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Comparing the nutritional status of vegetarians and non-vegetarians from a Buddhist Organisation in Kuala Lumpur, Malaysia

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ABSTRACT

Introduction: A vegetarian diet is generally considered as healthy for preventing metabolic-related diseases. There is lack of studies in Malaysia comparing the nutritional status of vegetarians and non-vegetarians. This cross-sectional study aims to compare body weight status, dietary intake and blood pressure level between these two groups. **Methods:** A total of 131 vegetarians and 135 non-vegetarians were recruited using convenience sampling from a Buddhist organisation in Kuala Lumpur. Body weight, height, waist circumference, percentage of body fat, and blood pressure measurements were taken, while dietary intake was assessed using a 2-day 24-hour dietary recall. **Results:** More vegetarians were underweight than non-vegetarians (31.3% vs 15.6%), while prevalence of overweight and obesity was higher among the non-vegetarians (23.7% vs 9.9%). A higher proportion of non-vegetarians (34.1%) had an unhealthy range of body fat percentage and significantly higher risk of abdominal obesity (24.4%) than the vegetarians (19.1% body fat; 13.7% abdominal obesity). Mean intakes for protein and fat were significantly lower among the vegetarians, while no significant differences were observed in the mean intake for energy and carbohydrate. Vegetarians had significantly higher intakes of vitamins C, D and E, calcium, potassium and folate, while vitamin B_{12} intake was significantly higher in the non-vegetarians. More non-vegetarians presented with unhealthy blood pressure status. **Conclusion:** Vegetarians in this study generally showed healthier dietary intake and lower body fatness than the non-vegetarians. Studies are suggested to be undertaken on a bigger sample size of vegetarians to confirm these findings.

Keywords: Body weight status, dietary intake, obesity, blood pressure, vegetarian

INTRODUCTION

A vegetarian is an individual who does not consume any animal-based foods. A vegetarian diet can be classified into several groups, namely vegan, lacto-ovo vegetarian, lacto-vegetarian, and ovo-vegetarian (Agnoli *et al.*, 2017; Melina, Craig & Levin, 2016). A vegan does not consume any form of animal-derived foods, which include red meat, poultry, fish, seafood, eggs and dairy products in their diet, and may exclude honey. In

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addition to consuming vegetables, lacto-ovo vegetarians allow the consumption of milk, other dairy products and eggs. On the other hand, the lacto-vegetarian community only consumes dairy products and plant-based foods, whereas, ovo-vegetarian only consumes eggs and plant-based foods.

In Asia, vegetarianism has been practised mostly by Buddhists and Hindus for centuries. To date, the increased number of publication for both scientific and non-scientific articles on vegetarian nutrition and a growing number of vegetarians in the world population portray that vegetarian diet has significantly increased in popularity (Melina *et al.*, 2016). The prevalence of vegetarian was 0.8% in Shanghai, China (Mao *et al.*, 2015), 1.6% in Belgium (Mullee *et al.*, 2017), 2.4% in the United States (Jaacks *et al.*, 2016), 34.0% in Taiwan (Chiu *et al.*, 2014) and 33.0% in South Asia (Jaacks *et al.*, 2016). However, there is no published national data showing the percentage of vegetarians among Malaysians. In Malaysia, there is an increased trend of vegetarianism and a rising demand for vegetarian food products among practising Chinese and Indian vegetarian communities. This is evident in the expansion of vegetarian food market and vegetarian meals (Wong *et al.*, 2011). There is also an increased production of mock-meat products to cater to this demand (Joshi & Kumar, 2015).

In recent decades, several studies have reported the benefits of vegetarian diet towards one's health (Chiu *et al.*, 2014; Jaacks *et al.*, 2016; Melina *et al.*, 2016). A well-planned vegetarian diet is appropriate for all stages of life because it provides numerous health benefits (Melina *et al.*, 2016). Vegetarians avoid the intake of meat, include high amounts of plant-based foods and in most instances, adopt other healthy lifestyles (Mihrshahi *et al.*, 2017). Vegetarians reportedly have lower risks of chronic diseases such as coronary heart disease, hypertension, diabetes, obesity and cancer, as well as having a longer lifespan than the non-vegetarians (Jaacks *et al.*, 2016; Melina *et al.*, 2016; Mihrshahi *et al.*, 2017). Furthermore, a well-planned vegetarian diet also meets the current recommended dietary allowance (RDA), where it provides essential nutrients and has lower levels of cholesterol and saturated fat (Melina *et al.*, 2016).

Despite the health and nutritional benefits, it remains a concern that a particular nutrient inadequacy is prevalent among vegetarians. The lack of some nutrients seems to be more of a concern in vegetarian diets and these nutrients include protein, n-3 fatty acids, calcium, iron, zinc, vitamin D and vitamin B_{12} (Melina *et al.*, 2016). Awareness of possible differences in nutrient profiles between vegetarian and non-vegetarian dietary patterns is vital as nutritional differences can contribute to the development of diseases. Therefore, a cross-sectional study was carried out to determine the differences in nutritional status (body weight status, dietary intake and blood pressure level) between Chinese vegetarians and non-vegetarians in Kuala Lumpur, Malaysia.

MATERIALS AND METHODS

Study design

This was a cross-sectional study conducted at a Buddhist organisation in Kuala Lumpur. The target population of this study was a group of healthy Chinese adults taking vegetarian or non-vegetarian diet. Ethical approval from the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia (JKEUPM) was obtained. A permission letter was obtained from the Buddhist organisation prior to

conducting the study. A written consent letter was also obtained from every participant of this study.

Participants

A convenience sampling technique was used to recruit the study participants. Members of the Buddhist organisation consist of vegetarians and non-vegetarians. All members were invited to participate in this study. Those pregnant or lactating women and those with physical disability or chronic diseases were excluded from this study. The estimated sample size of this study was 127 per group using the formula for hypothesis testing for two-group comparison, taking into account 95% confidence level and 80% power.

Anthropometry and blood pressure assessments

Body weight and height of the participants were measured by using a TANITA Digital Weighing Scale HD 306 (TANITA Corporation, USA) to the nearest 0.1 kg and a SECA Body Meter 206 (SECA, Germany) to the nearest 0.1 cm, respectively. Each measurement was repeated twice to get an average value. Based on the measurements obtained, the body mass index (BMI) was calculated, and its classification was based on the World Health Organization's criteria (WHO, 2000). Waist circumference (WC) of the participants was measured to determine abdominal obesity by using a non-stretchable SECA measuring tape (SECA, Germany) to the nearest 0.1 cm. The recommended sex-specific cut-off points of WC was based on the WHO/IASO/IOTF (2000) criteria for Asians, in which ≥90 cm for men and ≥80 cm for women to be considered as an increased risk of abdominal obesity. The percentage of body fat of the participants was measured using an Omron Body Fat Analyser HBF-306 (Omron, Japan) to the nearest 0.1%. The cut-off values for the percentage of body fat as recommended by Lee and Nieman (2013) were used in this study. In addition, blood pressure of the participants was measured using an Omron automatic blood pressure monitor HEM-7121 (Omron, Japan) and its classification was based on the Clinical Practice Guidelines on the management of hypertension (MSH/MOH/AMM, 2013).

Dietary assessment

Dietary intake of the participants was measured using a 2-day 24-hour dietary recall, which comprised one weekday and one day on a weekend. Participants were asked to recall foods and drinks that were consumed during the previous day. Detailed descriptions of the foods and beverages, including cooking methods and brands of processed food were recorded. The portion size of the participants' food intake was estimated based on the standard household measurement tools. Energy, macronutrient and micronutrient intakes were analysed using the Nutritionist Pro software. For Malaysian adult population, it is recommended to have 50%–65% of the total daily energy intake derived from carbohydrates, 25%–30% from fat, and 10%–20% from protein (NCCFN, 2017). The mean values for energy and nutrient intakes for each participant were compared with the Recommended Nutrient Intakes (RNI) 2017 to determine nutrient intake adequacy. Adequacy was considered achieved if the individual's mean nutrient intake met or exceeded 100% of the RNI.

Statistical analyses

The statistical analyses were performed using IBM SPSS Statistics version 22. Continuous variables were presented as means and standard deviations, whereas categorical variables were presented as frequencies and percentages.

Independent-samples *t*-test was employed to determine the differences in the means of dietary intake, body weight status and blood pressure between vegetarian and non-vegetarian groups. Chi-square test of independence was used to determine the differences in categorical variables between vegetarian and non-vegetarian groups. The level of statistical significance was set at $p<0.05$.

RESULTS

Socio-demographic characteristics of the participants are shown in Table 1. A total of 266 participants were enrolled in this study. They consisted of 131 vegetarians (49.1%) and 135 non-vegetarians (50.8%). Out of 131 vegetarians, 36.6% were lacto-ovo-vegetarians, 27.5% were semi-vegetarians, 26.7% were vegans, 6.9% were ovo-vegetarians and 2.3% were lacto-vegetarians. The main reason for practicing a vegetarian diet was due to religion (71.0%). The other reasons revolved around animal welfare (67.2%), environmental benefits (58.8%), health (45.0%) and world hunger (15.3%). Most of the vegetarians (43.5%) and non-vegetarians (46.7%) were in the age group of 19-29 years, with a mean age of 33.8±10.4 years and 34.6±12.3 years, respectively. Vegetarians had a higher educational level compared to non-vegetarians ($\chi^2=13.34$, $p=0.001$), in which more vegetarians (68.7%) attained tertiary education compared to non-vegetarians (47.4%).

Vegetarians showed significantly lower mean values for BMI, percentage of body fat and systolic blood pressure

Table 1. Socio-demographic characteristics of the participants ($n=266$)

Socio-demographic characteristics	*Vegetarian (n=131)*	*Non-vegetarian (n=135)*	χ^2	*p*
Age (years old)			6.06	0.109
19-29	57 (43.5)	63 (46.7)		
30-39	36 (27.5)	27 (20.0)		
40-49	26 (19.8)	21 (15.6)		
≥ 50	12 (9.2)	24 (17.8)		
Mean±standard deviation	33.8±10.4	34.6±12.3		
Sex			2.89	0.089
Male	61 (46.6)	48 (35.6)		
Female	70 (53.4)	87 (64.4)		
Educational Level			13.37	0.001*
Primary education	4 (3.1)	12 (8.9)		
Secondary education	37 (28.2)	59 (43.7)		
Tertiary education	90 (68.7)	63 (47.4)		
Marital Status			2.35	0.125
Single/widow/divorced	83 (63.4)	72 (53.3)		
Married	48 (36.6)	63 (46.7)		
Employment Status			14.83	0.002*
Public	10 (7.6)	28 (20.7)		
Private	72 (55.0)	72 (53.3)		
Retired/unemployed/not working	37 (28.2)	19 (14.1)		
Self-employed	12 (9.2)	16 (11.9)		
Monthly Personal Income (RM)			7.23	0.065
≤1,000	3 (2.3)	7 (5.2)		
1,001-3,000	39 (29.8)	49 (36.3)		
3,001-5,000	45 (34.4)	28 (20.7)		
>5,000	7 (5.3)	10 (7.4)		

*significant at $p<0.05$

Table 2. Comparison of BMI, waist circumference, body fat percentage and blood pressure between vegetarian and non-vegetarian groups

Characteristics	*Vegetarian (n=131)*	*Non-vegetarian (n=135)*	*t*	*p*
Height (m)	1.67±0.08	1.63±0.08	4.76	<0.001*
Weight (kg)	58.52±10.95	59.91±12.03	-0.98	0.327
BMI (kg/m^2)[a]	20.80±3.16	22.62±4.17	-0.40	<0.001*
Underweight	41 (31.3)	21 (15.6)		
Normal	77 (58.8)	82 (60.7)		
Overweight/Obesity	13 (9.9)	32 (23.7)		
Waist circumference (cm)[b]	76.40±10.87	78.00±11.5	-1.17	0.245
Normal	113 (86.3)	102 (75.6)		
Abdominal obesity	18 (13.7)	33 (24.4)		
Body fat percentage (%)[c]	24.51±5.06	27.32±7.59	-3.56	<0.001*
Acceptable range (Lower end)	28 (21.4)	21 (15.6)		
Acceptable range (Upper end)	78 (59.5)	68 (50.4)		
Unhealthy (Too high)	25 (19.1)	46 (34.0)		
Systolic blood pressure (mmHg)[d]	113.95±8.28	118.69±12.34	-3.69	<0.001*
Normal	127 (96.9)	105 (77.8)		
Elevated	4 (3.1)	30 (22.2)		
Diastolic blood pressure (mmHg)[d]	73.67±6.47	72.59±8.96	1.14	0.257
Normal	128 (97.7)	122 (90.4)		
Elevated	3 (2.3)	13 (9.6)		
Hypertension classification[e]				
Optimal	90 (68.7)	71 (52.6)		
Normal	35 (26.7)	30 (22.2)		
High normal	5 (3.8)	26 (19.3)		
Stage 1 hypertension	1 (0.8)	8 (5.9)		

[a]BMI classification: Underweight <18.5 kg/m^2, Normal 18.5-24.9 kg/m^2, Overweight 25-29.9 kg/m^2, Obesity ≥30 kg/m^2 (WHO, 2000)

[b]WC classification: ≥90 cm for men and ≥80 cm for women as abdominal obesity (WHO/IASO/IOTF, 2000)

[c]Body fat percentage classification: lower end (male 6–15%, female 9–23%), upper end (male 16–24%, female 24–31%), too high (male ≥25%, female ≥32%) (Lee & Nieman, 2013)

[d]Elevated blood pressure: Systolic ≥130 mmHg, Diastolic ≥85 mmHg

[e]Hypertension classification: optimal (systolic <120 mmHg, diastolic <80 mmHg), normal (systolic 120-129 mmHg, diastolic 80-84 mmHg), high normal (systolic 130-139 mmHg, diastolic 85-89 mmHg), Stage 1 hypertension (systolic 140-159 mmHg, diastolic 90-99 mmHg) (MSH/MOH/AMM, 2013)

*significant at $p<0.05$

Table 3. Energy and macronutrient intakes of vegetarians and non-vegetarians

Nutrients	*Mean*±SD		*t*	*p*	*n (%)*		χ^2	*p*
	Vegetarian (n=131)	*Non-vegetarian (n=135)*			*Vegetarian (n=131)*	*Non-vegetarian (n=135)*		
Total energy intake (kcal)	1905±466	2005±360	-1.96	0.051				
Carbohydrate (g)	293±87.2	280±5.4	1.32	0.189				
Percentage of energy from carbohydrate (%)	61.02±7.97	55.89±7.64	5.36	<0.001*			33.62	<0.001*
<50%					11 (8.4)	33 (24.4)		
50 – 65%					78 (59.5)	93 (68.9)		
>65%					42 (32.1)	9 (6.7)		
Protein (g)	57.9±15.6	75.8±20.3	-8.07	<0.001*				
Percentage of energy from protein (%)	12.25±2.21	15.13±2.88	-9.18	<0.001*				<0.001*
<10%					15 (11.5)	0		
10 – 20%					116 (88.5)	126 (93.3)		
>20%					0	9 (6.7)		
Total fat (g)	53.5±19.0	64.4±20.6	-4.47	<0.001*				
Percentage of energy from total fat (%)	25.44±6.72	28.87±7.55	-3.91	<0.001*			9.25	0.010*
<25%					68 (51.9)	46 (34.1)		
25 – 30%					31 (23.7)	38 (28.1)		
>30%					32 (24.4)	51 (37.8)		

*significant at $p<0.05$

Table 4. Micronutrient intakes of vegetarians and non-vegetarians

Nutrients	*Mean±SD*		*t*	*p*
	Vegetarian (n=131)	*Non-vegetarian (n=135)*		
Vitamin A (μg)	797±363	760±468	0.72	0.471
Vitamin B_1 (mg)	1.0±0.3	1.0±0.4	1.73	0.084
Vitamin B_2 (mg)	1.4±0.5	1.5±0.8	-0.62	0.535
Vitamin B_3 (mg)	9±3	10±5	-1.95	0.052
Vitamin B_{12} (μg)	2.5±1.1	4.4±3.2	-6.47	<0.001*
Vitamin C (mg)	148±79	54±25	13.02	<0.001*
Vitamin D (μg)	0.6±0.5	0.5±0.4	2.07	0.040*
Vitamin E (mg)	6.8±3.7	3.8±2.6	7.59	<0.001*
Calcium (mg)	548±216	494±222	2.02	0.045*
Phosphorus (mg)	774±228	805±277	-1.02	0.309
Potassium (g)	1.5±0.5	1.3±0.5	3.24	0.001*
Iron (mg)	16±6	15±7	1.26	0.209
Folate (μg)	194±87	114±70	8.26	<0.001*
Sodium (mg)	4157±1346	3872±1294	1.76	0.080
Zinc (mg)	13.4±6.0	13.9±9.8	-0.55	0.582

*significant at $p<0.05$

level than non-vegetarians (Table 2). More non-vegetarians (23.7%) were overweight and obese than vegetarians (9.9%), whereas a higher percentage of vegetarians (31.3%) were underweight. In relation to abdominal obesity, nearly twice as many non-vegetarians (24.4%) tend to have abdominal obesity compared to vegetarians (13.7%). More non-vegetarians (34.0%) had a high body fat percentage (male ≥25%; female ≥32%) than vegetarians (19.1%). In term of blood pressure level, more non-vegetarians had elevated systolic and diastolic blood pressure.

No significant difference was observed in the mean energy intake between vegetarians (1905±466 kcal) and non-vegetarians (2005±360 kcal; t=-1.96, p=0.051) (Table 3). Non-vegetarians were more likely to have a higher percentage of energy intakes from protein and fat while vegetarians tended to have a higher proportion of energy intake from carbohydrate. In terms of micronutrient intake, vegetarians showed significantly higher intakes for vitamins C, D and E, calcium, potassium and folate, while vitamin B_{12} intake was significantly higher in non-vegetarians. The results revealed no significant differences in intakes of vitamins A, B_1, B_2, B_3, phosphorus, iron, zinc and sodium intakes between the two groups (Table 4). The prevalence of inadequacy in each micronutrient among vegetarians and non-vegetarians is summarised in Figure 1. More vegetarians met the RNI levels for most of the nutrient intakes compared to that of non-vegetarians.

DISCUSSION

The main findings of this study indicate that vegetarians had a better nutrient intake and blood pressure level and were

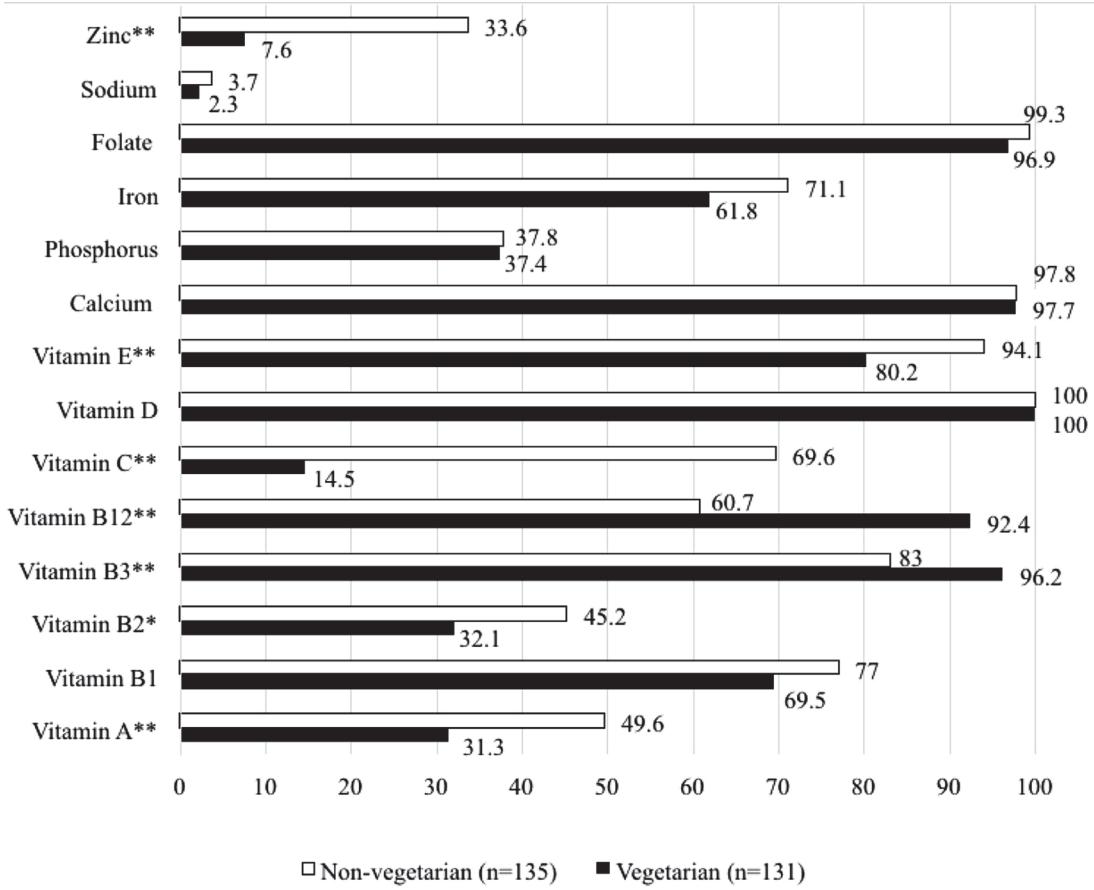

Figure 1. Prevalence of micronutrient inadequacy in vegetarians and non-vegetarians

**Chi-square test with p<0.05*
***Chi-square test with p<0.01*

more likely to be underweight and had a lower risk of both unhealthy body fat percentage and abdominal obesity than non-vegetarians. The result reaffirms findings of other studies (Jaacks *et al.*, 2016; Mihrshahi *et al.*, 2017; Rizzo *et al.*, 2013; Sabaté & Wien, 2010). The wider the spectrum of animal-based products consumed, the higher the BMI value of an individual (Rizzo *et al.*, 2013). A meta-analysis that was conducted over 60 studies showed a significantly lower weight and BMI in vegetarians than non-vegetarians (Sabaté & Wien, 2010). A cross-sectional study of 71,751 healthy adults from the Adventist Health Study 2 showed that mean BMI was significantly lower among vegetarians than non-vegetarians (Rizzo *et al.*, 2013). Rizzo *et al.* (2013) explained that high protein intake from meat based was strongly associated with increasing BMI among non-vegetarians, whereby similar findings were observed in the present study revealed that non-vegetarians had higher protein intake than vegetarians. However, Wong *et al.* (2013) reported that the mean BMI among non-vegetarians (22.0±4.66 kg/m^2), lacto-ovo vegetarians (22.5±4.96 kg/m^2) and strict vegetarians

(20.5±3.10 kg/m^2) in Selangor, Malaysia was not significantly different. The authors postulated individual's lifestyle, daily habit and varied dietary patterns in different countries could result in lack of difference observed in the mean BMI of vegetarians and non-vegetarians.

Non-vegetarians in the current study showed a slightly higher mean WC (78.0±1.52 cm) than vegetarians (76.4±10.9 cm). Similarly, Huang *et al.* (2014) reported that WC of non-vegetarians (72.8±9.5 cm) was slightly higher than vegans (72.2±11.0 cm) and lacto-ovo vegetarians (72.7±8.7 cm). Chiu *et al.* (2014) in Taiwan also found that WC of non-vegetarians was significantly higher than vegetarians. Sedentary lifestyle and overconsumption of fatty and processed foods may increase abdominal fat accumulation among non-vegetarians (Nande, 2014).

A significantly higher body fat percentage was evident among non-vegetarians when compared with vegetarians in the present study. The latter had a significantly lower total fat intake and this may result in having lesser fat accumulation in the body. However, another study in Malaysia reported that body fat percentages were higher, albeit not significantly, among lacto-ovo vegetarians (25.2±10.3%) than among non-vegetarians (21.2±7.5%) (Wong *et al.*, 2013).

Vegetarians especially vegans have a significantly lower prevalence of hypertension compared with non-vegetarians (Garbett, Garbett & Wendorf, 2016; Melina *et al.*, 2016). A meta-analysis comparing blood pressure from more than 21,000 people around the world found that vegetarians had significantly lower mean value of systolic and diastolic blood pressure than non-vegetarians (Yokoyama *et al.*, 2014). Low blood pressure in vegetarians may be attributed to high consumption of vegetables and less salt and total fat together with high intake of antioxidants such as vitamin C and folate (Shridhar *et al.*, 2014), which were also shown in this study.

No significant difference was observed in the mean energy intake between vegetarians and non-vegetarians. Clarys *et al.* (2013) which highlighted a similar finding in that the mean total energy intake was comparable among matched-paired vegetarians (2070±570 kcal) and non-vegetarians (2120±585 kcal) for age, sex, health and lifestyle characteristics. Deriemaeker *et al.* (2010) also showed no significant difference in total energy intake between vegetarians (2110±460 kcal) and non-vegetarians (2215±678 kcal). Conversely, a study conducted by Clarys *et al.* (2014) that involved a large sample size (n=1,475) revealed that non-vegetarians had a significantly higher total energy intake (2985±1029 kcal) than vegetarians (2722±875 kcal).

The mean carbohydrate intake among the vegetarians was almost similar to that of non-vegetarians in this study and finding was consistent with previous study (Clarys *et al.*, 2014). Vegetarians showed a significantly higher percentage of energy derived from carbohydrate than non-vegetarians in the present study. The finding can be attributed to higher consumption of starchy vegetables such as potatoes, corn and peas among vegetarians compared to non-vegetarians. Non-vegetarians consumed a significantly higher mean protein intake than vegetarians, which is consistent with findings of previous study (Clarys *et al.*, 2013). Furthermore, non-vegetarians had a higher total fat intake in their diet compared to vegetarians in this study. Individuals who are more educated and well-informed would tend to be more conscious about health-related issues when choosing various types of food to consume (Cramer *et al.*, 2017). The vegetarian participants in this study were

found to be more educated compared to non-vegetarians. This could explain the low-fat intake among vegetarians in the present study.

Non-vegetarians in the present study had a significantly higher mean intake of vitamin B_{12} than vegetarians, in which the finding is consistent with another local study (Wong *et al.*, 2013). A long-term lacto-ovo-vegetarian diet may cause vitamin B_{12} status to be low among vegetarians, especially pregnant women, where the risk of experiencing neural tube defect in the newborn is substantially increased (Koebnick *et al.*, 2005). Vegetarians who had an increased risk of experiencing vitamin B_{12} deficiency could attribute to this circumstance to the lack of consumption of animal-based food products. The mean vitamin B_{12} intake among non-vegetarians was approximately 3 to 4 times higher than strict vegetarians and lacto-ovo vegetarians (Wong *et al.*, 2013). Therefore, vegetarians should consume more plant-based foods that are high in vitamin B_{12} such as dried purple laver (nori), fermented soybean-based food, and mushroom to maintain an adequate intake of this particular vitamin (Watanabe *et al.*, 2014).

As for the consumption of minerals, the vegetarian participants consumed higher amounts of folate, calcium and potassium than their non-vegetarian counterparts. A local study conducted by Wong *et al.* (2013) found that strict and lacto-ovo vegetarians had a significantly higher folate and calcium intakes than non-vegetarians. Folate is abundantly found in legumes and green leafy vegetables. A plausible explanation for the higher folate intake among vegetarians than non-vegetarians is the frequent consumption of legumes and green leafy vegetables in their daily diet as shown in the present study. On the other hand, nearly half of the vegetarian participants were lacto-ovo vegetarians (48%) where their diet consist of dairy products and eggs that are the main sources of calcium. Additionally, vegetarians consumed higher amounts of dark-green vegetables, legumes and soy based food (such as *tempeh*, pickled tofu, *tau-kua*, *fucok* and tofu) than the non-vegetarians in this study. These plant-based foods are the alternative sources of calcium. However, calcium status among vegetarians needs to be given due consideration because, for example, soy bean contains a high level of oxalic acid. This form of acid may affect calcium bioavailability in the body.

In relation to the intake of iron, no significant difference was found between vegetarians and non-vegetarians in this study, which is consistent with a local study done by Wong *et al.* (2013). Similarly, another study done by Hawk, Englehardt & Small (2012) showed that mean iron intake did not differ significantly (p=0.480) between vegetarians (16.8±6.36 mg) and non-vegetarians (14.8±7.10 mg). This could be due to an increased consumption of iron-fortified food among vegetarians. The intake of iron can easily be achieved in a vegetarian diet as iron can be obtained from grains, cereals, nuts, legumes and vegetables. However, non-heme iron in the vegetarian diet is less bio-available than heme iron of non-vegetarians. Therefore, the status of iron is of great concern among vegetarians. Moreover, phytate in whole grains, legumes, lentils and nuts; polyphenols in tea, coffee, red wines and certain vegetables; protein from soy and eggs as well as calcium and phosphate, can inhibit the absorption of iron. Hence, vegetarians should increase the recommended daily iron intake by 1.8 times more than non-vegetarians (IOM, 2006) due to the low bioavailability of non-heme iron in the vegetarian diet, which can potentially cause iron deficiency.

There are several limitations in the present study. First, this study was a cross-sectional study in which causal relationship between variables cannot be determined. Second, convenience sampling was used in this study which may cause selection bias and the sample population was not representative to the general population. Furthermore, this study did not match-pair the vegetarians with the non-vegetarians in terms of age and sex due to small sample size. Future studies should match the vegetarian and non-vegetarian groups in order to increase the accuracy of the results. Additionally, 24-hour dietary recall which is characterised as a retrospective method of dietary assessment was largely relies on the honesty and memory of the participants. Different types of food group intake were not assessed in this study. Lastly, the current findings may not be generalised to Indian vegetarians as this study did not include Indian vegetarians. Also, the dietary patterns between Chinese and Indian-styled vegetarianism are different. Nevertheless, this study is able to provide baseline data for future research on comparison of nutritional status between vegetarians and non-vegetarians. The findings of this study can also help in the development of vegetarian dietary guidelines.

CONCLUSION

This study provides some insights into body weight status, dietary intake and blood pressure level among Malaysian Chinese vegetarians and non-vegetarians. Although more vegetarian participants achieved nutrient adequacy than their non-vegetarian counterparts, they should be aware of the likelihood of deficiencies of vitamin B_{12}, folate, calcium and niacin. Nutrition education programmes and interventions should be held more frequently for the benefit of vegetarians in general. Future studies should assess blood micronutrient concentrations to provide a better understanding of the nutritional status of vegetarians.

Authors' contributions

Gan WY, principal investigor, conceptualized and designed the study, prepared the draft of the manuscript and reviewed the manuscript; Boo S, data collection and reviewed the manuscript; Seik MY, data collection and reviewed the manuscript; Khoo HE, data analysis and interpretation, assisted in drafting of the manuscript and reviewed the manuscript.

Conflict of interest

The authors have no conflict of interest.

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