VEGETABLE CONSUMPTION AND COOKING SKILLS AMONG UNIVERSITY STUDENTS

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Abstract

A high vegetable diet has proved to offer health benefits that can lower blood pressure, reduce the risk of heart disease and stroke, prevent some types of cancer, lower the risk of eye and digestive problems, and have a positive effect on blood sugar, which can help control appetite. However, the prevalence of vegetable consumption below the recommended daily intake is worrying. Nearly 95% of Malaysian adults, including university students, have not met the recommended daily amount of vegetables. Sociodemographic factors and a lack of cooking skills may contribute to inadequate vegetable consumption. A study was carried out to determine the relationship between sociodemographic characteristics and cooking skills with vegetable consumption among Malaysian university students. By utilizing a random sample, a cross-sectional study was conducted to evaluate the frequency of vegetable consumption and cooking skill among university students aged 18 and older. The data was obtained via online survey using the Food Frequency Questionnaire (FFQ) and the Cooking Skills Questionnaire validated and tested by previous researchers. Vegetable consumption was divided into daily and non-daily consumption and a chi-square test was performed to analyze the association followed by the Bonferroni posthoc test. The association between sociodemographic and five dimensions of cooking skills with daily vegetable consumption was subject to logistic regression and an adjusted odds ratio was applied. Results demonstrated that only 24% of students (20% of males and 52% of females) consumed vegetables regularly, while the rest did not. There is a positive association between cooking skills dimensions (availability and accessibility of fruits and vegetables; produce consumption self-efficacy and knowledge of cooking terms and techniques) with daily vegetable consumption. Students who were 25 years old and older, male, lived alone, with friends, or with children, understand how to cook, ordered outside during lunchtime, and dined at the cafeteria for lunch were significantly associated with daily vegetable consumption.

Keywords: Accessibility, Availability, Cooking Skills, Sociodemographic, Vegetables

Introduction

Vegetables have been recognized as a key component of a healthy diet because of their positive effects on blood pressure, heart, anti-cancer, digestive systems, and blood sugar (1, 2). A diet rich in vegetables would minimize the risk of developing non-communicable diseases (NCDs) while ensuring enough dietary fiber intake. Malaysian Dietary Guideline issued in 2010 suggested eating at least five servings of fruits and non-starchy vegetables every day, where three servings of vegetables and two servings of fruits are associated with a positive impact on health (3).

Nearly 63% of university students have unhealthy eating habits, including low intake of fruits, vegetables, fish, whole grains, and legumes (4). Many studies reported that students do not follow the dietary standards' healthy eating recommendations as suggested by experts (5). This is due to factors such as time constraints, unhealthy snacking, a lack of availability, the convenience of high-calorie foods, stress, high prices for healthy food, and easy access to junk food (6).

Various factors were found to be associated with vegetable consumption, which are sociodemographic, health, and

personal characteristics including female sex, living with parents, high socioeconomic background, low body mass index (BMI), normal blood pressure, final years of undergraduate education, high physical activity level, high knowledge level of nutrition, regular self-care, breakfast consumption, and low energy consumption (7).

Cooking skills are also one of the determinants of food choice and impel the overall quality of a person's diet through how frequently someone cooks at home and results in greater inclusion of vegetables compared with meals consumed or prepared away from home (8). In first-year college students, cooking more frequently, cooking with more skill, and adopting meal planning behaviors are linked to higher fruit and vegetable intake and a lower BMI according to previous research (9). However, students stated that a lack of cooking skills was a problem for healthy eating habits which could affect the nutritional quality of vegetables and a decline in cooking meals at home. These trends may have contributed to the rise in obesity (10).

Although similar study had already been conducted in Brazil, the differences in factors associated with vegetables may be significant given the two countries' vast socio-cultural differences. Therefore, the primary objective of the study was to explore the relationship between sociodemographic characteristics and cooking skills with vegetable consumption among university students in Malaysia.

Materials and Methods

Sample collection

A cross-sectional study was conducted from May 2022 to August 2022 at 20 public and 47 private universities in Malaysia. Participants who were recruited, fulfilled the inclusion criteria: being at least 18 years old, enrolled in an undergraduate course during the time of data collection, and willing to participate in the study.

A random sample was used to recruit the students. Students were contacted randomly via email or social media platforms such as Facebook, Twitter, and WhatsApp. They were requested to answer the Google Form online questionnaire and had to agree to participate, sign an informed consent form, and receive an email with more information on the study.

We used a validated online questionnaire survey as a measuring instrument for self-reported measures in this study. All questions were presented in multiple-choice form. There were three sections, i.e: Section A: Sociodemographic Characteristics (10); Section B: Cooking Skills (11); and Section C: Food Frequency Questionnaire (FFQ).

In this study, participants were divided based on gender (male and female), age, self-reported height and weight (to calculate BMI), parental education level was categorized into five categories (preschool, primary, secondary, post-secondary, and tertiary education), undergraduate courses into two categories (health science and other than health science), living arrangements into three categories (with children, with parents, and living alone or with a friend) and family income into three categories (< RM4850 for B40, RM4851-RM10,970 for M40, and > RM10,971 for T20). The time spent for cooking was divided into three categories (1 hour, 1-3 hours, and > 3 hours), and the location to eat daily main meals was divided into three categories (at university, eat at home or bring homemade food, and eat away from home or delivery food). Participants were also asked whether they knew how to cook (yes or no).

Cooking Skills questionnaire measured skills in preparing meals. The questionnaire contained five dimensions and indicators for assessing cooking skills developed in previous study by Bernardo et al. (12): The measures of Availability and Accessibility of Fruits and Vegetables (AAFV), Cooking Attitude (CA), Cooking Behavior (CB), Produce Consumption Self-Efficacy (SEPC), and Knowledge of Cooking Terms and Techniques (CTT).

Availability and accessibility of fruits and vegetables at home contain two questions, in which the response to each question will be coded as "Yes" or "No." Cooking attitudes containing six items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Cooking behavior contains three items that were rated on a 5-point Likert scale ranging from 1 (never) to 5 (every day). Produce consumption self-efficacy contained two items that were rated on a 5-point Likert scale ranging from 1 (not confident at all) to 5 (extremely confident). The Knowledge of cooking techniques quiz contained four multiple-choice questions that were worth 1 point each. Participants were asked to select the best answer for each question. The greater the measure's value indicates the better the cook's skills.

The FFQ was used to measure the frequency of vegetable consumption. The participants were asked about the average use for the last year of fresh, frozen, or tinned vegetables of nine types of vegetables such as carrots, spinach, cabbage, tomatoes, cauliflower, dried (lentils, beans, peas), mushrooms, garlic, and beansprouts. The question consists of one item: how often do you eat vegetables? The possible answers provided were, "Never or less than once a month", "1-3 times per month", "Once a week", "2-4 times per week", "5-6 times per week", "Once a day", "2-3 times per day", "4-5 times per day" and "6+ per day". Then, participants were asked to self-report on how often they consumed vegetables by providing five possible answers: "never", "once or twice a month", "once a week", "2-6 times a week", and "every day".

Data analysis

Using IBM SPSS version 20, socio-demographic data were analyzed through descriptive analysis. Mean and standard deviations were calculated to examine the frequency of vegetable consumption based on responses from the FFQ of nine types of vegetable items. A multiple logistic

regression analysis was used to display the association of sociodemographic characteristics with vegetable intake. One-way ANOVA analysis followed by a Bonferroni post hoc test was used to examine the relationship between cooking skills dimension scores with vegetable consumption. A significance level of 0.05 was set as significant for all the analysis and their associated odd ratios (ORs) and 95% CI were presented.

Results

Socio-demographic characteristics of respondents

Three hundred participants were identified prospectively for the study and were recruited. The frequency and percentage of vegetable consumption based on sociodemographic characteristics were summarized in Table 1.

Table 1: Socio-demographic and characteristics of respondents (N = 300)

	Total N (%)	Vegetable consumption (%)					p-value
		Never n = 8 (2.7)	Once or twice a month n = 52 (17.3)	Once a week n = 40 (13.3)	2-6 times a week n = 128 (42.7)	Every day a month n = 72 (24.0)	
Age (years)-mean (SD)	22.76 (3.29)	8 (2.7)	52 (17.3)	40 (13.3)	128 (42.7)	72 (24.0)	0.219 [t]
< 25 years old	259 (86.3)	8 (2.7)	46 (15.3)	39 (13.0)	109 (36.3)	57 (22.0)	0.062 [t]
≥ 25 years old and above	41 (13.7)	0 (0.0)	6 (2.0)	1 (0.3)	19 (6.3)	15 (5.0)	
Gender Male	59 (19.7)	1 (1.7)	9 (15.3)	7 (11.9)	22 (37.3)	20 (33.9)	0.398 [t]
Female	241 (80.3)	7 (2.9)	43 (17.8)	33 (13.7)	106 (44.0)	52 (21.6)	
Level of paternal education Lower institution	134 (44.7)	2 (0.7)	19 (6.3)	23 (7.7)	62 (20.7)	28 (9.3)	0.135 [t]
Higher institution	166 (55.3)	6 (2.0)	33 (11.0)	17 (5.7)	66 (22.0)	44 (14.7)	
Level of maternal education Lower institution	133 (44.3)	3 (1.0)	23 (7.7)	23 (7.7)	54 (18.0)	30 (10.0)	0.492 [t]
Higher institution	167 (55.7)	5 (1.7)	29 (9.7)	17 (5.7)	74 (24.7)	42 (14.0)	
BMI Classification Underweight [a]	47 (15.7)	1 (0.3)	11 (3.7)	5 (1.7)	20 (6.7)	10 (3.3)	0.606 [t]
Normal [b]	125 (41.7)	3 (1.0)	22 (7.3)	20 (6.7)	52 (17.3)	28 (9.3)	
Overweight [c]	77 (25.7)	4 (1.3)	10 (3.3)	6 (2.0)	37 (12.3)	20 (6.7)	
Obese [d]	51 (17.0)	0 (0.0)	9 (3.0)	9 (3.0)	19 (6.3)	14 (4.7)	
Overweight or Obese Yes	128 (42.7)	4 (1.3)	19 (6.3)	15 (5.0)	56 (18.7)	34 (11.3)	0.721 [t]
No	172 (57.3)	4 (1.3)	33 (11.0)	25 (8.3)	72 (24.0)	38 (12.7)	
Undergraduate course Health Sciences	78 (26.0)	2 (0.7)	11 (3.7)	12 (4.0)	35 (11.7)	18 (6.0)	0.890 [t]
Others	222 (74.0)	6 (0.2)	41 (13.7)	28 (9.3)	93 (31.0)	54 (18.0)	
Living arrangement I With children	7 (2.3)	0 (0.0)	1 (0.3)	0 (0.0)	2 (0.7)	4 (1.3)	0.233 [t]
With parents and/or grandparents	219 (73.0)	4 (1.3)	41 (13.7)	29 (9.7)	90 (30.0)	55 (18.3)	
Alone or with friends	74 (24.7)	4 (1.3)	10 (3.3)	11 (3.7)	36 (12.0)	13 (4.3)	

Table 1: Socio-demographic and characteristics of respondents (N = 300) (continued)

	Total N (%)	Vegetable consumption (%)					p-value
		Never n = 8 (2.7)	Once or twice a month n = 52 (17.3)	Once a week n = 40 (13.3)	2-6 times a week n = 128 (42.7)	Every day a month n = 72 (24.0)	
Living arrangement II							
With children	47 (15.7)	1 (0.3)	8 (2.7)	5 (1.7)	16 (5.3)	17 (5.7)	0.311 [t]
Without children	253 (84.3)	7 (2.3)	44 (14.7)	35 (11.7)	112 (37.3)	55 (18.3)	
Living arrangement III							
With parents and/or grandparents	256 (85.3)	7 (2.3)	45 (15.0)	39 (13.0)	104 (34.7)	61 (20.3)	0.162 [t]
Without parents or grandparents	44 (14.7)	1 (0.3)	7 (2.3)	1 (0.3)	24 (8.0)	11 (3.7)	
Family income (RM/ month) B40 (< RM4850)	162 (54.0)	4 (1.3)	25 (8.3)	25 (8.3)	69 (23.0)	39 (13.0)	0.340 [t]
M40 (RM4851-RM10,970)	110 (36.7)	2 (0.7)	21 (7.0)	12 (4.0)	52 (17.3)	23 (7.7)	
T20 (> RM10,971)	28 (9.3)	2 (0.7)	6 (2.0)	3 (1.0)	7 (2.3)	10 (3.3)	
Do you have kids? Yes	9 (3.0)	0 (0.0)	1 (0.3)	1 (0.3)	3 (1.0)	4 (1.3)	0.682 [t]
No	291 (97.0)	8 (2.7)	51 (17.0)	39 (13.0)	125 (41.7)	68 (22.7)	
Time available for cooking (hour) < 1 hour	141 (47.0)	5 (1.7)	25 (8.3)	21 (7.0)	62 (20.7)	28 (9.3)	0.843 [t]
1–3 hours	130 (43.3)	3 (1.0)	23 (7.7)	15 (5.0)	53 (17.7)	36 (12.0)	
> 3 hours	29 (9.7)	0 (0.0)	4 (1.3)	4 (1.3)	13 (4.3)	8 (2.7)	
Do you know how to cook? Yes	240 (80.0)	4 (1.3)	40 (13.3)	30 (10.0)	100 (33.3)	66 (22.0)	**0.019** [t] **(<0.05)**
No	60 (20.0)	4 (1.3)	12 (4.0)	10 (3.3)	28 (9.3)	6 (2.0)	
Where do you usually have lunch? University restaurant	128 (42.7)	3 (1.0)	20 (6.7)	24 (8.0)	58 (19.3)	23 (7.7)	0.028 [t] (<0.05)
Eat at home or bring homemade food	135 (45.0)	3 (1.0)	26 (8.7)	10 (3.3)	52 (17.3)	44 (14.7)	
Eat away from home or use food delivery services	37 (12.3)	2 (0.7)	6 (2.0)	6 (2.0)	18 (6.0)	5 (1.7)	
Where do you usually have dinner? University restaurant	99 (33.0)	2 (0.7)	18 (6.0)	20 (6.7)	41 (13.7)	18 (6.0)	0.064 [t]
Eat at home or bring homemade food	154 (51.3)	3 (1.0)	28 (9.3)	12 (4.0)	66 (22.0)	45 (15.0)	
Eat away from home or use food delivery services	47 (15.7)	3 (1.0)	6 (2.0)	8 (2.7)	21 (7.0)	9 (3.0)	

Table 1: Socio-demographic and characteristics of respondents (N = 300) (continued)

	Total N (%)	Vegetable consumption (%)					p-value
		Never n = 8 (2.7)	Once or twice a month n = 52 (17.3)	Once a week n = 40 (13.3)	2-6 times a week n = 128 (42.7)	Every day a month n = 72 (24.0)	
Cooking skills-mean (SD)							
Availability and Accessibility of Fruits and Vegetables (AAFV) Index	1.19 (0.80)	0.62 (0.74)ᵍ	0.94 (0.87)ᵍ	1.13 (0.82 ᶜ	1.15 (0.74) ᶜ	1.56 (0.71) ᵉ,ʰ,ⁱ	**<0.001ᵗᵗ**
Cooking Attitude (CA) Scale	3.31 (0.55)	3.27 (0.89)	3.31 (0.68)	3.43 (0.43)	3.34 (0.50)	3.21 (0.55)	0.315ᵗᵗ
Cooking Behavior (CB) Scale	3.06 (0.96)	3.0 (0.67)	3.01 (0.97)	2.98 (0.99)	2.98 (0.97)	3.28 (0.95)	0.284ᵗᵗ
Produce Consumption Self-Efficacy (SEPC) Scale	3.36 (1.04)	2.69 (1.51)ᵍ	2.85 (1.06) ⁱ,ᵍ	2.84 (0.93) ⁱ,ᵍ	3.44 (0.91) ᵉ,ʰ,ᵍ	3.97 (0.87)ᶠ,ᵉ,ʰ,ⁱ	**<0.001ᵗᵗ**
Knowledge of Cooking Terms and Techniques (CTT)	2.51 (0.47)	1.88 (1.13)	2.54 (1.06)	2.83 (1.03)	2.76 (0.84)	2.99 (0.83)	**<0.001ᵗᵗ**

Notes: SD, Standard deviation. ᵗ Pearson Chi-Square.ᵗᵗ One-way ANOVA analysis of variance followed by Bonferroni post hoc test. WHO 2004 (Asian) ᵃ < 18.5 kg/m². ᵇ 18.5-22.9 kg/m². ᶜ 23.0-27.4 kg/m². ᵈ 27.5 kg/m². Significant values (p < 0.05) are shown in bold. ᵉ significance difference compared with 'once or twice'. ᶠ significance difference compared with 'Never'. ᵍ significance difference compared with 'every day a month'. ʰ significance difference compared with 'once a week'. ⁱ significant difference compared with '2-6 times a week'.

Based on Table 1, participants who reported consuming vegetables 'everyday' had higher cooking skills scores for availability and accessibility of fruits and vegetables at home (< 0.001); produce consumption self-efficacy (< 0.001); and knowledge of cooking terms and technique (< 0.001) compared to students who stated 'never' consumed vegetables. In addition, regarding cooking attitude higher scores were found in 'once a week' compared to daily vegetable consumption; while cooking behavior had higher scores in daily vegetable consumption compared to 'once a week'. Overall, cooking skills scores differed significantly according to vegetable consumption categories, except for scores for 'cooking attitude' and 'cooking behavior'. The mean score for availability and accessibility of fruits and vegetables is 1.19, showing a higher score; produce consumption self-efficacy is 3.36, showing a higher score; and knowledge of cooking terms and techniques is 2.51, showing a higher score.

Association between socio-demographic characteristics with daily vegetable consumption.

The factors associated with daily vegetable consumption are detailed in Table 2. Age was positively associated with daily vegetable consumption (OR, 2.05; 95% CI, 1.02-4.12; p = 0.045). Students aged ≥ 25 years old tend to consume vegetables twice as much in a day compared to those who are younger. Besides, males' vegetable consumption is 1.86

times higher than their counterparts (OR, 1.86;95% CI, 1.00–3.47; p = 0.0 49). Participants who live with parents and grandparents are 75% less likely to consume daily vegetable consumption than people who live alone or with friends (OR, 0.25;95% CI, 0.06-1.16; p = 0.077). This discrepancy might be due to kitchen in student residency have less equipped kitchen, thus they tend to eat more fruit and vegetable which can be consume without processing (raw) (13). Participants who live in a house with children consume daily vegetables 2.04 times more than those who live without children (OR, 2.04; 95% CI, 1.05-3.97; p = 0.036). In addition, participants who consume daily vegetable consumption reported knowing how to cook 3.41 times more than those who do not know how to cook (OR, 3.41; 95% CI, 1.40-8.31; p = 0.007). Next, participants who order food delivery during lunchtime tend to consume more daily vegetable consumption compared to those who eat at university restaurants (OR, 1.40; 95% CI, 0.49–3.99; p = 0.007). Students who eat or bring homemade meals for lunch are 0.45 times less likely to consume daily vegetable consumption compared to those who dined at a university restaurant (OR, 0.45; 95% CI, 0.25-0.81; p = 0.007). Among five cooking skills dimensions, only two were associated with higher daily vegetable consumption, which were "availability and accessibility of fruits and vegetables" and "produce consumption self-efficacy."

Table 2: Factor associated with vegetable consumption among university students in Malaysia (N = 300)

	Daily Vegetable Consumption	
Variable	Crude OR (95% CI)	p-value
Age (years)-mean (SD)		
< 25 years old	1.00	
≥ 25 years old and above	2.05 (1.02-4.12)	**0.045**
Gender		
Male	1.86 (1.00-3.47)	**0.049**
Female	1.00	
Level of paternal education		
Lower institution	0.37 (0.80-2.34)	0.259
Higher institution	1.00	
Level of maternal education		
Lower institution	1.15 (0.68-1.97)	0.601
Higher institution	1.00	
Overweight or Obese		
Yes	1.00	
No	1.28 (0.75-2.17)	0.371
Undergraduate course		
Health Sciences	1.00	
Others	1.07 (0.58-1.97)	0.824
Living arrangement I		
With children	1.57 (0.80-3.08)	0.186
With parents and/or grandparents	0.25 (0.06-1.16)	0.077
Alone or with friends	1.00	
Living arrangement II		
With children	2.04 (1.05-3.97)	0.036
Without children	1.00	
Living arrangement III		
With parents and/or grandparents	1.07 (0.51-2.23)	
Without parents or grandparents	1.00	0.866
Family income (RM/month)		
B40 (< RM4850)	1.00	
M40 (RM4851-RM10,970)	1.20 (0.67-2.15)	0.542
T20 (> RM10,971)	0.57 (0.24-1.34)	0.197
Do you have kids?		
Yes	1.00	
No	2.62 (0.69-10.05)	0.159
Time available for cooking (hour)		
< 1 hour	1.54 (0.62-3.83)	0.356
1–3 hours	0.99 (0.40-2.45)	0.991
> 3 hours	1.00	
Do you know how to cook?		
Yes	3.41 (1.40-8.31)	
No	1.00	**0.007**

Table 2: Factor associated with vegetable consumption among university students in Malaysia (N = 300) (continued)

	Daily Vegetable Consumption	
Variable	Crude OR (95% CI)	p-value
Where do you usually have lunch?		
University restaurant	1.00	
Eat at home or bring homemade food	0.45 (0.25-0.81)	**0.007**
Eat away from home or use food delivery services	1.40 (0.49-3.99)	0.526
Where do you usually have dinner?		
University restaurant	1.07 (0.44-2.59)	
Eat at home or bring homemade food	0.57 (0.26-1.28)	0.888
Eat away from home or use food delivery services	1.00	0.176
Cooking skills-mean (SD)		
Availability and Accessibility of Fruits and Vegetables (AAFV) Index	0.303	**0.005 (< 0.05)**
Cooking Attitude (CA) Scale	0.595	0.052
Cooking Behavior (CB) Scale	1.045	0.797
Produce Consumption Self-Efficacy (SEPC) Scale	2.193	**0.000 (< 0.001)**
Knowledge of Cooking Terms and Techniques (CTT)	0.698	0.698

Notes: OR odds ratio; CI, confidence interval. Data were subjected to logistic regression. Significant values (p < 0.05) are shown in bold.

Association between cooking skills scores with daily vegetable consumption.

After adjusting for cooking knowledge and lunch location, the two dimensions of cooking skills remain significant. The association between cooking skills and daily vegetable consumption is shown in Table 3. The availability and accessibility of fruits and vegetables are three times higher in correlation with increased vegetable consumption (OR, 3.79; 95% CI, 2.11-6.83; p = 0.001). "Cooking attitude" was 21% less likely to increase the chance of daily vegetable consumption (OR, 0.79; 95% CI, 0.81-3.43; p = 0.753). However, no association was found between "cooking behavior" and daily vegetable consumption. A one-point increase in 'produce consumption self-efficacy' increased the likelihood of daily vegetable consumption by 3.78 (OR, 3.78; 95% CI, 1.10-12.98; p = 0.034). As for 'Knowledge of cooking terms and techniques', a significant association was found with daily vegetable consumption by two times (OR, 2.0; 95% CI, 1.05-3.83; p = 0.036).

Table 3: Association between cooking skills scores and daily vegetable consumption among university students in Malaysia (N = 300)

Variable	Daily Vegetable Consumption				
	OR1	95% CI	OR2	95% CI	p-value
Availability and Accessibility of Fruits and Vegetables (AAFV) Index Scale	0.26	0.15-0.46	0.28	0.16-0.51	**0.000 (<0.001)**
Cooking Attitude (CA) Scale	1.06	0.28-4.02	3.31	1.35-8.15	0.753
Cooking Behavior (CB) Scale	0.53	0.28-1.02	0.74	0.37-1.45	0.257
Produce Consumption Self-Efficacy (SEPC) Scale	0.19	0.06-0.64	3.01	1.21-7.49	**0.034**
Knowledge of Cooking Terms and Techniques (CTT) Scale	0.58	0.32-1.07	3.09	1.25-7.65	**0.036**

Notes: OR1, unadjusted odds ratio. OR2, adjusted odds ratio for 'know how to cook' and 'location having for lunch'. CI, confidence interval. Data were subjected to logistic regression. Significance values (p < 0.05) are shown in bold.

Discussion

This study finds that 76% of university students in Malaysia are not meeting the recommendations for vegetable intake as recommended by the National Health and Morbidity Survey 2019. The findings were consistent with Condrasky et al. (14), who discovered that 95% of adult university students do not consume enough vegetables. One concern about the findings on vegetable intake was that there was a portion of students that had never eaten vegetables in their life. Because of the lack of time and cost, we decided to not further investigate this finding.

One of the primary reasons people do not consume enough fruits and vegetables is that they are not available in convenient locations and are not accessible to people with low income (15). Our results suggest that increasing the availability of fruits and vegetables in public spaces, such as sidewalks and university cafeterias, could increase their consumption. Future research could also consider how to increase accessibility for people with low income across multiple domains (16). Overall, these findings are the following findings reported by one study demonstrated in a previous analysis of university students in Brazil, whereby there was a significantly positive increase in daily vegetable consumption (10).

The produce consumption self-efficacy showed a positive association with daily vegetable intake among university students, showing that the degree of confidence in meeting vegetable recommendations is higher. According to a previous study by Hanson et al. (10), similar findings were found among female students who showed higher self-efficacy in cooking and fruit and vegetable consumption. According to research, having low cooking self-efficacy is linked to one's attitude towards preparation techniques as well as cooking skills in general for various foods (17).

This is an important finding in the understanding of the knowledge of cooking terms and techniques associated with daily vegetable consumption. These results are markedly similar to previous studies among university students in Brazil (10). The higher the knowledge of cooking, the greater the understanding of eating habits,

food safety, and nutrition (18). This knowledge can be used to improve cooking skills and build a healthy eating pattern. Knowing how to cook involves understanding cooking terminology and processes, using the right tools and ingredients, and substituting acceptable ingredients during final food preparation (12). Nevertheless, more studies are required to explore the other underlying factors that might affect the cooking dimensions of vegetables. The approach utilized suffers from the limitation that it only includes vegetables reported by students, meaning that students who consumed vegetables less frequently might not be included in the sample, even though they could have been very important in influencing their cooking dimensions.

Availability and accessibility of fruits and vegetables were associated with daily vegetable consumption (OR, 0.26; 95% CI, 0.15-0.46; p < 0.001). Other results were broadly in line with the study reported by (10), who discovered that university students who had a high level of accessibility to fruits and vegetables contributed to high daily vegetable consumption. This is particularly important when investigating the consumption of fruit and vegetables among low-income populations (19). Previous studies have found that low-income individuals are less likely to consume fruits and vegetables and have lower fruit and vegetable consumption than their higher-income counterparts (20-21).

Our results demonstrated that cooking attitude was 21% less likely to increase the chance of daily vegetable consumption (OR, 0.79; 95% CI, 0.81-3.43; p = 0.753). These results go beyond previous reports, showing that cooking attitudes may be a potential target for interventions to increase vegetable consumption among university students (10). Future research should examine the mechanisms by which cooking attitude is associated with vegetable consumption. For example, is vegetable consumption lower for those who do not have the confidence or knowledge to cook or do not have time to cook? The relationship between cooking attitude and vegetable consumption could be strengthened by increasing cooking attitude among those who do not cook regularly.

The limitation of this study is the small sample size in determining the prevalence of vegetable intake among university students in Malaysia. The participants' sample population is mostly from Selangor, which contributes to bias and precludes generalization of the results among students from universities in Malaysia. However, it should be noted that the findings may reflect the reality of university students in other parts of the state. Another possible limitation is the cooking dimension and frequency of vegetable intake tools measurement prone to measurement error, especially when recalling long periods of intake. This might have resulted in an overestimate or underestimate of the intake. Other than that, the question asked regarding whether they know or not how to cook is very vague. Some participants might answer 'no' even if they were excellent at cooking. Continuing with the topic of cooking skills, it is important to establish clear and specific parameters when asking such questions in surveys. Besides, in order to fully understand the dietary habits of individuals, it's important to take into consideration their living arrangements. But we failed to provide specifically question regarding whether participants are living in a hostel, rented house, or own house. This information is crucial because living in a hostel may prohibit individuals from cooking, which can be a confounding factor in their consumption of vegetables. One important limitation of this study is the lack of data regarding participants who live with their parents or grandparents and consume less vegetables compared to those who live alone or with friends, as previous studies have said otherwise. However, it is possible that individuals living in these types of households consume fewer vegetables compared to those living alone or with friends. But due to a lack of available and reliable data on this contradiction, we failed to provide a meaningful relationship between these two variables, which limited our analysis.

Conclusion

University students are not consuming an adequate number of vegetables, which leads to global health concerns globally. Sociodemographic factors and lack of cooking skills among students were found to contribute to lower vegetable consumption. The World Health Organization (WHO) recommends consuming 400 grams of fruits and vegetables per day to minimize the risk of developing non-communicable diseases (NCDs) while also ensuring enough dietary fiber intake (8). The Malaysian Food Pyramid 2020 advises that to satisfy the recommendations, each fruit and vegetable should be consumed in at least two and three servings, respectively. Evidence suggests that knowledge of cooking skills was one factor that contributed to vegetable intake in university students. We confirmed that university students had higher levels of cooking skills and daily vegetable consumption than they had not. Therefore, cooking skills should be improved by increasing the availability and accessibility of affordable vegetables by expanding the number of outlets selling them. Future studies could fruitfully explore this issue further by exploring the other factors that might contribute

to vegetable consumption because the behavior acquired at this life stage can last longer throughout old age. This is very much the key component in future attempts to overcome the prevalence of vegetable consumption among other populations in Malaysia.

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