



# Asian Journal of Clinical Nutrition

ISSN 1992-1470

**science**  
alert

**ANSI***net*  
an open access publisher  
<http://ansinet.com>

## Contribution of Different Food Groups to the Energy Intake and Weight Status of Adults: A Cross-Sectional Study in a Malaysian Public University

<sup>1</sup>W.B. Fokeena, <sup>1</sup>R. Jamaluddin and <sup>2</sup>H. Khaza'ai

<sup>1</sup>Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia

<sup>2</sup>Department of Biomedical Sciences, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia

*Corresponding Author: R. Jamaluddin, Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia*

### ABSTRACT

Similar to other countries, Malaysia is not spared from the epidemic of obesity. The fundamental cause of obesity is an imbalance between energy intake and expenditure in which diet is a key, modifiable risk factor. While the food and nutrient intake of Malaysian adults is documented, data on the extent to which each food group contributes to total calorie ingested has not been reported to date. A cross-sectional study was conducted among Malaysian adults ( $n = 360$ ) aged 18-58 years in a public university. Through face-to-face interview, nutrient intake data was collected using a previously validated food frequency questionnaire. The calorie acquired from different food groups was calculated as a percentage of total calorie intake. Body weight, height and waist circumference were also measured. Food group-wise, the highest calorie derived from vegetables, drinks and confectioneries were by normal weight, obese and overweight participants, respectively. Positive correlations were established between percentage of calorie from eggs and waist circumference ( $p = 0.035$ ) and percentage of calories from sauces and body mass index ( $p = 0.013$ ). Percentage of calorie from drinks was positively correlated with all three measures of adiposity, namely; body weight ( $p = 0.010$ ), body mass index ( $p = 0.044$ ) and waist circumference ( $p = 0.020$ ). Adiposity was associated with intake of a larger amount of calories from drinks, confectioneries as well as from eggs and sauces and consumption of lesser calories from vegetables. Such a dietary pattern of overweight and obese individuals can predispose them to health complications such as type 2 diabetes, hypertension and cardiovascular diseases.

**Key words:** Percentage energy contribution, food groups, body weight, body mass index, waist circumference

### INTRODUCTION

Malaysia is a fast developing country in South East Asia with a population of 29,239,900 inhabitants as per the latest available statistics. Compared to other countries, it is not spared from the epidemic of obesity (Ministry of Health Malaysia, 2010). Prevalence of overweight and obesity among Malaysian adults are 33.6 and 19.5%, respectively and these problems are considered burdens to the nation (Mohamud *et al.*, 2011). Besides being a risk factor for several Non-Communicable Diseases (NCD), obesity is associated with social, economic and psychological consequences (Bogsan *et al.*, 2011). The Government of Malaysia is highly aware of the consequences of this growing health problem and is encouraging research on the prevention of

NCD as stated in the third objective of the National Strategic Plan for the prevention of NCD in Malaysia (Ministry of Health Malaysia, 2010).

The fundamental cause of obesity and overweight is an imbalance between energy intake and energy expended (WHO., 2014). While the roots of obesity is still unclear, it is well documented that diet plays a key role and is a modifiable risk factor in its development (Swinburn *et al.*, 2004). With food industrialisation and globalisation, the dietary habits of human beings has changed enormously as compared to the gatherer-hunter's diet of the Palaeolithic times, with more refined cereals, sugars, oils, salt being consumed nowadays. This evolution has been accompanied by a rise in the incidence of obesity and NCD (Chauveau *et al.*, 2013).

Dietary interventions to manage obesity include energy restriction and portion size control (Rolls, 2014). Nevertheless, one piece of information that is used prior to the implementation of any intervention is the baseline dietary pattern of the target population. National dietary studies such as the Malaysian Adult Nutrition Survey in 2008 have been previously conducted in Malaysia and reports on the food and nutrient intake of its population is available. However, data on the extent to which each food group contributes to the total calorie ingested has not been reported to date. Comparison of the energy obtained from different food groups with respect to people's weight status could be an additional and valuable input for the formulation of tailored weight management intervention programmes. The objectives of this study were, firstly to evaluate the contribution of different food groups to total energy intake and secondly to determine whether differences in contribution is associated with adiposity.

## **MATERIALS AND METHODS**

**Study subjects:** The study population comprised of a total of 360 Malaysian adults, both males and females aged between 19-58 years. Using the formula,  $n = (Z^2pq/e^2)$  (Daniel, 1999), sample size (n) was calculated based on the prevalence of overweight and obesity among adults in Malaysia as per latest reported statistics (Mohamud *et al.*, 2011). Confidence interval was set at 95% and precision at 5.5%. The calculated sample size was approximately 316, which was subsequently increased to 360. Using a multistage sampling method, five faculties/institutions were randomly selected from the 16 faculties and 9 institutions of Universiti Putra Malaysia. From each faculty/institution, 72 participants (36 staff and 36 students) were randomly chosen, including both males and females. Data collection was carried out by interview on a one-to-one basis during the months of February, March and April 2015 by trained enumerators. A questionnaire was used as instrument to collect information on socio-demographic factors (age, gender, ethnicity and family income), nutrient intake and anthropometric measures. The study was approved by the Universiti Putra Malaysia Ethics Committee for Research on Human Subjects.

## **Measures**

**Dietary intake:** Through a face-to-face interview, participants' dietary intake was assessed using the Malaysian Adult Nutrition Survey 126 items-food frequency questionnaire (MANS FFQ). It is a validated instrument in Bahasa Melayu appropriate for surveys. The frequencies of intake (number of times per day, number of times per week, number of times per month, number of times per year and never) are based on the habitual intake for the past year. Participants were also required to provide the serving size consumed each time for the different food items. As described elsewhere, the food frequencies in the MANS FFQ can be converted into amount of food intake using the formula devised by the Wessex Institute of Public Health (1995); the formula is given in following equation (Norimah *et al.*, 2008):

$$\text{Amount of food (g day}^{-1}\text{)} = \frac{\text{Frequency of intake (conversion factor)} \times \text{serving size}}{\text{total number of servings} \times \text{weight of food in one serving}}$$

Data on serving sizes and weight of food in one serving is available in the Atlas of Food Exchanges and Portion Sizes (Shahar *et al.*, 2010). From the values of amount of food per day, the daily energy intake was determined using Nutritionist Pro™, a dietary analysis software. Eventually the energy derived from each food group was calculated as a percentage of total energy.

**Anthropometry:** Adiposity was determined using Body Mass Index (BMI) and Waist Circumference (WC). Using a portable stadiometer, digital body weighing scale and anthropometric measuring tape, the height, body weight, WC were measured by the enumerators according to a standard protocol (CDC., 2007). Body weight was recorded to the nearest 0.1 kg and height and WC to the nearest 0.1 cm. BMI was calculated as weight (kg) divided by the square of height and was classified according to cut-off values of the World Health Organization (WHO., 2009).

**Statistical analysis:** All statistical analyses were conducted using the software Statistical Package for Social Sciences version 21.0. The significance level was set at  $p < 0.05$ .

**Sample description:** For descriptive statistics (participants' socio-demographic data and BMI) mean and standard deviation were used. Data for diet quality scores, adiposity and physical activity level were presented both as continuous and categorical data. Each of the independent variables were compared for males and females and differences were analyzed for statistical significance using the Mann-Whitney U-test.

**Association of adiposity with differences in calorie contribution by food groups:** Spearman's Rank Order correlation was used to determine the relationship between adiposity (as defined by body weight, BMI and WC) and differences in proportion of energy from food groups of the MANS FFQ.

## RESULTS

**Socio-demographic data:** Participants were aged between 19-58 years. Out of the 360 participants, 160 (44.4%) were males and 200 (55.6%) were females. Most of them (86.9%) belonged to the Malay ethnic group. The majority were educated up to secondary school and reported an income (per family member) of Malaysian Ringgit (MYR) 351-600 (Table 1).

**Anthropometric data:** Based on calculated BMI, most of the participants were found to be of normal weight (45.8%) (Table 1). The average weight of males was 65.7 and 56.0 kg for males and females, respectively. BMI was almost the same for both genders (males =  $22.8 \text{ kg m}^{-2}$ , female =  $22.7 \text{ kg m}^{-2}$ ). The average WC for males and females were 79.8 and 75.5 cm (Table 2). The difference between males and females was statistically significant for body weight, height and WC but not BMI. The proportion of obesity as classified by BMI was 17.2 and 15.8% among males and females, respectively.

**Contribution of food groups to calorie intake:** The average total calorie intake of males (2310 kcal) was significantly higher than that of females (1870 kcal) ( $p = 0.001$ ) (Table 2). In

Table 1: Characteristics of participants

Characteristics	No.	Percentage
<b>Age (years)</b>		
≤21	96	26.70
22-23	129	35.80
24-25	18	5.00
26-27	53	14.70
≥27	51	14.20
<b>Gender</b>		
Male	160	44.40
Female	200	55.60
<b>Ethnicity</b>		
Malay	313	86.90
Chinese	27	7.50
Indian	12	3.30
Others	8	2.20
<b>Education level</b>		
Up to secondary school	182	50.60
Certificate/diploma holder	48	13.30
Bachelor's degree holder	107	29.70
Master's degree/PhD holder	23	6.40
<b>Income (per family member)</b>		
≤MYR† 350	55	15.30
MYR 351-600	65	18.10
MYR 601-850	50	13.90
MYR 851-1100	63	17.50
≥MYR 1100	40	11.10
<b>Body mass index (kg m<sup>-2</sup>)</b>		
Underweight	16	4.50
Normal weight	165	45.80
Overweight	118	32.80
Obese	61	16.90

†MYR: Malaysian ringgit (US\$1 is approximately MYR 3)

Table 2: Anthropometric measurements and energy intake of participants

Parameters	Males			Females			p-value
	Minimum	Maximum	Mean±SD	Minimum	Maximum	Mean±SD	
Body weight (kg)	43.0	86.00	65.70±10.3	37.8	120.00	56.00±12.0	<0.001*
Height (m)	1.60	1.80	1.70±0.06	1.45	1.70	1.57±0.056	<0.001*
Body mass index (kg m <sup>-2</sup> )	16.0	30.50	22.80±3.20	16.1	47.50	22.70±4.67	0.263
Waist circumference	70.0	98.00	79.80±6.83	30.3	117.00	75.50±9.81	0.003*
Total energy intake (kcal)	1430	3310.00	2310.00±553	1230	3970.00	1870.00±598	0.001*

\*Significant results from Mann-Whitney U test (p<0.05 (2-tailed))

general, most of the energy were derived from cereal and cereal products (43.9%), followed by confectioneries (11.1%), drinks (10.89%) and meat and meat products (10.89%). Sauces had the least contribution to energy intake (0.889%) (Table 3). When participants were classified according to BMI, differences were noted in the calorie contribution from different food groups as shown in Table 3. However, the differences were significant for vegetables, drinks and confectioneries only. Participants of normal BMI obtained 3.33% of their calories from vegetables, followed by overweight, obese and underweight participants who respectively derived 2.96, 2.39 and 1.42% of energy from vegetables (Fig. 1a). With regard to the intake of drinks, obese participants derived the most energy from them (12.9%), followed by overweight (10.9%), normal (10.4%) and underweight (9.61%) participants (Fig. 1b). The highest calories derived from confectioneries were by overweight participants (15.8%), followed by obese (12.7%), normal (10.2%) and underweight individuals (9.72%) (Fig. 1c).

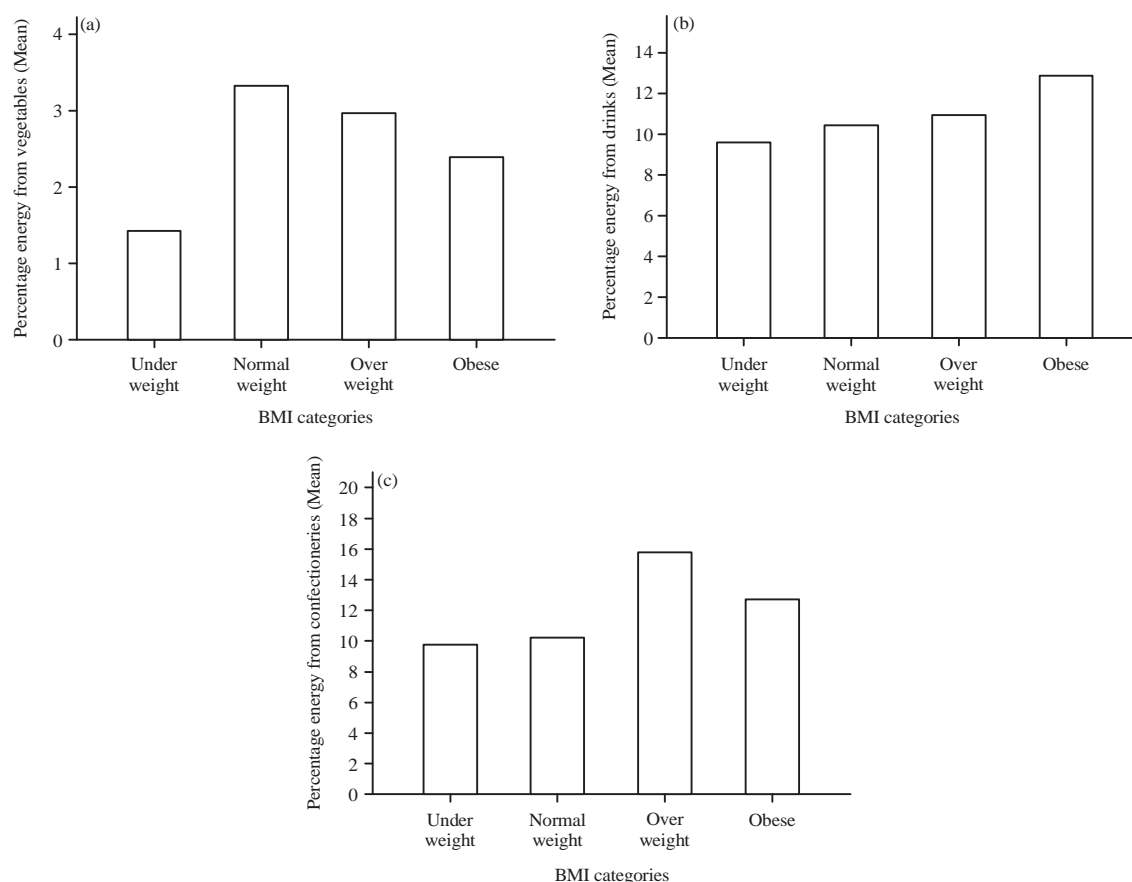


Fig. 1(a-c): Percentage of energy obtained from (a) Vegetables, (b) Drinks and (c) Confectioneries by different BMI categories

Table 3: Contribution of different food groups to total energy intake

Food groups	Percentage contribution to total energy intake (Mean±SD)						Spearman rank order correlation, rho (p-value)			
	Total	BMI				p-value	Body weight	BMI	WC	
		Under weight	Normal weight	Over weight	Obese					
Cereal and cereal products	43.90±11.6	43.0±10.5	44.10±11.9	43.40±11.3	44.20±12.2	0.942	0.077 (0.337)	-0.002 (0.979)	-0.040 (0.620)	
Meat and meat products	10.90±6.81	11.5±3.81	11.10±7.50	9.97±4.35	10.50±7.66	0.562	0.059 (0.467)	-0.033 (0.681)	0.037 (0.656)	
Fish and sea foods	6.17±4.75	4.86±2.95	6.24±5.02	6.27±3.39	6.80±6.59	0.801	0.102 (0.208)	0.136 (0.093)	0.129 (0.117)	
Eggs	2.33±1.99	1.99±1.25	2.25±1.71	2.17±1.29	3.92±4.78	0.897	0.090 (0.274)	0.105 (0.200)	0.174 (0.035)**	
Legumes and their products	1.88±2.40	0.628±0.554	1.80±1.98	2.82±3.97	1.60±1.61	0.134	0.078 (0.393)	0.109 (0.233)	0.090 (0.334)	
Milk and milk products	5.79±5.05	4.64±3.14	5.96±5.11	6.01±4.99	4.89±6.68	0.435	-0.040 (0.636)	0.005 (0.951)	-0.005 (0.953)	
Vegetables	3.06±2.77	1.42±1.35	3.33±2.98	2.96±2.53	2.39±1.69	0.032*	0.175 (0.300)	0.128 (0.114)	0.124 (0.131)	
Fruits	3.56±2.66	3.13±3.08	3.56±2.54	3.40±1.98	4.60±4.57	0.727	0.021 (0.795)	0.034 (0.679)	0.049 (0.562)	
Drinks	10.90±6.39	9.61±5.3	10.40±5.31	10.90±8.05	12.90±7.73	0.040*	0.205 (0.010)**	0.161 (0.044)**	0.189 (0.020)**	
Confectioneries	11.10±6.39	9.72±4.12	10.20±6.32	15.80±7.69	12.70±5.56	0.004*	-0.071 (0.381)	-0.004 (0.961)	-0.043 (0.599)	
Spreadings	2.62±3.00	2.27±3.55	2.96±3.30	1.80±1.60	1.90±1.90	0.279	-0.043 (0.673)	-0.071 (0.490)	-0.037 (0.725)	
Sauces	0.889±1.17	0.549±0.400	0.852±1.11	1.23±1.64	0.720±0.601	0.691	0.059 (0.517)	0.224 (0.013)**	0.093 (0.317)	

\*Significant results from Mann-Whitney U test ( $p < 0.05$  (2-tailed)), \*\*Significant results from Spearman's Rank Order correlation ( $p < 0.05$  (2-tailed)), BMI: Body mass index, WC: Waist circumference

Table 3 also shows the results of Spearman's Rank Order correlation. Statistically significant positive correlation was obtained between percentage calorie from eggs and waist circumference

and percentage calorie from sauces and BMI. A statistically significant positive correlation was also obtained between calories from drinks and all of the three indicators of adiposity, namely body weight, BMI and WC (Table 3).

## DISCUSSION

**Anthropometric data:** The participants of this study were mostly of normal weight followed by overweight, obese and underweight individuals. This is in accordance to the latest national study on the BMI status of Malaysian adults. The researchers reported 4.7% underweight, 42.2% normal weight, 36.6% overweight and 19.5% obese individuals in their sample using the WHO cut-off values (Mohamud *et al.*, 2011). This demonstrates that the sample of the current study was representative in terms of BMI.

**Average calorie ingested:** The average total calorie ingested was higher among males than females. The latest nationwide study reporting energy intake of Malaysian adults dated back to 2008. The average energy intake of males and females were 1776 and 1447 kcal, respectively, similarly showing that males had higher energy intake than females (Mirnalini *et al.*, 2008). However, both values were less than the energy intake reported in the present study. The nationwide study mentioned above did not describe the proportion of underweight, normal weight, overweight and obese individuals in its sample and this can affect the average energy intake values. Nevertheless, the average nutrient intake of the present study is in line with the recommended nutrient intake for Malaysia which is 2010 to 2440 kcal for male adults and 1780-2000 for female adults (Ministry of Health Malaysia, 2005).

**Sources of energy according to food groups:** Cereals were the main source of energy followed by confectioneries, drinks and meat and meat products among the participants. A national study reported that rice or nasi was the most common food consumed by Malaysian adults with an average of two and a half plates per day and bread was the sixth most common food with an average of three slices per day. Local cakes (local kuih) and biscuits were also among the ten most common foods consumed on a daily basis. The average consumption of sweetened beverages was reported to be about one cup daily. They found that chicken was the most common meat and it was third in the list of top ten weekly consumed foods (Norimah *et al.*, 2008). These data partly explained the findings of the present study that cereals, confectioneries and drinks were the main sources of energy among the participants.

**Association between adiposity and vegetables, drinks and confectioneries:** With respect to the percentage of energy obtained from vegetables, individuals with a normal BMI tended to derive the most, followed by overweight, obese and underweight individuals. This might indicate a higher consumption of vegetables by participants with normal BMI. A high intake of nutrient-dense foods such as vegetables is usually indicative of a healthy dietary pattern which in turn has been found to be associated with a normal BMI (He *et al.*, 2004; Tapsell *et al.*, 2014). This is further confirmed by the findings of two prospective cohort studies which reported an inverse association between changes in BMI and vegetable consumption over the years (Kahn *et al.*, 1997; Mozaffarian *et al.*, 2011). The reason behind the observation that vegetables are associated with lower BMI could be partly explained by the fact that they have a low energy density, enhance satiety and reduce hunger and have been known to play a role in weight management (Rolls *et al.*, 2004).

Overweight participants derived the highest amount of calories from confectioneries. Cakes, biscuits, ice cream, sweets, snacks, crackers and chips which were included in this food group usually contain a considerable amount of calories and refined carbohydrates and less dietary fibre. Frequent consumption of such types of food could lead to weight gain over years (Santiago *et al.*, 2015). A 2 year cohort study in Germany showed that intake of sweets was associated with large weight gains in both women and men (Schulz *et al.*, 2002). Similar findings were also reported in a sample of Australian adults. Cakes and muffins were among the highest contributors to their daily energy intake (Rangan *et al.*, 2008). However, a study among children and adolescents in Britain reported that being overweight was not necessarily associated with a higher calorie intake from biscuits, cakes and confectioneries (Gibson *et al.*, 2004). Further investigation will help to clarify whether intake of such foods is associated with a particular BMI category. Nevertheless, the findings reported herein indicate that Malaysian adults who are overweight still need to be vigilant with respect to their intake of confectioneries.

Drinks were being consumed mostly by obese participants followed by overweight, normal and underweight participants. In addition, there was a linear association between energy derived from drinks and body weight, BMI and waist circumference. The drinks included tea, coffee, chocolate drinks, malted drinks, cordials, syrup, fruit juices, carbonated drinks, energy drinks, soy-based beverages and herbal drinks. In Malaysia, tea and coffee are usually consumed with added condensed sweetened milk which contributes largely to the calorie ingestion. Several cohort studies as well as feeding trials have found a positive correlation between consumption of sugar-sweetened beverages and weight gain, obesity or both among children, adolescents as well as adults (Mozaffarian *et al.*, 2011; Malik *et al.*, 2006). The mechanisms by which intake of such beverages can lead to weight gain is the high empty calorie content and low satiating effect of carbohydrate-rich beverages (Bachman *et al.*, 2006). Intake of sweetened beverages is not only a risk for adiposity, but it is also associated with the development of metabolic syndrome and type 2 diabetes as reported by a meta-analysis (Malik *et al.*, 2010). Therefore, the maximum benefit of soy-based beverages, tea, coffee, fruit juices can be derived when they are taken without added sugar.

There is a positive correlation between calories obtained from eggs and waist circumference. This finding is similar to a study conducted among Bengalee Hindu men in Calcutta, India. They found a significant positive correlation between egg consumption and waist circumference and other measures of central adiposity (Ghosh *et al.*, 2003). No other study were found which reported the effect of egg consumption on abdominal adiposity. Rather than adiposity, egg consumption has mostly been associated with cardiovascular risks due to its high cholesterol and lecithin content (Li *et al.*, 2013; Spence *et al.*, 2013, 2010). In the present study it is most probably that the effect on waist circumference is not only due to egg, but a combined effect of other foods rich in saturated fats as a significant positive correlation was also noted between saturated fat intake and energy derived from eggs (results not detailed herein).

Despite that there was a positive correlation between calories acquired from sauces and BMI, it should be noted that the contribution of sauces to total calorie intake was still very small. In itself, this is not as much a problem for weight gain as it is for other health complications. It however could imply that participants with higher BMI were consuming more sauces. The sauces that were included in the FFQ were mainly soy sauce, fish sauce, oyster sauce, shrimp paste, chilli sauce, tomato sauce which have a high sodium content. It represents a double threat if individuals



with high BMI are consuming more of the sauces, as both high sodium intake and obesity are strong risk factors for hypertension (Reddy *et al.*, 2015; Nguyen and Lau, 2012; Mikhail *et al.*, 1999).

In the present study, adiposity has been found to be associated with intake of a larger amount of energy from drinks, confectioneries as well as from eggs and sauces and consumption of lesser energy from vegetables. Overweight individuals are already susceptible to health complications such as type 2 diabetes, hypertension and cardiovascular diseases and such a dietary pattern only can aggravate the situation if corrective measures are not taken promptly. Calorie obtained from other food groups were not found to be associated to adiposity in this study. One possible explanation could be that the choice and consumption of foods belonging to these groups varied from participant to participant and did not show consistency. Findings of this study can be useful for the designing of cross-sectional studies in different settings to assess whether the same situation prevails among other Malaysian adults.

## ACKNOWLEDGMENT

The authors are grateful to all the participants who consented to be involved in this study and to enumerators who helped in data collection.

## REFERENCES

- Bachman, C.M., T. Baranowski and T.A. Nicklas, 2006. Is there an association between sweetened beverages and adiposity? *Nutr. Rev.*, 64: 153-174.
- Bogsan, C.S.B., A.C.R. Florence, N. Perina, R.C. Barbuti, T. Navarro-Rodriguez, J.N. Eisig and M.N. Oliveira, 2011. RETRACTED: Probiotics intake and metabolic syndrome. A proposal. *Trends Food Sci. Technol.*, 22: 457-464.
- CDC., 2007. Health and Nutrition Examination Survey anthropometry procedures manual. [http://www.cdc.gov/nchs/data/nhanes/nhanes\\_07\\_08/manual\\_an.pdf](http://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf).
- Chauveau, P., D. Fouque, C. Combe and M. Aparicio, 2013. [Evolution of the diet from the paleolithic to today: Progress or regress?]. *Nephrol. Ther.*, 9: 202-208.
- Daniel, W.W., 1999. *Biostatistics: A Foundation for Analysis in the Health Sciences*. 7th Edn., John Wiley and Sons, New York, USA., ISBN-13: 978-0471163862, Pages: 907.
- Ghosh, A., K. Bose and A.B.D. Chaudhuri, 2003. Association of food patterns, central obesity measures and metabolic risk factors for Coronary Heart Disease (CHD) in middle aged Bengalee Hindu men, Calcutta, India. *Asia. Pac. J. Clin. Nutr.*, 12: 166-171.
- Gibson, S., J. Lambert and D. Neate, 2004. Associations between weight status, physical activity and consumption of biscuits, cakes and confectionery among young people in Britain. *Nutr. Bull.*, 29: 301-309.
- He, K., F.B. Hu, G.A. Colditz, J.E. Manson, W.C. Willett and S. Liu, 2004. Changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women. *Int. J. Obes.*, 28: 1569-1574.
- Kahn, H.S., L.M. Tatham, C. Rodriguez, E.E. Calle, M.J Thun and C.W. Heath, Jr., 1997. Stable behaviors associated with adults' 10-year change in body mass index and likelihood of gain at the waist. *Am. J. Public Health*, 87: 747-754.
- Li, Y., C. Zhou, X. Zhou and L. Li, 2013. Egg consumption and risk of cardiovascular diseases and diabetes: A meta-analysis. *Atherosclerosis*, 229: 524-530.

- Malik, V.S., B.M. Popkin, G.A. Bray, J.P. Despres, W.C. Willett and F.B. Hu, 2010. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes a meta-analysis. *Diabetes Care*, 33: 2477-2483.
- Malik, V.S., M.B. Schulze and F.B. Hu, 2006. Intake of sugar-sweetened beverages and weight gain: A systematic review. *Am. J. Clin. Nutr.*, 84: 274-288.
- Mikhail, N., M.S. Golub and M.L. Tuck, 1999. Obesity and hypertension. *Prog. Cardiovasc. Dis.*, 42: 39-58.
- Ministry of Health Malaysia, 2005. Recommended nutrient intakes for Malaysia 2005. <http://www2.moh.gov.my/images/gallery/rni/insert.pdf>.
- Ministry of Health Malaysia, 2010. National strategic plan for non-communicable diseases. <http://www.moh.gov.my/images/gallery/nspncd/NSPNCD.pdf>.
- Mirnalini, Jr. K., M.S. Zalilah, M.Y. Safiah, A. Tahir and M.D.S. Haslinda *et al.*, 2008. Energy and nutrient intakes: Findings from the Malaysian Adult Nutrition Survey (MANS). *Malaysian J. Nutr.*, 14: 1-24.
- Mohamud, W.N.W., K.I. Musa, A.S. Khir, A.A.S. Ismail and I.S. Ismail *et al.*, 2011. Prevalence of overweight and obesity among adult Malaysians: An update. *Asia Pac. J. Clin. Nutr.*, 20: 35-41.
- Mozaffarian, D., T. Hao, E.B. Rimm, W.C. Willett and F.B. Hu, 2011. Changes in diet and lifestyle and long-term weight gain in women and men. *N. Engl. J. Med.*, 364: 2392-2404.
- Nguyen, T. and D.C.W. Lau, 2012. The obesity epidemic and its impact on hypertension. *Can. J. Cardiol.*, 28: 326-333.
- Norimah, Jr. A.K., M. Safiah, K. Jamal, S. Haslinda and H. Zuhaida *et al.*, 2008. Food consumption patterns: Findings from the Malaysian Adult Nutrition Survey (MANS). *Mal. J. Nutr.*, 14: 25-39.
- Rangan, A.M., S. Schindeler, D.J. Hector, T.P. Gill and K.L. Webb, 2008. Consumption of 'extra' foods by Australian adults: Types, quantities and contribution to energy and nutrient intakes. *Eur. J. Clin. Nutr.*, 63: 865-871.
- Reddy, V., A. Sridhar, R.F. Machado and J. Chen, 2015. High sodium causes hypertension: Evidence from clinical trials and animal experiments. *J. Integr. Med.*, 13: 1-8.
- Rolls, B.J., 2014. What is the role of portion control in weight management. *Int. J. Obes.*, 38: S1-S8.
- Rolls, B.J., J.A. Ello-Martin and B.C. Tohill, 2004. What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? *Nutr. Rev.*, 62: 1-17.
- Santiago, S., I. Zazpe, M. Bes-Rastrollo, A. Sanchez-Tainta and C. Sayon-Orea *et al.*, 2015. Carbohydrate quality, weight change and incident obesity in a Mediterranean cohort: The sun project. *Eur. J. Clin. Nutr.*, 69: 297-302.
- Schulz, M., A. Kroke, A.D. Liese, K. Hoffmann, M.M. Bergmann and H. Boeing, 2002. Food groups as predictors for short-term weight changes in men and women of the EPIC-Potsdam cohort. *J. Nutr.*, 132: 1335-1340.
- Shahar, S., N.A.M. Yusoff, N.S. Safii, R. Ghazali and R. Ahmad, 2010. Atlas of Food Exchanges and Portion Sizes. 2th Edn., UniversitiKebangsaan Malaysia, Malaysia, pp: 32-127.
- Spence, J.D., D.J.A. Jenkins and J. Davignon, 2010. Dietary cholesterol and egg yolks: Not for patients at risk of vascular disease. *Can. J. Cardiol.*, 26: e336-e339.
- Spence, J.D., D.J.A. Jenkins and J. Davignon, 2013. Egg yolk consumption, smoking and carotid plaque: reply to letters to the Editor by Sean Lucan and T Dylan Olver *et al.* *Atherosclerosis*, 227: 189-191.

- Swinburn, B.A., I. Caterson, J.C. Seidell and W.P.T. James, 2004. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr.*, 7: 123-146.
- Tapsell, L.C., M.J. Batterham, R.L. Thorne, J.E. O'Shea, S.J. Grafenauer and Y.C. Probst, 2014. Weight loss effects from vegetable intake: A 12-month randomised controlled trial. *Eur. J. Clin. Nutr.*, 68: 778-785.
- WHO., 2009. BMI classification. <http://apps.who.int/bmi/index.jsp?introPage=intr-3.html>
- WHO., 2014. Overweight and obesity fact sheet number 311. <http://www.who.int/mediacentre/factsheets/fs311/en/>