

## Assessment of fruit and vegetable consumption among female university students

<sup>1</sup>Ahmad Sirfan, A.S., <sup>1\*</sup>Hamirudin, A.H. and <sup>2</sup>Sidek, S.

<sup>1</sup>Department of Nutrition Sciences, Kulliyah of Allied Health Sciences, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, 25200 Kuantan, Pahang, Malaysia

<sup>2</sup>Department of Psychology, Kulliyah of Islamic Revealed Knowledge and Human Sciences, International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur, Malaysia

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### Abstract

The low intake of fruits and vegetables is a global issue. This research aimed to determine the association of fruit and vegetable intake with waist circumference and barriers of intake. A total of 279 female students from the International Islamic University Malaysia, Kuantan, were recruited through convenience sampling and provided with a set of questionnaires to identify their fruits and vegetable intake. The waist circumference of respondents was measured. The majority of students consumed only one serving of fruit and vegetable per day, which is less than the levels recommended by the Malaysian Dietary Guideline. Only 9.0% of students had a fruits intake of two servings/day, while 6.5% had a vegetable intake of three servings/day which meets the recommendation. There was no significant association of fruits and vegetable intake with waist circumference among female students. Non-availability and not delicious were identified as major barriers to fruit and vegetable consumption respectively. In conclusion, the fruit and vegetable intake among the majority of female university students is inadequate. Thus, there is a need to increase awareness and develop strategies to promote adequate fruit and vegetable intake among this specific target group.

## 1. Introduction

A significant concern in diet and nutrition is the insufficient consumption of fruit and vegetable (FV). Globally, the pattern of fruits intake has gradually increased over the past two decades, but vegetable intake varies, with the majority of countries demonstrating less than optimal intake (Micha *et al.*, 2015). According to Hall *et al.* (2009), 77.6% of men and 78.4% of women from low- and middle-income countries have lower FV intake than the minimum recommended intake of five daily servings of FV. In Washington, only 5% to 6% of adults meet the Dietary Guidelines for Americans on Recommended Intakes of Fruit and Vegetable (Ta *et al.*, 2012). Recent data from the World Health Organisation (WHO) (2019) estimated that about 3.9 million global deaths in 2017 were associated with inadequate consumption of FV.

FV are known for their richness in vitamins, minerals, electrolytes, phytochemicals, antioxidants and dietary fibre as well as in disease prevention and treatment (Slavin and Lloyd, 2012). Interestingly, FV

intake has a significant impact on mental health as individuals meeting the recommended FV intake have a lower likelihood of moderate or high distress levels compared to those who did not (Richard *et al.*, 2015; Bishwajit *et al.*, 2017). Adequate intake of FV is very prominent in maintaining a balanced diet, health and well-being.

WHO (2003) recommends at least 400 g of FV daily, excluding starchy tubers, which is equal to five servings per day. This recommendation is parallel with the Malaysian Dietary Guidelines published in 2010 (National Coordinating Committee on Food and Nutrition, 2010). It states that the fifth key message is to consume at least five servings of fruits and non-starchy vegetables every day. The five servings refer to three servings of vegetables and two servings of fruits. In December 2016, the Department of Health of Ireland released a new and updated food pyramid. The FV section was changed from the second to the first shelf, which is the base of the pyramid with a recommended five to seven servings per day (Government of Ireland,

\*Corresponding author.  
Email: [aliza@iium.edu.my](mailto:aliza@iium.edu.my)

2016).

Studies have been conducted to identify the adequacy of FV consumption. Pem and Jeewon (2015) noted that in 2012, the mean intakes for fruit and vegetable in Malaysia are 179 g/day and 133 g/day, respectively, which are still below the recommendation. Among Sri Lankan university students, Perera and Madhujith (2012) found that the FV consumption is below the recommendations. Other studies also reported the inadequacy of FV intake, which is below the recommended intake (Herbert *et al.*, 2010; Gan *et al.*, 2011; Teschl *et al.*, 2018).

Sufficient FV consumption also provides multiple beneficial consequences on some metabolic diseases. For instance, body adiposity and abdominal obesity are inversely correlated with higher intake of FV (Yu *et al.*, 2018). According to WHO (2008), waist circumference is an indicator of abdominal obesity. It has been shown that abdominal obesity can aggravate the risk of cardiovascular disease (CVD), insulin resistance, and dyslipidaemia (Zhang *et al.*, 2008). Studies have emphasised that FV intake is associated with reduced risk of cardiovascular disease, cancer and all-cause mortality (Hartley *et al.*, 2013; Wang *et al.*, 2014; Aune *et al.*, 2017). Mo and colleagues (2019) demonstrated that a moderate increase in FV intakes such as an additional of half serving of fruit or one serving of vegetable would gradually minimise the percentage of CVD from 12.6% to 8.5%. Yip *et al.* (2019) stated that there is a 10% to 30% reduction in the risks for associated diseases. Furthermore, there is a significant association between green leafy vegetable consumption and incidence of diabetes, suggesting a beneficial effect of green leafy vegetables in reducing the risk of diabetes (Cooper *et al.*, 2012; Li *et al.*, 2014). Li *et al.* (2014) highlighted that the intake of fruit is also associated with a remarkably reduced risk of type 2 diabetes. It is notable that FV provides abundant health benefits. Additionally, a higher intake of vegetable or fruit results in weight loss (Ghalaeh *et al.*, 2012; Mytton *et al.*, 2014).

Several barriers related to inadequate consumption of FV have been reported. According to Perera and Madhujith (2012), the highest barriers of FV intake are non-availability and prices, with almost 83.4% of students stating that their place of residence influences their FV intake. Other study identified a barrier in which young adults moving away from home to live in halls tend to have limited choices of FV (Herbet *et al.*, 2010). Another finding consistently showed that FV intake is lower among students after entering college as they tend to eat FV based on their preference (Hakim *et al.*, 2012). Meanwhile, environmental factors also play a big role in

influencing FV intake, especially availability (Othman *et al.*, 2012).

With the heightened concern on the importance of sufficient FV intake, this study was conducted among female university students due to the scarcity of comprehensive research related to this topic, particularly in Malaysia. Furthermore, females were selected as study participants due to significantly higher rates of abdominal obesity among female as reported in the National Health and Morbidity Survey 2015 (Institute for Public Health, 2015); and lower intake of fruits and vegetable in this age group based on the findings by the Malaysian Adults Nutrition Survey (MANS) 2014 (Institute for Public Health, 2014). Hence, this study aimed to determine the fruit and vegetable intake among female university students, the association of fruit and vegetable intake with waist circumference, and barriers of fruit and vegetable intake. The findings will be beneficial for future planning to promote adequacy of FV intake as well as healthy eating and lifestyles.

## 2. Materials and methods

### 2.1 Study design and respondents

A cross-sectional study was conducted among female students of the International Islamic University Malaysia (IIUM) Kuantan Campus from four eligible kulliyahs (faculties). The criteria for inclusion and exclusion were set prior to data collection. The inclusion criteria of this study were healthy undergraduate Malaysian female students of IIUM Kuantan (first to fourth year students) and age ranging from 19 to 26 years old. The exclusion criteria were students diagnosed with diseases or disorders which might impair their FV intake such as gastrointestinal disorders. Additionally, the students in the fifth year of study were excluded in order to standardise the participants from different kulliyahs with four years of study duration.

### 2.2 Data collection

Data were obtained through convenience sampling. Information regarding the study was explained to the respondents, and informed consent forms were completed by potential respondents prior to their participation.

#### 2.2.1 Measures

A set of self-administered questionnaires was distributed to the respondents who were required to answer all questions provided. Pre-testing was conducted among 10% of the total sample size to test the questionnaires prior to data collection.

### 2.2.1.1 Sociodemographic

Sociodemographic data of the participants were collected. The data consists of name, matric number, phone number, age, year of study and kulliyah.

### 2.2.1.2 Waist circumference

The waist circumference of the respondents was measured using a flexible measuring tape between the highest part of the iliac crest and lowest palpable rib based on established guideline published by WHO (2008). The tape was snugged around the respondents' body but not too tight. Measurement values were taken when respondents exhaled. The measurements were performed by a researcher to avoid bias and measurement error. The cut-off values of waist circumference were referred to the South Asian guidelines by WHO (2008), which stated that the ideal waist circumference for female South Asian is less than 80 cm.

### 2.2.1.3 Fruit and vegetable intake

The second section comprises questions on frequency, types, number of serving, and eating time of FV intake. The structured questions on frequency and number of servings were adopted from a study by Al-Otaibi (2014) which was conducted among students in different countries. A comparison of respondents' FV intake according to serving size in this present study was made against the Malaysian Dietary Guidelines (National Coordinating Committee on Food and Nutrition, 2010). Recommended serving size for daily fruit intake is two servings, while the daily recommendation for vegetable intake is three servings (Tee, 2011).

### 2.2.1.4 Barriers of FV consumption

The last section concerns the barriers of FV consumption. The questions on the barriers of consumption were adopted from Perera and Madhujith (2012) and Al-Otaibi (2014).

## 2.3 Statistical analysis

The data were analysed with SPSS Statistics version 12.0.1. Descriptive analysis was used to analyse the demographic variables. The Spearman Correlation test was run to assess the association between the number of servings of fruit and vegetable with waist circumference. Meanwhile, the barriers of fruit and vegetable consumption were analysed in percentage. A significance level of  $p < 0.05$  was set for all statistical tests.

## 2.4 Ethical approval

This study was approved by the IIUM Research Ethics Committee (IREC) (ID No. IREC 2018-055).

## 3. Results

### 3.1 Demographic characteristics of respondents

A convenience sample of 290 female students was screened in the study. However, only 279 were eligible for recruitment as study participants. Eleven students were excluded due to meeting the exclusion criteria. The summary of demographic variables, including age, year of study, faculty, and waist circumference are tabulated in Table 1. The majority of the respondents were aged 22 years ( $n=68$ , 24.4%), year 1 students ( $n=104$ , 37.3%), Kulliyah of Allied Health Sciences (KAHS) students ( $n=125$ , 44.8%), and with less than 80 cm waist circumference ( $n=198$ , 71.0%).

Table 1. Demographic characteristics of respondents

Characteristics	n (%)	
Age	19 years old	32 (11.5%)
	20 years old	56 (20.1%)
	21 years old	29 (10.4%)
	22 years old	68 (24.4%)
	23 years old	65 (23.3%)
	24 years old	27 (9.7%)
	25 years old	2 (0.7%)
Year of study	Year 1	104 (37.3%)
	Year 2	67 (24.0%)
	Year 3	78 (28.0%)
	Year 4	30 (10.8%)
Kulliyah	Allied Health Sciences	125 (44.8%)
	Science	69 (24.7%)
	Pharmacy	53 (19.0%)
	Nursing	32 (11.5%)
Waist circumference	> 80 cm	81 (29.0%)
	< 80 cm	198 (71.0%)

### 3.2 Fruit and vegetable consumption

Table 2 shows a summary of fruit consumption among female students. Notably, more than half of the students had only one serving of fruits a day ( $n=151$ , 54.1%), followed by no serving ( $n=94$ , 33.7%), two servings ( $n=25$ , 9.0%), and three servings ( $n=9$ , 3.2%). While for the frequency of intake, the majority of the students consumed fruits about one to three times a week ( $n=115$ , 41.2%) and less than once a week ( $n=103$ , 36.9%). Next, out of 279 students, 139 preferred to eat fruits during lunch (33.3%), and 92 ate fruits during dinner (22.1%). Out of a list of 11 fruits, the top three fruits favoured by the female students were apples ( $n=129$ , 29.0%), bananas ( $n=74$ , 16.7%), and watermelons ( $n=50$ , 11.3%), while the least favourite was pineapple

Table 2. Fruits consumption among female university students

Characteristics	n (%)	
Number of servings	None	94 (33.7%)
	1 serving	151 (54.1%)
	2 servings	25 (9.0%)
	3 servings	9 (3.2%)
Frequency of intake	≥ 1 time/day	25 (9.0%)
	1 – 3 times/week	115 (41.2%)
	4 – 6 times/week	26 (9.3%)
	< 1 time/week	103 (36.9%)
	Never	10 (3.6%)
Timing of intake	Breakfast	51 (12.2%)
	Morning tea	28 (6.7%)
	Lunch	139 (33.3%)
	Afternoon tea	65 (15.6%)
	Dinner	92 (22.1%)
	Supper	42 (10.1%)
Types of fruits	Apple	129 (29.0%)
	Banana	74 (16.7%)
	Watermelon	50 (11.3%)
	Guava	48 (10.8%)
	Orange	47 (10.6%)
	Papaya	33 (7.4%)
	Honeydew	25 (5.6%)
	Mango	12 (2.7%)
	Pear	12 (2.7%)
	Grapes	11 (2.5%)
	Pineapple	3 (0.7%)

(n=3, 0.7%).

The consumption of vegetables among female students in IIUM is shown in Table 3. Half of the students (n=143, 51.3%) took one serving of vegetables per day, while 87 of the respondents consumed two servings daily (31.2%), 31 respondents consumed no serving of vegetables (11.1%), and 18 students had three servings daily (6.5%). The frequency of vegetable intake was outstanding with once or more per day (n=95, 34.1%) and four to six times per week (n=82, 29.4%). Next, most of the students had vegetables in their meals during lunch (n=263, 58.8%), followed by dinner (n=154, 34.5%). Additionally, the top three vegetables preferred by the students were cabbage (n=111, 26.0%), kangkung (n=56, 13.1%), and salad (n=55, 12.9%), while the least preferred vegetable was tomato (n=12, 2.8%).

### 3.3 Association of fruit and vegetable intake with waist circumference

Spearman's correlation test was run to analyse, which is tabulated in Table 4. The results show no significant correlation between fruits intake, vegetable intake and waist circumference ( $p=0.873$ ;  $p=0.889$ ) respectively.

Table 3. Vegetable consumption among female university students

Characteristics	n (%)	
Number of servings	None	31 (11.1%)
	1 serving	143 (51.3%)
	2 servings	87 (31.2%)
	3 servings	18 (6.5%)
Frequency of intake	≥ 1 time/day	95 (34.1%)
	1 – 3 times/week	69 (24.7%)
	4 – 6 times/week	82 (29.4%)
	< 1 time/week	27 (9.7%)
	Never	6 (2.2%)
Timing of intake	Breakfast	18 (4.0%)
	Morning tea	1 (0.2%)
	Lunch	263 (58.8%)
	Afternoon tea	8 (1.8%)
	Dinner	154 (34.5%)
	Supper	3 (0.7%)
Types of vegetables	Cabbage	111 (26.0%)
	Kangkung	56 (13.1%)
	Salad	55 (12.9%)
	Mustard leave (sawi)	46 (10.7%)
	Spinach	33 (7.7%)
	Cucumber	30 (7.0%)
	Leafy green	27 (6.3%)
	Carrot	25 (5.8%)
	Ulam-ulaman	19 (4.4%)
	Long bean	14 (3.3%)
Tomato	12 (2.8%)	

Table 4. Association of fruit and vegetable intake with waist circumference

	r		p-value	
	Fruits	Vegetables	Fruits	Vegetables
Waist circumference (cm) (n=279)	-0.01	-0.008	0.873	0.889

### 3.4 Barriers of fruit and vegetable consumption

Based on Table 5, more than half of the students (n=165, 59.1%) reported that non-availability was the greatest barrier to them to consume fruits. The second barrier was the price of fruits (n=65, 23.3%), which was rather expensive for students. This explained the reason for the low intake of fruits among female students which was mostly only one serving per day and one to three times per week. For the option of 'others', students listed their barrier such as difficult to store fruits, forgot to eat, too lazy to buy and peel them off, financial limitation as a university student and need to buy fresh fruits outside the university.

Meanwhile, for vegetables, the trend of barriers was quite similar to that of fruits. The utmost barrier was not delicious (n=69, 24.7%) followed by difficult to eat three servings a day (n=62, 22.2%), poor quality of vegetables (n=41, 14.7%) and non-availability (n=40, 14.3%).

Table 5. Barriers of fruit and vegetable consumption among female university students

Characteristics	n (%)	
Fruits	Difficult to eat 2 servings a day	9 (3.2%)
	Expensive	65 (23.3%)
	Not delicious	6 (2.2%)
	Non-availability	165 (59.1%)
	Fear of pesticides and other chemicals on fruit	5 (1.8%)
	Poor quality	6 (2.2%)
	Time constraint	16 (5.7%)
	Others	7 (2.5%)
Vegetables	Difficult to eat 3 servings a day	62 (22.2%)
	Expensive	19 (6.8%)
	Not delicious	69 (24.7%)
	Non-availability	40 (14.3%)
	Fear of pesticides and other chemicals on fruit	23 (8.2%)
	Poor quality	41 (14.7%)
	Time constraint	8 (2.9%)
	Others	17 (6.1%)

While for the ‘others’ option, some students indicated that there was no specific barrier to them consuming vegetables, worried about the cleanliness of vegetables prepared at the cafeteria, bad opinion and experience on vegetables since childhood, no appropriate storage at the hostel, choosy, limited choices at the cafeteria, and too little vegetables in a la carte meals at the cafeteria.

#### 4. Discussion

This study identified fruit and vegetable intake among female university students, the association of fruit and vegetable intake with waist circumference and the barriers of intake.

##### 4.1 Fruit and vegetable consumption

The findings of this study showed that most of the female students only had one serving of FV per day. Previous studies also reported similar findings on FV intakes such as one to two servings of fruits and only one serving of vegetables daily (Pessoa *et al.*, 2015). A similar pattern was observed in the low-income urban African American youth where findings showed that only 1.5 servings of fruit and 1.8 servings of vegetables were consumed in a day (Trude *et al.*, 2016).

On the other hand, the present study demonstrated that only 9.0% of students had fruits intake of two servings in a day; while 6.5% had vegetable intake of three servings per day to meet the intake recommended by the Malaysian Dietary Guideline (2010). The results were much lower than the result of Al-Otaibi (2014) where 22% of female students in a Saudi Arabia University consumed five or more servings of FV. Our findings were consistent with other studies which identified that young people and university students tend

to consume below the recommended FV intake (Herbert *et al.*, 2010; Gan *et al.*, 2011; van den Bogerd *et al.*, 2018). Moreover, studies among university students showed that only 20% of Pakistani students, 2.78% female Saudi Arabian students, and 7.3% female German students consumed FV as per the recommended daily intake (Al-Otaibi, 2014; Alsunni and Badar, 2015; Teschl *et al.*, 2018). Teschl *et al.* (2018) and van den Bogerd *et al.* (2018) noted that students who met the recommended FV intake had general knowledge about the recommended intake and were living in shared households as the cost for FV groceries was more affordable. Similarly, as reported by Lutfiyya *et al.* (2012), most Americans failed to consume FV to meet the recommended servings, with rural residents being at greater risk for not making healthy dietary choices. This could be due to environmental access issues and affordability.

For frequency of intake, fruits were consumed one to three times a week and less than once a week, while for vegetable intake was once or more per day and four to six times per week. This was in line with the findings by Kpodo *et al.* (2015) which stated that 36.6% of Ghanaian students had fruits intake between one to five times a week. Pessoa and colleagues (2015) also identified five or more days of FV intake a week. However, this is contradictory with Kpodo *et al.* (2015) where more than half of the sampled Ghanaian students had vegetables at least three times per day. In addition, if FV intake was compared to the frequency of once or more per day, students had more vegetables compared to fruits daily. This finding was supported by evidence from studies in Tanzania and Sri Lanka (Perera and Madhujith, 2012; Msambichaka *et al.*, 2018).

Regarding the timing of the FV intake, the present study showed that the majority of female students consumed FV during lunch and dinner. This was aligned with Perera and Madhujith (2012) where female students liked to eat fruits during the main meals and had vegetables during lunch and dinner. A similar observation was presented in a study by Pedersen *et al.* (2012) where vegetable consumption was strongly associated with lunch consumption. Nago *et al.* (2012) reported that fruits were preferably consumed at night or as desserts, and the authors mentioned that some of the commonly consumed vegetables such as onions and tomato were used in most of the cooking preparation of everyday meals. Sugiyama *et al.* (2012) stated that the FV intake during breakfast was less likely due to other choices of breakfast such as bread and other cooked foods which could also differ according to the breakfast style of individuals.

#### 4.2 Association of fruit and vegetable intake with waist circumference

The present study found no significant correlation between fruits as well as vegetable intake with waist circumference. The findings were consistent with a study conducted among female Iranian university students which concluded that no significant association between FV intake with waist circumference (Ghalaeh *et al.*, 2012). The results are also parallel with findings by Reis *et al.* (2014) and Schwingshackl *et al.* (2015). On another perspective from Ledoux *et al.* (2011) in their review article, they found that there was a weak association between FV consumption and adiposity. Moreover, the association was not mutually exclusive and could be due to multiple weight-related behaviours; and one of them was reduced intake of energy-dense foods in compensation of increased FV intake.

#### 4.3 Barriers of fruit and vegetable consumption

The most-reported barriers of fruits intake among students were 'non-availability' and 'expensive'. While the barriers in vegetable consumption were 'not delicious', 'difficult to eat three servings a day', 'poor quality' and 'non-availability'.

Studies also reported that availability and prices were significant barriers to intake (Herbet *et al.*, 2010; Othman *et al.*, 2012; Perera and Madhujith, 2012; Al-Otaibi, 2015). The findings align with Nago *et al.* (2012) whereby limited availability and accessibility in terms of the form, place and time were barriers to FV consumption. Thornton *et al.* (2012) noted that easy access to supermarkets was also related to increased FV consumption. With the consideration that university students did not have a fixed income, purchasing FV as

part of their groceries might be slightly unfeasible. Dunn *et al.* (2011) revealed that purchasing of FV increased when the income of the households increased too. This indicates that people will buy more fruits if they have a higher income or if the prices are lower and affordable, as well as easily accessible.

The financial support for students is either from parents or other sources, and it plays a significant role in determining the intake of FV (Perera and Madhujith, 2012). Al-Otaibi (2015) also found that young females believed that the price of FV was high. Furthermore, the intake of FV was associated with wealth as rich people afford to buy FV compared to those with low incomes (Yen and Tan, 2012). Similarly, Malaysian adults with higher incomes demonstrated greater consumption of vegetables than those from lower-income groups as they believed that people with lower incomes tended to spend most of the income on their basic needs instead (Othman *et al.*, 2012). A study in Port Vila, Vanuatu disclosed that about 20% of the total budget and more than 40% of the food budget of the poorest households were required in order to purchase the recommended amount of FV for all household members (Jones and Charlton, 2015). The difference in financial stability proved that it might also affect the affordability and thus the consumption of FV (Miller *et al.*, 2016). Other than financially compromise as a barrier to FV intake, it was also related to education level and age, and frequency and access to unhealthy food especially in socio-economically underprivileged communities (Pessoa *et al.*, 2015; Okop *et al.*, 2019).

As for the barrier to vegetable consumption, 'not delicious' was a factor consistent with Herbet *et al.* (2010) and Lucan *et al.* (2010) where sensory factors such as taste or flavour played an important role in consumption. In a review article by Krølner *et al.* (2011), the authors argued that vegetables were often linked to unappealing and negative tastes such as bitter and insipid, and sometimes these taste perceptions were more likely based on prejudice than the actual taste. Nevertheless, the same article highlighted that the taste of fruits was generally preferred compared to the taste of vegetables. This was supported by Nago *et al.* (2012), who identified that most of the participants in their study preferred sweet-tasting fruits compared to bitter vegetables. It was further explained that this personal taste might also be affected by the way the vegetables were prepared (Nago *et al.*, 2012). Besides, FV intakes were considered an inconvenient snack food due to the meticulous preparations needed before FV was ready to be served (Krølner *et al.*, 2011). In short, consumption was in accordance with one's preference and acceptance of certain foods.

The limitations of this present study include the probability of self-reported bias and incomplete answers as the questionnaire was self-administered. In addition, other data on anthropometry assessment and modifying factors were not assessed. Despite that, the use of strict inclusion and exclusion criteria to identify eligible respondents was recognised as important strengths of this study.

For future study, the food recording method is suggested for a more detailed data collection on dietary intake as well as the inclusion of other anthropometry assessment. Moreover, further research on other modifying factors such as physical activity and knowledge on FV intake can be examined. The target population can be expanded with the inclusion of male students for gender comparison in FV intake, differences in preference of FV and the barriers of FV consumption. Intervention can then be planned accordingly for this population. A study showed that participation in FV intervention study has demonstrated an outstanding and positive outcome such as increased FV liking and intake, as well as diminishing the barriers to FV consumption (Neville *et al.*, 2015).

## 5. Conclusion

In conclusion, most of the female university students did not meet the recommended daily intake of FV based on serving size with the varied frequency of intake. The participants displayed preferences towards several types of FV, and the most common barriers to FV consumption were identified. Thus, the strategy of promoting a healthy lifestyle, specifically on increasing FV consumption, as well as overcoming the barriers among university students can be planned for successful implementation.

## Conflict of interest

All authors declare no conflict of interest pertaining to this study.

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