

Nuts consumption pattern among Malaysian adults: a socio-demographic and dietary behaviour perspective

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Abstract: The nuts consumption pattern of Malaysian adults were assessed by a set of food frequency questionnaire collected from June to December 2008 from 364 adults (129 men and 235 women) which were selected by stratified random sampling from five areas of Penang state. Average total nuts consumption of 0.77 g/day among Penang adults was found to be no gender-specific difference but was significantly different ($P < 0.05$) among ethnic groups with the highest among Indians (0.94 g/day). Kuih pau kacang was the most consumed product with a median of 0.81 g/day. Average monthly nuts expenses were only 0.4% from the household income. Majority of the adult population purchased nuts and their products twice a month (56.3%) from supermarket (34.7%). For the good benefits of nuts, authority should encourage higher nuts intake in Malaysia while enforce a more stringent regulation to protect the consumers from any health effect caused by aflatoxins in nuts and nut products.

Keywords: consumption pattern, nuts, food frequency questionnaire

Introduction

Nuts (tree nuts or peanuts) have become part of the human daily diet since the ancient times. In countries of the Mediterranean region, nuts are an integral part of their diet and have been consumed in high quantities (Willett et al., 1995), for example Lebanese and Greek consumed 12.4 kg/person per year and 12.0 kg/person per year, respectively in 2005 (FAOSTAT, 2010). In Malaysia, although nuts are not principle staple but have been included in some of the local cuisine and are consumed in the form of snacks. Recently, the 2010 Malaysian Dietary Guidelines is being launched and promoting appropriate and healthy dietary patterns to the population, including the importance of nuts and seeds consumption and they are recommended to be included in weekly diet (Ministry of Health Malaysia, 2010). Diet which is rich in fruits, vegetables, fish, lean meats, legumes and nuts, is widely promoted, for example the DASH (Dietary Approaches to Stop Hypertension) by the National Heart, Lung and Blood Institute (NHLBI) (NHLBI, 2010), and has been recognized as an example of healthy eating pattern in the 2005 Dietary

Guidelines for American (USDA, 2010). This is plausible since nuts are a good source of fiber, protein (arginine), minerals and contain a high proportion of mono and polyunsaturated fatty acids. The protective effects of nuts consumption against coronary heart disease (Blomhoff et al., 2006; Kelly and Sabaté, 2006; Sabaté, 1999), hypertension (Djoussé et al., 2009), effect of lowering cholesterol (Griel and Kris-Etherton, 2006; Mukuddem-Petersen et al., 2005) and gallstone disease (Tsai et al., 2004) are well established.

However, the acute and chronic toxicity associated with ingestion of aflatoxins in nuts is a major public health problem worldwide affecting the community on nuts intake. Aflatoxins are secondary metabolites of certain strains of *Aspergillus* species of fungi and have been classified as group one carcinogen, primarily affecting liver by the International Agency for Research on Cancer (IARC) (IARC, 1993). They are commonly identified as contaminants in a wide variety of important commodities such as groundnuts, tree nuts, corn, rice, wheat and spices. Our previous study on the occurrence of aflatoxins in nuts and commercial nut products in Malaysia has

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shown a high level and incidence of aflatoxins in this food group (Leong et al., 2010). An acute outbreak of aflatoxicosis in Malaysia has been reported (Chao et al., 1991; Lye et al., 1995). Because of this contradiction, it is important to study the nuts acceptability and their consumption pattern in relation to the dietary behaviour and socio-demographic factors.

Many studies on the consumption of fruit and vegetables and its relation with socioeconomic status were reported (Irala-Estevez et al., 2000; Kamphuis et al., 2006). Even for the legumes, there is considerable research on its consumption (Messina, 1999; Mitchell et al., 2009). However, there is only scarce information on the nuts consumption and their relationship with socio-demographic or behaviour factors. To our knowledge, no similar study from Asian countries is reported. In this study, we examined the nuts and nut products consumption among Malaysian adults and their association with variety of socio-demographic characteristics by ethnicity. Dietary practices included the quantity and intake frequency of the nuts, and the behaviour factors (purchase place, expenditure and etc) are also reported in this paper. This is an initial step in understanding nuts consumption patterns in detail which eventually leads to further analysis on the relationship between these eating patterns with the exposure of aflatoxins as the natural contaminant and the risk posed to the population.

Material and Methods

This was a cross-sectional study which adopted a stratified random sampling design. This study covered geographically five areas of Penang inclusive of South-West and North-East of Penang Island, North, Central and South of Province Wellesley. A minimum number of 340 subjects were determined based on the estimated prevalence of nuts and oilseed consumption from Far East Country (2.8%) (GEMS, 2007), 95% level of confidence, 5% margin of error and a non-response rate of 35%. Factors of rural and urban strata, ethnicity and age have also been taken into account for sample size calculation. A random sample was drawn from the computer-generated random list from the data of Population and Housing Census year 2000 (Department of Statistics Malaysia, 2007) assisted by the Department of Statistics, Malaysia.

Eligible subject was defined as being Malaysian (three main ethnics only: Malay, Chinese or Indian), aged 18 and above and not pregnant or breastfeeding at the time of the survey. Data was successfully collected from 364 subjects comprising 129 men and 235 women. Field survey was conducted from June until December 2008. The study protocol was

approved by Research and Ethnic Committee, School of Medical Science of Universiti Sains Malaysia, and consent participation was obtained from the subjects earlier.

Data collection

Height was measured in centimeters using a wall-mounted measuring tape while body weight was measured in kilograms using a digital scale (SECA model 7621319009, SECA Corp., Hamburg, Germany, 2008). Body mass index (BMI) was calculated as the ratio of body weight in kilograms to the square of height in meters. A structured interviewer-administered questionnaire was used to collect socio-demographic information, nuts intake pattern and other consumption relevant information. Household income instead of personal income was assessed because subjects are generally unwilling to provide their income.

Food related questions included amount and frequency of nuts and nut products consumption, monthly food expenses, monthly nuts and nut products expenses, places and frequency of purchasing, awareness of mould on foods and knowledge of aflatoxins. There were 37 nuts and nut products categorized into three groups (peanuts and their products, other nuts and their products and nuts as decoration). Nuts variety included peanuts, almonds, walnuts, hazelnuts, cashew nuts, chestnuts, Brazil nuts and their products. Atlas of Food Exchanges and Portion Sizes (Suzana et al., 2002) and Nutrient Composition of Malaysian Foods (Tee et al., 1997) were used to identify all the food sources of nuts and nut products (including mixed dishes) in Malaysia. Additional of 23 food items were listed into the questionnaire so that it covered most of the nuts and their products available in the market. Subjects were requested to answer to the number of servings consumed each time either "per day, per week, per month, per year or never" based on the habitual intake of the past one year. The survey was facilitated with pictures of each listed food items, the household measures and serving dishes.

The serving size and weight of each listed food items followed the Atlas of Food Exchanges and Portion Sizes (Suzana et al., 2002) and Nutrient Composition of Malaysian Foods (Tee et al., 1997). For unavailable foods, wherever possible, at least three different brands or sources were obtained and mean values were calculated as the weight of one serving of that particular food product. The conversion of food frequency to the amount of food intake was calculated as below:

Amount of food (g/day) = frequency of intake x conversion factor x total number of servings x weight of food in one serving (Norimah et al., 2008).

Different conversion factor was used to estimate food intake based on different frequency of intake. For frequency intake on “per week, per month and per year” basis, each of the number of times per week, per month and per year need to be multiplied by 1/7, 1/30 and 1/365 respectively to obtain the same factor as per day in order to have a final calculated amount of food in an unit of g/day.

Data analysis

Data were analyzed using the Statistical Package for Social Science (SPSS, version 16.0 for Windows, 2007). Data was cleaned and checked for discrepancies before analysis. Basic descriptive statistics and one-way ANOVA were conducted to determine significant interactions of several demographic and other lifestyle characteristics. Significant findings were further analyzed using Tukey post hoc tests. Pearson correlation was used to correlate two quantitative variables. Non parametric test was used to analyze nuts and nut products consumption among eaters due to the skew distribution of the variance. Data were presented as medians (with interquartile range) and the statistical significance of difference was assessed using Kruskal-Wallis test and followed by Mann-Whitney test. The α level of 0.05 was used to determine statistical significance.

Results and Discussions

Data in Table 1 shows that majority of the subjects were Malays (54%), female (65%) and married (69%). The average age of the subjects was 43.9 years (range 18-96 years) and mean household income was RM 2664 with an average household size of 5.1 \pm 2.2 people. There were 46% of subjects with normal weight (BMI=18.5-24.9) while 41% of them were obese (BMI \geq 30). A significant difference (P=0.002) of BMI was reported among different ethnic groups. Mean BMI was 24.7 \pm 5.3 for Malays, 22.5 \pm 4.3 for Chinese and 25.0 \pm 4.8 for Indians while the overweight and obese frequency was 46.9%, 27.7% and 49.1%, respectively for Malays, Chinese and Indians. Conversely, no significant difference of BMI between genders was observed.

Prevalence and consumption of nuts and nut products

Table 2 shows the consumption of nuts and nut products across ethnicity. The median consumption ranged between 0 to 2.02 g/day. The consumption amount of *satay* or peanut sauce, *rojak* sauce, almond

powder, roasted almond, roasted peanut in shell, roasted peanut shelled, roasted cashew nut, coated peanut, ice cream with nuts, *ais kacang*, boiled peanut in shell, coated hazelnut, peanut cake, and coated almond was significantly different (P<0.05) among ethnic groups. *Satay* or peanut sauce (0.60 g/day) and *rojak* (fruits and vegetable salad with a topping of thick dark prawn paste) (0.40 g/day) are very popular and more consumed in the Malay society. Peanut sauce is served with *satay* (grilled chunks or slices of variety of meats), *nasi impit* or *ketupat* (compressed rice cake) in everyday life of Malays and *rojak* is eaten as snack especially during festive events. Almond powder was found more consumed by Chinese (0.21 g/day) while the roasted almond (2.02 g/day) was favoured by Indian.

Generally, men were found to consume more nuts and nut products than women. However, significant difference was only seen in the consumption of roasted peanut in shell (P=0.020). Average total nuts consumption of 0.77 g/day among Penang adults was observed and found to be significantly different (P<0.05) among ethnic groups. The highest consumption was among Indian (0.94 g/day), followed by Malay (0.89 g/day) and Chinese (0.46 g/day). The average total nuts consumption was found significant higher in single (1.31 g/day) compared to married (0.67 g/day) and others (0.37 g/day) (P=0.000). Moreover, it was also associated with household number ($r=0.152$, P=0.004). There was only a weak positive correlation between the average total nuts consumption with year of education ($r=0.159$, P=0.002), while there was no significant correlation with BMI. Correlations between selected socio-demographic characteristics and nuts consumption of the study subjects is shown in Table 3.

Nuts and nut products expenses

Average monthly nuts and nut products expenses were markedly low, only 0.4% from the household income. All the three ethnic groups spent around 23-25% of their household income on monthly food expenses but only less than 2% of them were allocated for the nuts and nut products. Although significantly higher for mean household income was reported for Chinese (RM 3814) than Indian (RM 2264) and Malay (RM 2115) (P<0.05), but this does not contribute to higher nuts consumption among Chinese. No significant correlation between nuts consumption with household income was observed. Mean frequency of buying these products was twice a month and significant difference (P<0.001) was observed among ethnicity with the Malay purchasing more frequently than the others. A weak positive correlation between

Table 1. Socio-demographic characteristics of the study subjects (n=364)

Characteristic	Ethnicity				P value
	Malay n=198	Chinese n=113	Indian n=53	Total n=364	
Gender					0.531
Male	69 (53.5%)	44 (34.1%)	16(12.4%)	129 (35.4%)	
Female	129 (54.9%)	69 (29.4%)	37 (15.7%)	235 (64.6%)	
Age group (years)					0.001*
18-30	56 (59.6%)	22 (23.4%)	16 (17.0%)	94 (25.8%)	
31-50	88 (59.4%)	38 (25.7%)	22 (14.9%)	148 (40.7%)	
51-70	44 (45.8%)	38 (39.6%)	14 (14.6%)	96 (26.4%)	
>70	10 (38.5%)	15 (57.7%)	1 (3.8%)	26 (7.1%)	
Education Level					0.000*
Primary or lower	50 (43.9%)	52 (45.6%)	12 (10.5%)	114 (31.3%)	
Secondary	116 (57.4%)	51 (25.2%)	35 (17.4%)	202 (55.5%)	
College/university	32 (66.7%)	10 (20.8%)	6 (12.5%)	48 (13.2%)	
Occupation					0.328
No working/housewife	77 (56.2%)	40 (29.2%)	20 (14.6%)	137 (37.6%)	
Self-employed	19 (50.0%)	16 (42.1%)	3 (7.9%)	38 (10.4%)	
Government	26 (89.7%)	1 (3.4%)	2 (6.9%)	29 (8.0%)	
Private	45 (45.0%)	35 (35.0%)	20 (20.0%)	100 (27.5%)	
Student	16 (59.3%)	7 (25.9%)	4 (14.8%)	27 (7.4%)	
Retired	15 (45.5%)	14 (42.4%)	4 (12.1%)	33 (9.1%)	
Marital status					0.133
Single	37 (51.4%)	19 (26.4%)	16 (22.2%)	72 (19.8%)	
Married	138 (54.8%)	81 (32.1%)	33 (13.1%)	252 (69.2%)	
Others	23 (57.5%)	13 (32.5%)	4 (10.0%)	40 (11.0%)	
Body Mass Index (BMI)					0.000*
<18.5	23 (51.1%)	19 (42.2%)	3 (6.7%)	45 (12.5%)	
18.5-24.9	81 (48.5%)	62 (37.1%)	24 (14.4%)	167 (46.3%)	
25-29.9	65 (59.1%)	25 (22.7%)	20 (18.2%)	110 (30.5%)	
≥30	27 (69.2%)	6 (15.4%)	6 (15.4%)	39 (10.7%)	
Household income (RM)					0.000*
<1500	90 (78.9%)	11 (9.6%)	13 (11.5%)	114 (31.3%)	
1500-5000	101 (47.0%)	78 (36.3%)	36 (16.7%)	215 (59.1%)	
>5000	7 (20.0%)	24 (68.6%)	4 (11.4%)	35 (9.6%)	
Monthly food expenses (RM)					0.000*
<500	106 (70.7%)	24 (16.0%)	20 (13.3%)	150 (41.2%)	
500-1000	78 (44.1%)	68 (38.4%)	31 (17.5%)	177 (48.6%)	
>1000	14 (37.8%)	21 (56.8%)	2 (5.4%)	37 (10.2%)	
Monthly nuts and nut products expenses (RM)					0.843
<10	126 (54.1%)	71 (30.5%)	36 (15.4%)	233 (64.0%)	
10-50	70 (54.7%)	41 (32.0%)	17 (13.3%)	128 (35.2%)	
>50	2 (66.7%)	1 (33.3%)	0 (0.0%)	3 (0.8%)	
Frequency of buying nuts and nut products per month					0.000*
<2	97 (47.3%)	77 (37.6%)	31 (15.1%)	205 (56.3%)	
2-5	87 (60.4%)	35 (24.3%)	22 (15.3%)	144 (39.6%)	
>5	14 (93.3%)	1 (6.7%)	0 (0.0%)	15 (4.1%)	

BMI indicates body mass index (calculated as kg/m²)

*Significant at P<0.05

Table 2. Consumption of nuts and nut products among eaters

Food item	Consumption [#] (g/day)				P value
	Malay	Chinese	Indian	Total	
<i>Kuih pau kacang</i> ^d	0.81 ± 1.42	0.80 ± 1.49	0.27 ± 3.41	0.81 ± 1.42	0.665
Peanut butter	0.73 ± 3.02	0.37 ± 1.49	1.57 ± 3.11	0.73 ± 3.08	0.592
Roasted peanut shelled	0.85 ± 4.90 ^a	0.34 ± 0.89 ^b	1.26 ± 2.81 ^{ab}	0.63 ± 2.36	0.010*
Peanut butter biscuit/wafer	0.70 ± 2.84	0.23 ± 1.46	0.70 ± 8.92	0.63 ± 2.64	0.107
Coated peanut	0.52 ± 2.36 ^a	0.35 ± 0.70 ^b	1.04 ± 4.07 ^a	0.52 ± 1.95	0.022*
<i>Kuih kacang</i> ^e	0.71 ± 1.57	0.41 ± 1.10	0.41 ± 1.40	0.41 ± 1.50	0.080
<i>Satay</i> ^f or peanut sauce	0.60 ± 1.80 ^a	0.15 ± 0.72 ^b	0.53 ± 2.12 ^a	0.40 ± 1.40	0.000*
Coated almond	1.20 ± 2.24 ^a	0.20 ± 0.50 ^b	0.20 ± 2.02 ^{ab}	0.40 ± 2.33	0.010*
<i>Rempeyek</i> ^g	0.39 ± 1.71	0.36 ± 0.86	0.81 ± 3.71	0.39 ± 1.70	0.435
Boiled peanut in shell	0.46 ± 1.25 ^a	0.15 ± 0.38 ^b	0.46 ± 0.82 ^{ab}	0.38 ± 0.82	0.032*
Coated hazelnut	0.95 ± 3.07 ^a	0.19 ± 0.88 ^b	0.38 ± 1.15 ^{ab}	0.38 ± 2.15	0.000*
Roasted almond	0.25 ± 0.42 ^a	0.33 ± 0.42 ^a	2.02 ± 10.17 ^b	0.33 ± 0.75	0.003*
<i>Rojak</i> ^h sauce	0.40 ± 1.07 ^a	0.20 ± 0.73 ^b	0.13 ± 0.73 ^{ab}	0.33 ± 0.70	0.021*
Roasted cashew nut	0.30 ± 1.19 ^a	0.15 ± 0.22 ^b	0.90 ± 3.64 ^c	0.29 ± 0.78	0.000*
Roasted peanut in shell	0.36 ± 1.34 ^a	0.12 ± 0.41 ^b	0.24 ± 0.67 ^{ab}	0.24 ± 0.65	0.001*
Canned braised peanut	0.23 ± 1.31	0.47 ± 1.61	0.15 ± 2.95	0.23 ± 1.80	0.965
Brazil nut	0.09 ± 0.00	0.18 ± 1.54	0.32 ± 0.00	0.22 ± 1.12	0.212
Almond biscuit	0.21 ± 0.31	0.15 ± 0.23	0.25 ± 0.54	0.21 ± 0.26	0.553
Coated walnut	0.24 ± 2.15	0.14 ± 0.34	0.14 ± 0.00	0.19 ± 1.17	0.503
Peanut biscuit	0.17 ± 0.25	0.14 ± 0.19	0.23 ± 0.83	0.16 ± 0.25	0.052
Pistachio	0.15 ± 0.51	0.13 ± 0.08	0.08 ± 0.31	0.15 ± 0.38	0.116
Coated cashew nut	0.14 ± 0.75	0.27 ± 0.14	0.07 ± 0.46	0.14 ± 0.34	0.266
Roasted chestnut	0.13 ± 0.46	0.31 ± 0.76	0.06 ± 0.10	0.13 ± 0.41	0.107
Hazelnut biscuit	0.21 ± 0.58	0.07 ± 0.20	0.05 ± 1.41	0.13 ± 0.40	0.102
Peanut soup	0.00	0.13 ± 0.33	0.10 ± 1.81	0.13 ± 0.33	0.383
Fried peanut	0.27 ± 0.62	0.13 ± 0.24	0.30 ± 1.10	0.13 ± 0.53	0.150
Peanut cake (<i>Gung tang</i>)	0.14 ± 0.62 ^a	0.06 ± 0.14 ^b	0.22 ± 0.75 ^a	0.11 ± 0.31	0.023*
Ice cream with nuts	0.10 ± 0.18 ^a	0.03 ± 0.08 ^b	0.10 ± 0.26 ^a	0.10 ± 0.18	0.011*
Noodle with nuts (fried noodle/ <i>pasembur</i> ⁱ / <i>mi kuah</i> ^j)	0.10 ± 0.27	0.08 ± 0.17	0.20 ± 4.39	0.10 ± 0.27	0.145
Walnut	0.17 ± 0.17	0.09 ± 0.13	0.04 ± 0.38	0.09 ± 0.21	0.138
Cashew nut biscuit	0.08 ± 0.12	0.08 ± 0.10	0.11 ± 0.29	0.08 ± 0.11	0.211
Almond powder	0.05 ± 0.12 ^a	0.21 ± 1.78 ^b	0.04 ± 0.00 ^{ab}	0.08 ± 0.40	0.010*
Roasted hazelnut	0.07 ± 0.62	0.10 ± 0.23	0.07 ± 0.40	0.07 ± 0.33	0.871
Peanut slice	0.08 ± 0.19	0.06 ± 0.16	0.12 ± 0.97	0.06 ± 0.16	0.574
<i>Ais kacang</i> ^k	0.08 ± 0.18 ^a	0.03 ± 0.08 ^b	0.10 ± 0.16 ^{ab}	0.05 ± 0.18	0.014*
Cake or bread with nuts	0.10 ± 0.40 ^a	0.02 ± 0.08 ^b	0.05 ± 0.42 ^{ab}	0.05 ± 0.28	0.007*
Others	0.20 ± 0.27	2.18 ± 0.00	1.51 ± 0.00	0.20 ± 0.28	0.497

#Median ± interquartile range

*Significant at P<0.05; Kruskal-Wallis test. Different letters in the same row indicate significantly different medians (P<0.05; Mann-Whitney test).

^dSteamed bun filled with peanut.

^eLocal dessert filled with peanut.

^fGrilled chunks or slices of chicken, beef or other type of meats.

^gLocal crisp made of rice flour with peanuts scattered on it.

^hFruits and vegetable salad with a topping of thick dark prawn paste.

ⁱIndian salad consisting of shredded cucumber, beancurd, prawn fritters and etc served with a sweet and spicy sauce.

^jNoodle cooked in a rich gravy made from the stock of prawn and chicken.

^kShaved ice served with sweet flavoured syrup, palm seed, sweet corn, jelly, nuts and etc.

Table 3. Correlations between socio-demographic characteristics and nuts consumption of the study subjects

	Year of education	BMI	Household income	Household number	Nuts consumption	Nuts expenditure	Frequency of buying nuts
Year of education	-						
BMI	-0.104* (0.049)	-					
Household income	0.120* (0.022)		-				
Household number	0.154** (0.003)		0.267** (0.000)	-			
Nuts consumption	0.159** (0.002)			0.152* (0.004)	-		
Nuts expenditure	0.168** (0.001)	-0.110* (0.037)	0.126* (0.016)		0.174** (0.001)	-	
Frequency of buying nuts	0.202** (0.000)				0.429** (0.000)		-

* Correlation is significant at the 0.05 level (2 tailed)

** Correlation is significant at the 0.01 level (2 tailed)

the nuts expenses ($r=0.168$, $P=0.001$) and purchasing frequency ($r=0.202$, $P<0.001$) with year of education was observed. Nuts and nut products purchases were also sporadic. Supermarket was the main avenue for obtaining the nuts and nut products for 34.9% of the subjects, followed by grocery shop (26.1%), night market (14.6%) and less than 10% of the subjects purchasing their products from hawker, wet market and others (Figure 1).

In Malaysia, variety of nuts that normally been consumed are included peanuts, almonds, walnuts, hazelnuts, cashew nuts and chestnuts. Nuts are seldom consumed as raw products but they are more frequently eaten in the form of roasted, grilled, cooked, boiled, salted and fried. This survey included different types of nuts in various preparations but excluded some products like pecan nuts, kola nuts and macadamia which are somewhat difficult to obtain in the market. Nuts consumption among Malaysian adults was comparably low compared to population from other countries (Aranceta et al., 2006) and much lower than the average intake of nuts and oilseeds group by population from Far East Countries (19.2 g/day) (GEMS, 2006). This result is expected because these food items are not principle staple and are normally consumed in small quantities in the form of snacks, in sauces or as one of the ingredients in dishes.

Different living style or cultural background leads to a very different food habits among the ethnic groups with the Chinese being more likely to consume steamed or stewed dishes rather than fried or deep fried food. Cultural influence from the past may also affect their dietary pattern. In India, consumption of almonds is believed to be good for the brain, while the Chinese consider it as a symbol of enduring sadness and female beauty. Almond powder is normally

taken as a drink mixed with milk and serve hot by Malaysian Chinese. Chinese society believes that almond (*Semen Armeniacae Amarum*) has the action of relieving cough and asthma (Anonymous, 2002).

In this study, women were found less consumed nuts and their products compared to men. Similar finding for higher nuts consumption from men compared to women was reported (Martínez-Lapiscina et al., 2009). Women probably more likely to be conscious of their body weight and appearance (pimple or acne), thus reducing the intake of nuts and nut products. This is especially obvious among women in 18-30 age group compared to men in the same age group. Study showed that many people believed that the acne was exacerbated by certain aspect of diet including nuts, chocolate, fried foods and other fatty foods (El-Akawa et al., 2006).

Fourteen subjects (4%), most of them were from >50 age group, had reported that they were never consumed nuts for the past one year with the reasons of chewing problem. Except one youth (0.3%) who claimed that she suffered allergenic reaction to peanut and/or related products. Studies from the United States, the United Kingdom and France showed that peanut allergy is common with the prevalence of 0.4% in children and an overall prevalence of 0.5-1.0% in the general population (Emmett et al., 1999; Kanny et al., 2001; Sicherer et al., 1999).

From all the surveyed food items, *kuih pau kacang* was identified as the most consumed item amongst Malaysian population. The prevalence of this item may be due to its availability and the affordability (price) by all population even those from low income category or in rural area. Peanut butter was the second prevalent food item after *kuih pau kacang*. This is because peanut butter is a very popular food

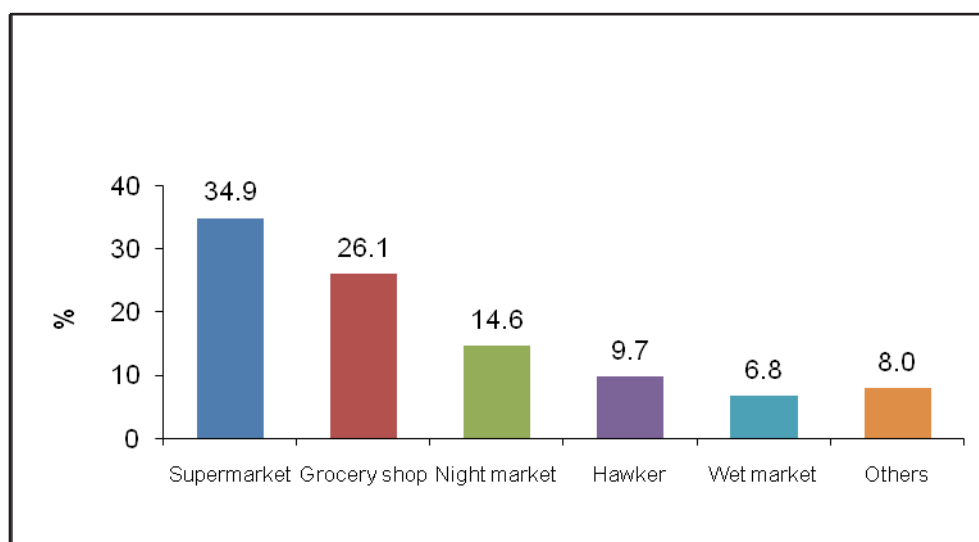


Figure 1. Places to purchase nuts and nut products by the study subjects

item which is served at breakfast or during tea time in Malaysia.

The consumption of nuts or nut products by adult population was not strongly influenced by the education factor or household income. The consumption may only be due to individual preference and not because of the nutrient or positive health benefits of taking the nuts and their products. There were only 5% of the subjects had the knowledge of aflatoxins and less than half of them (49%) aware and refused to take any mouldy products. This suggested that more publicity regarding aflatoxins should be carried out to educate the public on the association of aflatoxins and the mouldy products as well as the precaution steps.

Limitations

There are several limitations to the current study that should be noted. This study was stratified according to stratum (urban and rural) only. Consequently, there may be under-representation of certain ethnic and age groups. The study is also limited by unequal sex distribution with few male subjects that would have biased the data towards lower intakes of nuts and nut products. In addition, the consumption survey is based on the habitual intake of the past one year. This may contribute to underestimation of intake of some nuts or nut products which were occasionally taken but was not reported by the subjects. Moreover, only 37 nuts and nut products categorized into three groups (peanuts and their products, other nuts and their products and nuts as decoration) were included in the questionnaire resulted the list may not be exhaustive.

Conclusions

The results of this study conclude that the nuts consumption amongst Malaysian adults is very little and has been influenced by several socio-demographic and dietary behaviour characteristics. Nuts are well known to possess positive health benefits, however, authority should enforce a more stringent regulation to protect the consumer from any diet-related chronic disease such as aflatoxicosis while encouraging higher nuts intake in daily life.

Acknowledgements

Yin-Hui Leong acknowledges the support of the Universiti Sains Malaysia's Fellowship program to support her postgraduate studies. Financial support of this work through research grants from Food Safety & Quality Division, Ministry of Health, Malaysia is also acknowledged. Sincere gratitude also goes to all

participants of this study.

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