 (30.5%) Chinese and 41 (16.9%) Indian and their median age were 43.5 years. Most of the subjects were female (72%) as most of them were homemakers and at home during the visit. Only 28% of men who owned business, shift worker, on medical

leaved or retired were interviewed.

Table 1. Socio-demographic characteristics of the subjects included in the vegetable consumption survey in Selangor (N=242)

Socio-demographic variable	Malay (n=127)	Chinese (n=74)	Indian (n=42)	Overall total (n=243)	*P-value
Age (y±IQR)	44±17	44±21	40±23	43.5±18	NS
Gender	(n,%)	(n,%)	(n,%)	(n,%)	
Male	32(14)	21(9)	14(6)	67(28)	
Female	95(40)	53(23)	28(12)	176(72)	-
BMI Index(±IQR)	25.7±6.9 ^a	21.7±4.2 ^b	23.4±7.5 ^{ab}	24.2±7.1	0.000
Household number (±IQR)	6±3	5±3	5±2.5	5±3	NS
Selangor residential Period (y± IQR)	30±32	27.5±35	27±29	29±32	NS
Marital status	(n,%)	(n,%)	(n,%)	(n,%)	
Single	6(3)	13(6)	8 (3)	27(11)	
Married	110(47)	58(25)	33(14)	201(83)	
Widowed / divorced	9(4)	3(1)	1(0.4)	14(6)	-
House hold income per month(RM± IQR)	2,000±2,100 ^a	2800±2900 ^b	2500±1600 ^{ab}	2100±2500	0.014
Allocation for food per household per month(RM± IQR)	600±500 ^a	800±575 ^b	600±250 ^a	600±500	0.001

IQR – Inter-quartile Range

Significant difference (P<0.05) between different ethnics were evaluated using Kruskal-Wallis H and Mann-Whitney U test. Different alphabet within the same row indicate significant different (p<0.05)

The median for BMI was in the normal range, however the differences between ethnics were significant ($P < 0.001$). The BMI for Malays was in the overweight range compared to the Chinese and Indians, which were normal. The median number per household was five and many of them have resided in Selangor for nearly 30 years. Most of the subjects were married (83%), 11% of them were single and 6% were either widowed or divorced. The household income per month for the Chinese and Indians were higher ($P = 0.014$) compared to the Malays but only the Chinese spent significantly ($P < 0.001$) higher income on food. Overall, subjects spent about 29% of their income on food and only 4% on vegetables. The Malays spent less ($P = 0.018$) of their income on purchasing vegetables compared to the Chinese and Indians.

Fruits and vegetables preferences

Table 2 shows the frequencies of different types of vegetables consumed by subjects. Overall, there were 96 types of either commercial or traditional vegetables that were consumed as raw/salad or cooked as a vegetable dishes or as an ingredient in other prepared food. Among them were 6 leafy vegetables, 5 leguminous vegetables, 8 root vegetables, 10 brassica vegetables and 17 fruits vegetables. There were also 27 types of ulam and traditional vegetables and another 23 types of vegetables were group under other vegetables that inclusive of spices and flavorings.

Celery (*Apium graveolens*), spinach (*Spinacia oleracea*), water spinach (*Ipomoea aquatica*), long beans (*Vigna sesquipedalis*), French beans (*Phaseolus vulgaris*), carrot (*Daucus carota*) and potato (*Solanum tuberosum*) were among the most frequently consumed leafy, leguminous and root vegetables. Subjects preferred three brassica vegetables which were Chinese mustard (*Brassica juncea*), round cabbage (*Brassica reptans*) and cauliflower (*Brassica oleracea var cauliflora*). A total of 17 types of fruit vegetables were identified and most frequently consumed were chilies (red, green, small or dried) (*capsicum spp.*), tomato (*Lycopersicon esculentum*), cucumber (*Cucumis sativus*), long egg-plant (*Solanum melongena*) and okra (*Hibiscus esculentus*). Other fruit vegetables such as bitter melon (*Momordica charantia*), corn (*Zea mays*), round egg-plant (*Solanum melongena*) and capsicum (*Capsicum annum grossum*) were also among highly preferred fruit vegetables by subjects.

The most frequently consumed ulam was petai (*Parkia speciosa*) followed by Indian pennywort (*Hydrocotyle asiatica*), water dropwort (*Oenanthe*

javanica) and ulam raja (*Cosmos caudatus*). Highly consumed traditional vegetables were sweet leaves (*Sairopus andragynus*) and fern shoots (*Athyrium esculatum*). Spices and flavorings such as shallot (*Allium fistulosum*), garlic (*Allium sativum*), onion (*Allium cepa*), curry leaves (*Murraya koenigii*) and ginger (*Zingiber officinale*) were commonly used as an ingredient during food preparation and were the most frequent found in food samples. Green bean sprout (*Phaseolus aureus*) were frequently added as ingredient in prepared food such as noodles and prawn fritters, while baby corn (*Zea mays*) and grey oyster mushroom (*Pleurotus ostreatus*) were frequently prepared in mixed vegetables dishes.

Exploring the list of fruits (Table 2) consumed by subjects revealed 30 types of fruits inclusive of both local and imported fruits. The most consumed fruits were banana (*Musa sp.*) and apples (*Malus domestica*). Other fruits consumed by quite a number of subjects were water melons (*Citrullus lanatus*), mandarin orange (*Citrus suhuiensis*), papayas (*Carica papaya*), orange (*Citrus spp.*), Mango (*Mangifera spp.*) and Pear (*Pyrus spp.*). Fruits were mostly consumed raw, however banana was also eaten in the form of fritters which is consumed during afternoon tea as snack by most Malaysian.

Fruits and vegetables consumption

Table 3 shows consumption of fruits and vegetables at different categories by different ethnicity in Selangor. There were no significant differences on the intake of each category of vegetables and fruits among the three different ethnics. The median consumption of vegetables and fruits per day were 133 g/day and 179 g/day, respectively. However, when both category were combined and analyzed, it showed that Malays (202 g/day) consumed significantly ($P = 0.004$) more of fruits and vegetables compared to the other two ethnics groups.

Generally, women (193 g/day) were found to consume more fruits and vegetables than men (153 g/day) did, however the differences was not significant ($P \geq 0.05$). Subject resided in the rural areas consumed significantly ($P = 0.017$) more vegetables (213 g/day) compared to those in the urban areas (129 g/day). In contrary, the results showed that urban subjects (195 g/day) consumed more fruits compared to the rural (130 g/day); however, the difference was not significant ($P \geq 0.05$). Consumption of fruits and vegetables during weekdays and weekends also showed no significant differences ($P \geq 0.05$).

Table 2. Frequency of fruits and vegetables derived from food consumption survey of adults in Selangor (N=243)

No	Leafy vegetables, <i>Botany name</i> *	**Frequency
1	Celery, <i>Apium graveolens</i>	148
2	Spinach, <i>Spinacia oleracea</i>	137
3	Water spinach, <i>Ipomoea aquatica</i>	105
4	Lettuce, <i>Lactuca sativa</i>	43
5	Chives, <i>Allium odorum</i>	37
6	Celery stalk, <i>Apium graveolens</i>	23
No	Root vegetables, <i>Botany name</i> *	**Frequency
1	Carrot, <i>Daucus carota</i>	928
2	Potato, <i>Solanum tuberosum</i>	560
3	Chinese radish, <i>Raphanus sativus</i>	14
4	Turnip, <i>Pachyrrhizus erosu</i>	9
5	Sweet potato, <i>Ipomoea batatas</i>	4
6	Pickled Chinese radish, <i>Raphanus sativus</i>	2
7	Lotus root, <i>Nelumbo nucifera</i>	1
8	Taro, <i>Colocasia esculentum</i>	1
No	Brassica vegetables, <i>Botany name</i> *	**Frequency
1	Chinese mustard, <i>Brassica juncea</i>	630
2	Round cabbage, <i>Brassica reptans</i>	487
3	Cauliflower, <i>Brassica oleracea var cauliflora</i>	128
4	Chinese cabbage, <i>Brassica nga pak chinensis</i>	31
5	Broccoli, <i>Brassica oleracea</i>	17
6	Chinese white cabbage, <i>Brassica rapa</i>	16
7	Kale, <i>Brassica alboglabra</i>	12
8	Dwarf White Mustard, <i>Brassica juncea</i>	7
9	Pak Choy (Pickled vegetable), <i>Brassica rapa var chinensis</i>	3
10	Brussels sprout, <i>Brassica oleracea Gemmifera Group</i>	1
No	Fruits vegetables, <i>Botany name</i> *	**Frequency
1	Red chillies, <i>Capsicum annuum</i>	1099
2	Tomato, <i>Lycopersicum esculentum</i>	535
3	Cucumber, <i>Cucumis sativus</i>	428
4	Green chillies, <i>Capsicum annuum</i>	215
5	Egg-plant (long), <i>Solanum melongena</i>	169
6	Okra, <i>Hibiscus esculentus</i>	127
7	Bitter gourd, <i>Momordica charantia</i>	63
8	Small chillies, <i>Capsicum frutescens L.</i>	57
9	Corn, <i>Zea mays</i>	50
10	Dried chillies, <i>Capsicum annuum</i>	43
11	Egg-plant (round), <i>Solanum melongena</i>	14
12	Capsicum, <i>Capsicum annuum grossum</i>	13
13	Pumpkin, <i>Cucurbita moschata</i>	9
14	Angled loofah, <i>Luffa acutangula</i>	4
15	Bottle gourd, <i>Lagenaria siceraria</i>	3
16	Pickled green chillies, <i>Capsicum annuum</i>	1
17	Snake gourd, <i>Tricosanthes anguina</i>	1
No	'Ulam' and other traditional vegetables, <i>Botany name</i> *	**Frequency
1	'Petai', <i>Parkia speciosa</i>	92
2	Sweet leaves, <i>Sauropus andragynus</i>	18
3	Indian pennywort, <i>Hydrocotyle asiatica</i>	12
4	Water dropwort, <i>Oenanthe javanica</i>	9
5	'Ulam raja', <i>Cosmos caudatus</i>	6
6	Fern shoots, <i>Athyrium esculentum</i>	5
7	'Jering', <i>Pithecellobium jiringa</i>	3
8	Papaya shoots, <i>Carica papaya</i>	2
9	Roselle leaves, <i>Hibiscus sabdariffa</i>	2
10	Tapioca shoots, <i>Manihot utilissima</i>	2
11	African spider flower, <i>Gynandropsis gynandra</i>	1
12	Hummingbird tree leaves, <i>Sesbania grandiflora</i>	1
13	'Melinjo' leaves, <i>Gnetum gnemon</i>	1
14	Papaya flower, <i>Carica papaya</i>	1
15	Powder-puff tree leaves, <i>Barringtonia racemosa Roxb.</i>	1
16	Pumpkin shoot, <i>Cucurbita maxima</i>	1
17	'Salang' leaves, <i>Claoxylon longifolium</i>	1
18	Sweet potato shoot, <i>Ipomoea batatas</i>	1
19	Bitter chinese melon, <i>Momordica charantia L.</i>	1
20	Yellow 'meranti' leaves, <i>Shorea faguetiana</i>	1
21	Drumstick fresh pod, <i>Phaseolus aureus</i>	1
22	'Terung telunjuk', <i>Solanum spp.</i>	1
23	Young papaya, <i>Carica papaya</i>	1
24	Young jackfruit, <i>Artocarpus heterophyllus</i>	1
25	Young banana, <i>Musa sapientium</i>	1
26	Bamboo shoots, <i>Bambusa spp.</i>	1
27	Coconut shoots, <i>Cocos nucifera</i>	1

Continued...

No	Leguminous vegetables, <i>Botany name</i> *	**Frequency
1	Long beans, <i>Vigna sesquipedalis</i>	329
2	French beans, <i>Phaseolus vulgaris</i>	116
3	Four-angled beans, <i>Psophocarpus tetragonolobus</i>	18
4	Green peas, <i>Pisum sativum</i>	14
5	Hyacinth bean, <i>Dolichos lablab</i>	11
No	Other vegetables (inclusive spices and flavorings), <i>Botany name</i> *	**Frequency
1	Shallot, <i>Allium fistulosum</i>	1031
2	Garlic, <i>Allium sativum</i>	866
3	Onion, <i>Allium cepa</i>	657
4	Green bean sprout, <i>Phaseolus aureus</i>	379
5	Curry leaves, <i>Murraya koenigii</i>	139
6	Ginger, <i>Zingiber officinale</i>	93
7	Baby corn, <i>Zea mays</i>	83
8	Scallion, <i>Allium fistulosum</i>	72
9	Grey oyster mushroom, <i>Pleurotus ostreatus</i>	58
10	Dried shiitake mushroom, <i>Lentinula edodes</i>	11
11	Kaffir lime leaves, <i>Citrus hystrix</i>	8
12	'Kesum' leaves, <i>Polygonum minus</i>	8
13	Lemon grass, <i>Cymbopogon citratus</i>	7
14	Galangal, <i>Languas galanga</i>	4
15	Turmeric leaves, <i>Curcuma domestica</i>	2
16	Wood ear mushroom, <i>Auricularia polytricha</i>	2
17	Mint leaves, <i>Mentha arvensis</i>	2
18	Alfalfa, <i>Medicago sativa</i>	1
19	Basil leaves, <i>Ocimum sanctum</i>	1
20	Betel leaf, <i>Piper sarmentosum</i> Roxb.	1
21	Cekur, <i>Kaempferia galanga</i>	1
22	Seaweed	1
23	'Asam gelugur', <i>Garcinia atroviridis</i>	1
No	Fruits, <i>Botany name</i> *	***Frequency
1	Banana (Raw and fritters), <i>Musa spp.</i>	30
2	Apples (Red and Green), <i>Malus domestica</i>	18
3	Water melon, <i>Citrullus lanatus</i>	6
4	Mandarin orange (<i>Citrus suhuiensis</i>),	5
5	Papaya, <i>Carica papaya</i>	5
6	Orange, <i>Citrus sinensis</i>	5
7	Mango, <i>Mangifera spp.</i>	4
8	Pear, <i>Pyrus spp</i>	4
9	Dates, <i>Phoenix dactylifera</i>	3
10	Grape, <i>Vitis vinifera</i>	3
11	Guava, <i>Psidium guajava</i>	3
12	Rambutan, <i>Nephelium lappaceum</i>	3
13	Langsat, <i>Lansium domesticum</i>	3
14	Water apple, <i>Eugenia aquea</i>	3
15	Durian (fresh & fermented)	2
16	Corn, <i>Zea mays</i>	2
17	Cempedak (fresh and fritters), <i>Artocarpus integer</i>	2
18	Star fruit, <i>Averrhoa carambola</i>	2
19	Pineapple, <i>Ananas comosus</i>	2
20	Plum, <i>Prunus spp.</i>	2
21	Dragon fruit, <i>Hylocereus spp.</i>	1
22	Duku, <i>Lansium domesticum</i>	1
23	Honey dew, <i>Cucumis melo</i>	1
24	KerANJI, <i>Dialium spp.</i>	1
25	Kiwifruit (Chinese gooseberry) <i>Actinidia deliciosa</i>	1
26	Kundang, <i>Bouea oppositifolia</i>	1
27	Longan, <i>Dimocarpus longan</i>	1
28	Mangosteen, <i>Garcinia mangostana</i>	1
29	Peach, <i>Prunus persica</i>	1
30	Pulasan, <i>Nephelium mutabile</i>	1

*Halimatul Saadiah (1988); Tee *et al.* (1997); Department of Agriculture, Malaysia (1988).

**Frequency of vegetables obtained from food consumed by subjects within 24 hours, discrete and identified individually

***Frequency of fruits consumed by subjects were based on 24 hours diet record

Table 3. *Vegetable consumption (g/person/day)(±IQR) by adults of different ethnics in Selangor State, Malaysia .

**Food category	Ethnicity			Total (N=242)	SIG [#]
	Malays (n=127)	Chinese (n=74)	Indian (n=41)		
Vegetables	136(141)	132(140)	126(119)	133(136)	NS
Fruits	195(112)	131(120)	189(113)	179(129)	NS
Total consumption	202(201) ^a	159(179) ^{ab}	126(139) ^b	173(200)	0.004
** Vegetable category					
Leafy vegetables	24(63)	47(53)	48(61)	34(66)	NS
Leguminous vegetables	36(45)	42(39)	38(47)	39(43)	NS
Root vegetables	35(34)	29(46)	36(34)	34(36)	NS
Brassica vegetables	36(52)	61(58)	48(59)	45(57)	NS
Fruit vegetables	25(55)	43(60)	33(77)	32(67)	NS
Ulam and traditional vegetables	42(68)	13(45)	18(44)	40(63)	NS
Other vegetables	13(28)	13(38)	15(21)	13(30)	NS
Total consumption	144(131)	159(127)	155(194)	149(143)	NS
**Cooking category					
Sauté ^c	111(118)	88(105)	79(119)	97(113)	NS
Soup ^d	115(184)	124(97)	89(49)	133(118)	NS
Boiled ^e	161(120) ^a	106(76) ^{ab}	39(49) ^b	133(118)	0.029
Raw & salad ^f	36(54)	39(66)	30(34)	34(47)	NS
Total consumption	148(150)	133(134)	131(154)	138(146)	NS

*The calculation was based on duplicate samples collected within 24 hours

**Different types of vegetables obtained from food consumed by subjects were discrete and weight individually. Portion size of fruits were based on Tee *et al.* (1997) and Suzana *et al.* (2002)

[#] Significant difference (P<0.05) between different ethnics were evaluated using Kruskal-Wallis H and Mann-Whitney U test. Different alphabet within the same row indicate significant different (P<0.05)
IQR – Inter-quartile Range

^c vegetables prepared by the stir-fry method, cooked over very high heat with constantly stirring the food, requires a minimum amount of fat

^dvegetables cooked with various other ingredients such as chicken, meat or fish and often containing clear or thick liquid/gravy, with onion, garlic or other spices stir-fried. e.g., vegetable soup or any soup mixed with vegetables, Indian curry, ‘asam pedas’

^evegetables boiled with water or coconut milk with or without spices and flavoring, no stir-fry and no cooking oil added e.g. ‘sayur rebus’, tom yam or ‘sayur masak lemak’

^fA dish of mixed raw vegetables inclusive ulam

The consumption of different categories of vegetables by subject of different ethnics showed no significant differences ($P>0.05$) (Table 3). Subjects consumed more brassica vegetables (45 g/person/day) followed by ulam and traditional vegetables (40 g/person/day), leguminous vegetables (39 g/person/day), root and leafy vegetables (34 g/person/day, respectively) and fruits vegetables (32 g/person/day). The brassica and leafy vegetables were among commonly used as ingredients in prepared food such as fried rice and noodles. Other vegetables, which were the least consumed (13g /person /day), were mainly used as spices and flavoring.

No significant differences ($P>0.05$) were shown for the consumption of vegetables prepared using different methods or recipes by different ethnic groups, accepted for boiled vegetables (Table 3). The Malays (161 g/day) and Chinese (106 g/day) consumed more boiled vegetables compared to the Indians (39 g/day) ($P=0.029$). None of the Indian consumed salad at the time of the survey for this study. Only small amount of vegetables were consumed raw (34 g/person/day).

Discussion

This study examined the consumption of fruits and vegetable among adults of different ethnic resided in Selangor, Malaysia. Overall, it was observed that the daily consumption of vegetables among adults (55%) of different ethnics are still below than the recommended amount by WHO (2003). Nevertheless, the median consumption (133 g/day) from this study is nearly 40% higher than the results reported by the Ministry of Health Malaysia (2006) from the Malaysian Adult Nutrition Survey (MANS) in year 2003 (Norimah *et al.*, 2008). The difference may refer to duplicate portion method that was implemented in this study. All vegetables consumed by subjects which inclusive vegetable dishes and vegetable added as an ingredients in prepared food were collected as duplicate portion. The weight of each types of vegetable was measured and total consumption was calculated. Consumption data from previous study was calculated based on frequency of vegetable consumption that included vegetable dishes only.

In Malaysia, most prepared food contained vegetables as ingredients. An example of prepared food with vegetable added as an ingredients are varieties of soup (vegetable soup, tom yam soup, chicken soup, etc), rice dishes (fried rice, 'nasi kerabu', 'nasi dagang', chicken rice, etc), varieties of noodles dishes (fried noodles, 'laksa', fried kuew teow, fried rice noodle, etc) and traditional snacks

(prawn fritters, spring rolls, 'rojak', etc). The Food Frequency Questionnaire (FFQ) approach provided estimates on the frequency and quantity of food consumed by individuals (Kubena, 2000; Norimah *et al.*, 2008) with less specificity (McNutt *et al.*, 2008).

In contrast with vegetables consumption, the median consumption of fruits meet WHO recommendation (WHO, 2003) of 160 g per day. Although the consumption was slightly insufficient for the Chinese but the difference was not significant ($P>0.05$). However, these results were derived from the response of only 26.3% of study subjects who consumed fruits on the day the study was conducted. The pattern of fruit consumption was not affected by the availability of fruits as at the time of this survey (July to November) local fruits such as durian (*Durio sp.*), rambutans (*Nephelium lappaceum*), cempedak (*Artocarpus integer*), duku/dokong (*Lansium domesticum*) and mangosteen (*Garcinia mangostana*) are in season (fruit season in Selangor started from August to October) (FAMA, 2010). Since it was fruits season, the price of these fruits were comparatively cheaper than other fruits and abundance of them are put up for sale even at the road side. The data showed that consumption of seasonal fruits at lowest price point did not show an increased and frequent in intake. Thus, this indicated that price was not a single factor that determine preferences in consumption of these seasonal fruits. In agreement with this finding, another study on motive of food choice with a comparison of consumers from selected Asia countries showed that price is not an important food choice factors among Malaysian consumers, specifically the Chinese (Prescott *et al.*, 2002). A study conducted among Polish population also showed similar findings where price were only among moderate factor that influenced food choice (Wadolowska *et al.* 2008). However, many studies had showed a positive correlation between total household income with fruit consumption (Kamphuis *et al.*, 2007; Riediger *et al.*, 2007; Powell *et al.*, 2009). In Selangor, some of the lower-income families who live in rural neighbourhoods were less accessible to shops or supermarket but were surrounded by fruit trees and orchard which may explain consumption of fruits by means of its availability only. But for urban dwellers, more groceries stores and supermarkets offer varieties of local and imported fruits at affordable prices through-out the year.

Taste and preference suffice as the influential factors of fruits consumption. Unlike vegetables which had been reported containing compounds responsible for bitterness, pungency and/or astringency (Drewnowski and Gomez-Carneros,

2000; Dinehart, 2006), fruits were preferred based on interactions between its good texture and taste (Harker *et al.*, 2003). For example apples were preferred for its sweetness and hard texture or juiciness and acidic taste (Daillant-Spinnler *et al.*, 1996). Crunchy texture is particularly important for fruits and were always been associated with its freshness and wholesomeness. It is a desirable quality and contributed to enjoyment of eating fruits (Fillion and Kilcast, 2002).

The study disclosed that vegetable at all categories were preferred by subjects, however the traditional vegetables were only preferred by the Malays compared to the other two ethnic groups. The Chinese and Indians consumed more leafy and brassica vegetables compared to the Malays. Nevertheless, the variety of vegetables consumed covers dark green vegetables, starchy and fruits vegetables and other vegetables were consistent with recommendation by the Malaysian Food Pyramid (Ministry of Health, 2008). Subjects preferred boiled and soup vegetables compared to saute, less vegetables were consumed raw. Unlikely for Indians, none of the subject consumed salad on the day this study was conducted. The results of this study indicated that fruits and vegetable consumption behaviour are almost similar among different ethnics of Malaysians.

The low level of nutritional practice in relation to vegetables intake among subjects in this study showed that majority of subjects were not aware of the dietary recommendations for vegetables as stated in the Malaysian Food Pyramid. In Malaysia, no study has specifically examined factors influencing fruit and vegetable consumption, yet consumption data are scanty. Previous reports discussed on the numerous determinants of food choice and among the factors are demographic and socioeconomic variables, social, cultural and cognitive influences, hunger and satiety, individual taste preferences, as well as the sensory and other physical characteristics of food (Shepherd and Stockley, 1985; 1987). A dietary restraint was a consistent predictor of food choice compared to nutrition knowledge and food beliefs (Tepper *et al.*, 1997). Among other significant factors were the sensory and functional factors, while health and price were moderate (Wadolowska *et al.*, 2008).

Many theoretical approaches have been employed to explain general fruit and vegetable consumption in many studies inclusive the Theory of Planned Behaviour in which a central predictor of behaviour is an individual's intention to perform the behaviour (Blanchard *et al.*, 2009). There are research examining fruit and vegetables consumption

reported the attitudes, subjective norm and perceived behavioral control as significant predictors in study subjects (Blanchard *et al.*, 2009). Association between higher levels of fruit and vegetable consumption with lower prices were also reported (Powell *et al.*, 2009)

There is a need to conduct such studies in this country, as dietary recommendation intake has to be met for chronic diseases prevention. Nearly two decades ago, the Ministry of Health Malaysia had launched the Healthy Lifestyle Campaign with different disease-oriented themes each year where healthy eating was selected as theme for the year 1997. The theme was remained as one of the four basic elements in the following Healthy Lifestyle Campaign in 2003 (Ministry of Health Malaysia, 2003). Notwithstanding the effort through these campaigns, the intervention programs that aimed (1) to increase in nutrition knowledge (2) to show positive changes in attitudes toward healthy eating behaviours (including preference of vegetables) and sustainable ways of procuring food and (3) to consume more vegetables at home or out-side home are another wise attempt for implementation. Such programs had been carried out in United States (Richards *et al.*, 2006; Knai *et al.*, 2006; Rolnick *et al.*, 2009; Ha and Caine-Bish, 2009; Wang *et al.*, 2010) and European countries (Bere *et al.*, 2004; Panunzio *et al.*, 2007; Ha and Caine-Bish, 2009; Houston-Price *et al.*, 2009) where most of the programs were implemented as nutrition-related obesity prevention programs (Wang *et al.*, 2010). Youth are an important group to target for vegetables intervention efforts as intake that established in youth could be tracked into adulthood (French and Stable, 2003). School-based nutrition intervention have been an important setting examining strategies to increase healthy food choices among youth as it provide high access to youth of diverse/ethnics and socioeconomic groups (French and Stables, 2003; Richards *et al.*, 2006; Panunzio *et al.*, 2007; Ha and Caine-Bish, 2009; Wang *et al.*, 2010).

This study had a number of limitations. Firstly, it was a cross-sectional study that used the National Household Sampling Frame (NHSF), obtained from the National Census Database, Year 2000 (Statistical Department of Malaysia, 2001). In every selected household, only one adult participated in the study. This ended up with sample composed largely of female adults, as they were at home at the time the survey was conducted. Thus, the results may not be generalized to population adults as a whole. This situation can be improved if all adults from selected house-hold involved in the study. Secondly, the 24-hour recall method may suffer recall bias, limiting

the accuracy or completeness of the information. To minimize this bias, the enumerators were trained to properly execute the 24-hours recalls methodology. Finally, given the cross-sectional nature of the data, differences across levels of key demographic variables did not indicate a causal nature for differences in fruits and vegetable intakes. A major strength of this study was obtaining accurate all vegetable consumption data using duplicate portion of food containing vegetables consumed in one day by study subjects.

Conclusions

The survey procedure described in this study represents a reliable method in estimating fruits and vegetables consumption amongst Malaysian. The results showed that Malaysian adults consumed varieties of fruits and vegetables per day. The amount of vegetables consumed is much lower than the daily-recommended intake by World Health Organization, nevertheless, the intake of fruits fulfilled the minimum requirement. The study findings indicate a need for new and enhanced effort targeting improvement in vegetable intake in Malaysian adults.

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