

Case Study

Poor Diet Quality among Overweight/Obese (OW/OB) Young Adults in Klang Valley, Malaysia: A Case-control Study

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ABSTRACT

This study aimed to determine the differences in dietary intake and quality between normal-weight (NW) and overweight/obese (OW/OB) young adults in Klang Valley, Malaysia. A case-control study was conducted among 294 private universities students in Klang Valley, Malaysia. Respondents completed a set of questionnaire and 3 days 24-hr dietary recall. Weight, height, body fat percentage (%BF), visceral fat, and waist circumference of respondents were measured. Dietary intake of respondents was analyzed and their diet quality was evaluated using a healthy eating index (HEI) scale. Findings displayed OW/OB group had significantly higher energy, macronutrient, sugar, saturated fat, cholesterol and sodium intake ($p < 0.001$) than NW group. The total HEI score was significantly lower in OW/OB group [45.14 (11.13)] than NW group [51.43 (11.61)]. This was affected by component scores of percentages (%) of energy from fat ($p < 0.001$) and saturated fat ($p = 0.023$), cholesterol and sodium intake ($p < 0.001$) with OW/OB had significantly lower score than NW group. However, OW/OB group achieved a significantly higher component score for cereals ($p < 0.001$) and meat food groups ($p = 0.005$) than NW group. HEI analysis also displayed both groups achieved low component scores for fruits, vegetables, milk, and food variety. Although OW/OB group had poorer diet quality than NW group, both groups had low consumption of fruits, vegetables, milk, and less varied diet. Therefore, there is a need for educational campaigns on food groups' diversification especially in increasing nutrient-dense food in their diet to increase awareness in healthy eating among young adults.

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INTRODUCTION

Poor dietary habits have been viewed as an important public health issue among young adults who encounter the transition from family diets to diets of their own choices (Ganasegeran et al., 2012; Jiet & Soma, 2017). Since this is the critical time during which they are exposed to stress, time restricted and start establishing independence, they are more likely to adopt unhealthy dietary habits including low consumption of fruits, vegetables and milk and prefer fast foods (Gan et al., 2011; Ganasegeran et al., 2012). The challenges they face such as new environment, deficient cooking experience and facilities and having to learn to make their own food choices have negative impacts on their eating behaviors (Fokeena et al., 2016). These have led obesity to have potential to course into young adults' population (Hakim et al., 2012). According to National Health and Morbidity Survey [NHMS] (2015), the prevalence of overweight and obesity among young adults aged 20-24 years old has reached 31.7% in Malaysia and this indicates that the problem of overweight and obesity in Malaysia is more serious than other Asian countries such as Singapore, Thailand, and Laos which only reported that 29.3%, 28.3%, and 23.8%, respectively, for overweight/obese (OW/OB) young adults (Peltzer et al., 2014).

Young adults tend to make their food choices based on the availability of food in and around their universities (Jiet & Soma, 2017). The increased numbers of fast food restaurants, vending machines,

and convenient stores have paved the way for young adults to have a higher intake of energy-dense foods but lower intake of nutrient-dense food (Ganasegeran et al., 2012; Hakim et al., 2012). Besides, there has been an increase in processed food consumption among young adults lately due to the emergence of ultra-processed food such as processed meat, fast food, and soft drinks that are associated with obesity (Mendonça et al., 2016). Particularly, OW/OB young adults have a higher consumption of ultra-processed food than normal-weight (NW) individuals (Mendonça et al., 2016). Researchers have also found that OW/OB young adults tend to eat out more frequently for stress and frustration relief even when they are not hungry as compared to NW young adults (Ko, 2007). This has led to higher energy, fat, saturated fat, cholesterol, and sodium intake among them than the NW individuals (Seguin et al., 2016).

Therefore, the promotion of healthy eating is crucial for young adults especially for the OW/OB group. However, to the best of our knowledge, there were no case-controlled studies conducted to assess the difference of dietary pattern between NW and OW/OB young adults in Malaysia, hence, a case-control study was conducted to determine the differences in dietary intake and quality between NW and OW/OB young adults in order to implement specific intervention targeted on their food intake in the future. The data also helps authorities to increase food availability in certain aspects in and around the universities.

METHODS

Subjects

Stratified random sampling was utilized in the selection of private universities for the study. A list of private universities in Klang Valley was firstly obtained from Ministry of Higher Education Malaysia [MOHE] (2016) to randomly select eight private universities (Asia Metropolitan University, UNITAR International University, University Kuala Lumpur, Tunku Abdul Rahman University, Taylor's University, Sunway University, Asia Pacific University of Technology and Innovation and the International University of Malaya Wale) by Research Randomizer version 4.0 (Urbaniak & Plous, 2016). After gaining the approval from Research Ethics Committee at UCSI University (Proj-FAS-EC-15) and Scientific and Ethical Review Committee from the eight private universities, a total of 294 young adults were sampled conveniently. Subsequently, the recruited respondents were stratified based on their weight status into NW and OW/OB group. This is a case-control study conducted on young adults who meet the inclusion criteria who are Malaysians in the range of 18–25 years old and able to communicate well. Respondents with chronic disease, physically and mentally disabled were excluded. The informed consent was obtained prior to the data collection.

Anthropometric Measurements

The anthropometric measurements carried out were weight, height, waist

circumference, body fat percentage, and visceral fat. Height was first measured to the nearest 0.1 cm using SECA 206 body meter. Respondents were then weighed in light clothing without shoes to the nearest 0.1 kg using Omron HBF-356 Body Fat Analyzer. The same instrument was used for body fat percentage and visceral fat measurement. Body mass index (BMI) was calculated for each respondent. World Health Organization [WHO] (2004) Asian cut-off point was used to classify respondents as NW (18–23 kg/m²) and OW/OB (≥ 23 kg/m²) because Asians have different body composition, fatness and associations between BMI and health risk from Europeans. Waist circumference was measured horizontally at the midway point between the costal margin and iliac crest in the mid-axillary line to the nearest 0.1 cm by measuring tape to determine abdominal obesity of respondents and the classification was based on WHO (2011) whereby male <90 cm and female <80cm.

Dietary Assessment

Three days 24-hr diet recall was used for dietary assessment. Respondents were asked to recall and describe all food and beverage consumed in the past 24 hr during interview over 3 days (2 weekdays and 1 weekend). Household measures were used to facilitate the respondents in the quantification of portion sizes eaten. A dietary analysis software called Nutritionist Pro containing Malaysian food composition database (Tee et al., 1997) and USDA food database was later used for energy and nutrient analysis. Under-reporting and over-reporting of

energy intake were also examined by calculating the basal metabolic rate (BMR) equation for Malaysian adults (Ismail et al., 1998) and classified using Goldberg criteria (Goldberg et al., 1991).

Healthy Eating Index (HEI)

HEI was measured after the 3 days 24-hr dietary recall was recorded. It is a 100-point analytical tool used to assess the quality of diet consumed by young adults recommended by Malaysian Dietary Guidelines (Ministry of Health [MOH], 2016). There are 10 components in total with each respondent receiving scores ranged from 0 (for lack of compliance) to 10 (for full compliance) for each component. The score was calculated proportionately for the in between responses (Karupaiah et al., 2013).

As shown in Table 2, group A (components 1-5) measures the degree of compliance with the Malaysia Food Pyramid serving portion for fruits, vegetables, cereals and grains products, milk and dairy products and meat, poultry, egg, fish and legumes as expressed in servings/day. Group B (components 6-9) were nutrient-based adapted from the Malaysia Dietary Guidelines for total fat, saturated fat, cholesterol and sodium. Finally, group C (component 10) measures the variety apart by counting the total number of different foods and food groups categorized by Ali (2014) consumed over 3 days. The composite score is calculated by summing up the score of each component score with <51 indicates “poor” diet, score > 80

indicates a “good” diet whereas with scores of 51-80 indicates “needs improvement” (Karupaiah et al., 2013).

Statistical Analysis

Statistical Package for Social Sciences (SPSS) version 20.0 was used for all calculations and analyses. The descriptive statistics were used to assess the demographic information including age, gender, race, marital status, family household income and personal monthly allowance. Chi-square test was used for demographic information and diet quality distribution with NW and OW/OB group. Furthermore, normally distributed data was analyzed by independent *t*-test while non-parametric data was analyzed by Mann–Whitney *U* test. Both tests were used to determine differences in dietary intake and quality between NW and OW/OB group significantly. All the tests were two-tailed with a significance of $p < 0.05$.

RESULTS

Table 1 displays sociodemographic characteristic and anthropometric measurement according to NW and OW/OB group. The final number of completed questionnaires for NW and OW/OB group was 150 and 144, respectively, with the exclusion of 33 incomplete questionnaires. The mean age of the respondents was 20.25 (SD: 1.81) years old. The outcome of this study indicated that 55.6% of males were significantly more OW/OB than females (44.4%). The three predominant races were that of Chinese (50.7% and 43.8% for NW

and OW/OB groups, respectively), followed by Malay (36.7% and 41%) and Indian (12% and 12.5%) with no significance difference found in the proportions between two groups. Majority of the respondents had low family monthly household income (46% and 37.5% or NW and OW/OB groups, respectively) and <RM500 monthly personal allowance (65.3% and 59%) with no significant difference found. OW/OB respondents were also found to be significantly heavier and taller with higher BMI, BMR, percent body fat and visceral fat. In terms of abdominal obesity (AO), 63.9% of OW/OB group was AO which was

significantly higher than NW group (6.7%).

Table 2 displays the findings of HEI component and composite scores according to NW and OW/OB group. The mean composite score of the HEI was found to be significantly lower among OW/OB group [45.14 (11.13)] than the NW group [51.43 (11.61)], indicating poorer diet quality in OW/OB respondents than NW respondents. OW/OB group had a significantly lower component score for the percentage of energy from fat and saturated fat, cholesterol and sodium but a significantly higher component score for cereals and meat, poultry, egg, fish and legumes as compared

Table 1

Socio-demographic characteristics and anthropometric measurement according to normal-weight and overweight/obese, n (%)

Variables	Normal-weight (N = 150)	Overweight/Obese (N = 144)	p-value ^a
Gender			0.002**
Female	94 (62.7)	64 (44.4)	
Male	56 (37.3)	80 (55.6)	
Ethnicity			0.386
Chinese	76 (50.7)	63 (43.8)	
Malay	55 (36.7)	59 (41.0)	
Indian	18 (12.0)	18 (12.5)	
Others	1 (0.7)	4 (2.8)	
Family Monthly Household Income			0.113
Low (<RM2500)	69 (46.0)	54 (37.5)	
Middle (RM2500-RM5999)	47 (31.3)	62 (43.1)	
High (>RM5999)	34 (22.7)	28 (19.4)	
Personal Monthly Allowance			0.695
<RM500	98 (65.3)	85 (59.0)	
RM500-RM1000	38 (25.3)	43 (29.9)	
RM1001-RM1500	9 (6.0)	9 (6.3)	
>RM1500	5 (3.3)	7 (4.9)	

Table 1 (Continue)

Variables	Normal-weight (N = 150)	Overweight/Obese (N = 144)	p-value ^a
Anthropometric Measurement			
Height (m) ^b	1.64 (0.82)	1.67 (0.76)	0.001*
Weight (kg) ^c	53.45 (9.40)	73.4 (19.25)	<0.001*
BMI (kg/m ²) ^c	19.82 (2.61)	26.78 (4.83)	<0.001*
Basal metabolic rate (kcal) ^e	1183(223.03)	1522(324.15)	<0.001*
Body fat percentage (%) ^b	23.07 (6.91)	29.64 (6.78)	<0.001*
Visceral fat ^c	2.50 (1.00)	8.00 (5.25)	<0.001*
Waist Circumference			
Normal	140 (93.3)	52 (36.1)	<0.001*
Abdominal obesity	10 (6.7)	92 (63.9)	

to NW group. Also, fruits, vegetables, milk and dairy products and variety component scores were rated poorly for both. In this study, more than half of them (58.8%) have a poor diet and only 41.2% and none of them have the needs for improvement and a good diet, respectively (Figure 1). A significantly higher proportion of NW respondents (53.3%) were classified as having the need for improvement diet than OW/OB respondents (28.5%) and a significantly higher proportion of OW/OB respondents (71.5%) were classified as having poor diet than the NW respondents (46.7%) found.

As energy intake was evaluated, 28.9% and 3.1% of the entire sample under-reported and over-reported their energy intakes respectively. The prevalence of under-reporters and over-reporters appears higher among OW/OB (33.3% and 3.5%, respectively) and NW group at 24.7% and 0.7%, respectively (Figure 2). There were 203 and 6 respondents reported their energy

intakes within the normal range and over. Of these, the proportion of NW and OW/OB respondents was at 74.7% and 63.2%, respectively.

Table 3 shows an analysis of 203 respondents' average daily selected nutrient intake and nutrient density with the exclusion of 91 under- and over-reporters. Results displayed that OW/OB group had significantly higher energy, sugar, saturated fat, cholesterol, sodium and macronutrient intake than NW group. Particularly, sugar intake was found to be closely twice significantly higher among OW/OB group than the NW group. As regard to nutrient density, a significantly higher energy contribution from protein, fat and sugar among OW/OB group than the NW group was found. However, the significant difference in energy contribution from carbohydrate and ultra-processed food could not be established.

Poor Diet Quality among Malaysian Young Adults

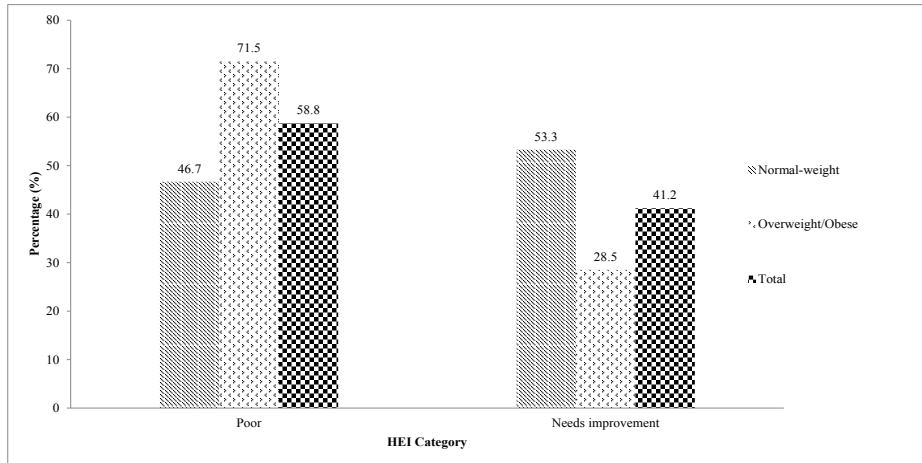


Figure 1. Distribution of HEI categories according to normal-weight and overweight/obese group

Table 2

Composite score and component scores for HEI between the normal-weight and overweight/obese group (n = 294)

HEI component ^a	Scoring range	Criteria for minimum score of 0	Criteria for maximum score of 10	Normal-weight	Overweight/Obese	p-value ^b
				Mean (SD)	Mean (SD)	
HEI composite score	0–100			51.43 (11.61)	45.14 (11.13)	<0.001*
Group A: Nutritional adequacy						
Cereals and grains	1–10	0	8–12 servings	6.55 (1.87)	7.41 (2.08)	<0.001*
Fruits	1–10	0	2 servings	1.47 (3.08)	1.00 (2.38)	0.143
Vegetables	1–10	0	3 servings	3.12 (2.29)	3.22 (2.60)	0.757
Meat, poultry, egg, fish and legumes	1–10	0	2–3 servings	8.69 (2.13)	9.32 (1.67)	0.005*
Milk and milk products	1–10	0	1-2 servings	2.41 (3.51)	2.10 (3.16)	0.439
Group B: Moderate intake						
% of energy from total fat	1–10	≥35%	≤30%	4.41 (4.47)	2.42 (3.89)	<0.001*
% of energy from saturated fat	1–10	≥ 15%	≤ 10%	9.21 (2.21)	8.51 (2.97)	0.023**
Cholesterol	1–10	≥450 mg daily	≤300 mg daily	9.05 (2.53)	7.05 (4.10)	<0.001*
Sodium	1–10	≥2300 mg daily	≤2000mg daily	5.00 (4.70)	2.67 (4.25)	<0.001*

Table 2 (Continue)

HEI component ^a	Scoring range	Criteria for minimum score of 0	Criteria for maximum score of 10	Normal-weight	Overweight/Obese	<i>p</i> -value ^b
				Mean (SD)	Mean (SD)	
Group C: Optimized choice						
Variety	1–10	≤6 different foods over three days	≥ 16 different foods over three days	1.51 (1.29)	1.44 (1.38)	0.657

Adapted from Karupaiah et al. (2013)

^aBased on Malaysian Dietary Guidelines and Food Pyramid (2010)

^bIndependent Sample *t*-test analysis

*significantly different, *p* < 0.01

**significantly different, *p* < 0.05

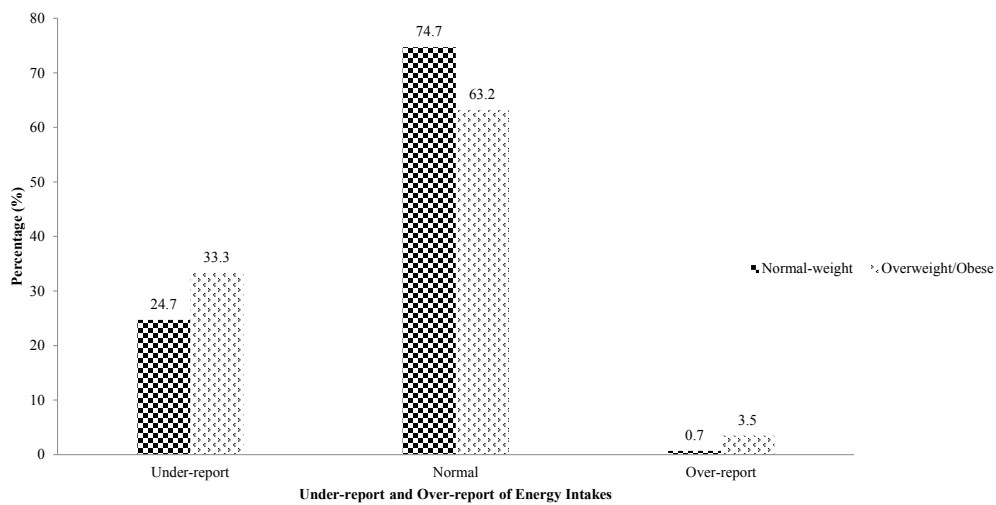


Figure 2. Proportion of normal-weight and overweight/obese group in normal, under-reporters and over-reporters

DISCUSSION

Previous study has found that the diet quality of young Malaysian adults is either in need of improvement or poor (Fokeena et al., 2016). In our study, 58.8% and 42.2% of young adults had poor and in need of improvement diet, respectively. Besides, OW/OB group in this study had

poorer diet than NW group and this was concurrent with Yosae et al. (2016) study which discovered OW respondents had significantly lower total HEI score and 57.14% of them had a poor diet which was significantly higher than NW respondents (2%). This phenomenon could be due to OW/OB respondents in this study who achieved significantly lower component

Table 3

Comparison of dietary and water intake and nutrient density between normal-weight and overweight/obese group

	Normal-weight (N = 112)		Overweight/Obese (N = 91)		p-value ^a
	Median	IQR	Median	IQR	
Dietary intake					
Energy (kcal)	1485	279.4	1967	348.0	<0.001*
Protein (g)	68.8	24.2	93.2	40.6	<0.001*
Carbohydrate (g)	188.1	59.6	237.6	97.4	<0.001*
Sugar (g)	28.4	38.9	50.0	64.0	<0.001*
Fat (g)	59.8	18.5	79.6	21.9	<0.001*
Saturated fat (g)	12.5	6.0	17.9	8.4	<0.001*
Cholesterol (mg)	177.0	136.0	228.8	171.0	<0.001*
Sodium (mg)	2193.1	1175.6	3023.4	1473.7	<0.001*
Nutrient density					
% of energy from carbohydrate	47.87	10.70	47.63	16.95	0.770
% of energy from protein	17.90	5.12	21.03	8.89	0.002*
% of energy from total fat	33.85	9.44	36.86	11.08	0.001*
% of energy from sugar	7.68	8.90	9.20	11.10	0.047**
% of energy from ultra-processed food	11.83	11.60	12.49	15.10	0.304

scores for % of energy from fat and saturated fat, cholesterol and sodium than NW respondents indicating their diets were higher in fat, saturated fat, cholesterol and sodium than NW respondents. Particularly, OW/OB group achieved relatively poorer component scores for % of energy from fat and sodium than NW group. This has high possibility due to the high consumption of fast food and higher intake frequency of French fries, fried nuggets, hot dogs, pizza and potato chips that are laden with fat and sodium than NW ones (Choong et al., 2012).

Furthermore, both groups in this study showed a poor score of food variety obtaining only less than 2 points and this was

lower than Ali's (2014) study which reported Malaysians achieved 2.1 scores. This could be due to the low consumption of fruits, vegetables and milk and dairy products for both as shown in this study. According to the component scores achieved, NW group only met 14.7% of the recommendation for fruits suggested by MOH (2016), 31.2% met for vegetables and 24.1% met for milk and dairy products; while OW/OB group only met 10% for fruits, 32% met for vegetables and 21% met for milk and dairy products.

A high consumption of nutrient-dense foods such as fruits, vegetables and milk usually indicates a healthy dietary pattern which thus has been observed to be

associated with NW group (Fokeena et al., 2015). However in this study, there was no significant difference found between NW and OW/OB groups in the consumption of fruits, vegetables and milk with both groups showing similar and low consumption. But Fokeena et al. (2015) and Al-Otaibi (2014) studies also showed a similar trend whereby there was no significant difference found between different BMI groups in the consumption of fruits, vegetables and milk among young adults. Peltzer and Pengpid (2015) study reported that 82.8 % of young adults in 26 countries across Asia, Africa and the Americas consumed less than the recommended five servings of fruits and vegetables. Besides, in Norimah et al. (2008) study, Malaysian young adults also found to have not met the recommendation of milk and dairy products.

Barriers such as low availability of fruits and vegetables sold in universities and nearby restaurants, deficient knowledge about health benefits and recommended intake of fruits and vegetables and lack of time to prepare have led young adults to consume insufficient fruits and vegetables (Al-Otaibi, 2014; Hakim et al., 2012). Also, the consumption of soft drink has slowly increased and displaced milk and dairy products intake since last few decades (Ha et al., 2009). Therefore, the association between nutrient dense foods intake and body weight status shown in this study may also be the consequence of other interplaying factors which have not been considered. Peltzer et al. (2014) identified factors such as smoking, physical inactivity

and frequent alcohol consumption that were also associated with overweight and obesity among young adults.

On the other hand, when the energy intake was evaluated, the proportion of under-reporters and over-reporters in this study could be considered as lower when compared to other Malaysian studies such as Ali (2014) (46% and 7% for under-reporters and over-reporters, respectively) and Lee et al. (2010) studies (59.1% and 0%). Also, the finding of the prevalence of under-reporters appears to increase with overweight and obesity was comparable with the findings of Lee et al. (2010) study which similarly reported an energy under-reporting incidence of higher percentage among OW/OB group (68.3%) than NW group (49.2%).

In dietary intake analysis, energy and macronutrient intake were significantly higher among OW/OB respondents as compared to NW respondents and this was similar to a study by Ko (2007). The finding of significantly higher sugar intake among OW/OB respondents in this study is in line with the increased in sugars intake is associated with weight increase through the excess caloric load and this might be due to the higher consumption of sugar-sweetened soft drinks among them (Boo et al., 2010; Te Morenga et al., 2013). In contrast, the significant higher intake of energy, protein, fat, saturated fat, cholesterol and sodium among OW/OB group than NW group in this study had high possibility due to the higher consumption of meat, poultry, fish, eggs and legumes among them as shown

in this study. The findings also highlighted the sodium intake was particularly high among young adults in this study with both groups far exceeding the recommendation of Recommended Nutrient Intake (RNI) for Malaysians (National Coordinating Committee on Food and Nutrition [NCCFN], 2017) which suggested that the intake of sodium should be <1,500 mg and this was consistent with (Gan et al., 2011) study. This might be due to the frequent consumption of high salt contents food including fried rice, fried noodles, noodles with soy sauce, noodle soup and dried anchovies, prawns and cuttlefish among Malaysian young adults (Jiet & Soma, 2017).

As the energy contribution from macronutrients and sugar was compared to the recommendation of nutrient intake goals suggested by NCCFN (2017) whereby the intake of carbohydrate should be within 50-65% of energy, protein should remain at 10–20%, fat is 25–30% and sugar is <10%, both groups have exceeded the recommendation of fat intake and OW/OB group had exceeded the recommendation for protein intake with a significantly higher value among OW/OB group. This is comparable with Lee et al. (2010) study which revealed NW, OW and OB groups also had exceeded the recommendation for fat intake but they did not exceed the recommendation for protein intake with higher value among OW/OB respondents. High dietary acid load from protein will cause cellular dysfunction and ultimately lead to weight gain while fat provides higher energy density and is more efficiently

stored as body fat than other macronutrients; hence, excessive protein and fat intake from diet will contribute to weight gain (Berkemeyer, 2009; Swinburn et al., 2004). Also, higher consumption of ultra-processed food was proven to associate with higher risk of obesity among university students (Ko, 2007), but the significant difference could not be established between two groups with OW/OB having a higher value in this study and this was similar to Ali's (2014) study which also revealed OW/OB group had higher energy contribution from ultra-processed food than NW group without any associations found.

In conclusion, since none of the respondents could achieve a good diet and majority of them have a poor diet in this study, the diet quality of Malaysian young adults in this study could be considered as "poor diet" and this might be due to frequent eating out leading to low compliance with the recommended serving intake in several HEI components. This can be supported by Gan et al.'s (2011) study which reported 60% male and 54.5% female young adults in Malaysia eating away from home at least four to six times per week (Gan et al., 2011). Besides, though fruits and vegetables have same satiating effect as carbohydrate and protein based foods when eaten in the same amount, young adults prefer to purchase cheaper foods which are carbohydrate and protein based foods such as cereals, grains, meat and poultry to satisfy their food needs. Fruits and vegetables are still assumed as expensive and unaffordable for them (Badari et al., 2013; Chambers et

al., 2015) since majority of respondents in this study were found to have low monthly family household income and personal allowance. When comparing the studies conducted among young adults in selected private universities in Klang Valley with other studies conducted among Malaysians, US adults and Australian young adults, diet quality also seem to be poorer in current studied population (Karupaiah et al., 2013; Nour et al., 2015; Yosae et al., 2016).

There are several limitations to the study, despite that; evaluating dietary pattern through HEI was able to reflect diet quality among NW and OW/OB groups. This data serves as a baseline to address inadequacy in food groups among young adults. 24-hour diet recall used in this study relied heavily on memory, truthfulness and honesty. Hence, the results may not reveal the actual dietary intake and pattern of the respondents. Besides, the Malaysia food composition database may influence the accuracy of the estimation of nutrient intake due to unavailability of certain foods.

CONCLUSIONS

The present study showed that overweight/obese group had significantly higher energy, sugar, saturated fat, sodium and macronutrient intake the NW group. OW/OB respondents also had a significantly higher energy contribution from protein, fat and sugar than NW respondents. Despite that OW/OB group had poorer diet with significantly higher percentage of energy from fat and saturated fat, cholesterol and sodium than NW group, both groups

showed low variety in their diet and had low fruits, vegetables, milk and dairy products consumption. Furthermore, since young adults who experience the transition into university life undergo rapid changes in psychosocial development in addition to lacking knowledge in making healthy food choices, they tend to adopt unhealthy dietary habits (Ganasegeran et al., 2012). Therefore, educational campaigns regarding healthier food choices and weight management should be tailored to increase a positive impact on the health of young adults. Also, by knowing their diet quality, nutrition education regarding knowledge of food components and groups could be given to help young adults in making more informed decisions. In conclusion, it is considered that desirable dietary choices are needed for the improvement of health in both groups and also this study can be used as reference to tailor specific intervention for both groups.

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Abbreviations: AO: abdominal obesity; %BF: body fat percentage; BMI: body mass index; BMR: basal metabolic rate; HEI: Healthy Eating Index; NW: normal-weight; OW/OB: overweight/obese; MANS: Malaysian Adult Nutrition Survey; MOH: Ministry of Health; MOHE: Ministry of Higher Education; NCCFN: National Coordinating Committee on Food and

Nutrition; NHMS: National Health & Morbidity Survey; RNI: Recommended Nutrient Intake; WHO: World Health Organization

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