


Original Article



Factors Associated With Dietary Behaviors Among Malaysian Adults: Application of the Social Cognitive Theory

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Abstract

Background: Dietary behavior applying theory-based approaches is seldom documented in the general adult population. Thus, the objective of this study was to determine the eating behavior of Malaysian adults and the demographic factors that were associated with positive eating habits.

Methods: In this cross-sectional survey, the convenience sampling technique was used to sample Malaysian adults aged 18 or older. The questionnaire was based on constructs from Bandura's Social Cognitive Theory (SCT), which has six scales or constructs, including self-efficacy, intentions, situation, social support, behavioral strategies, and outcome expectations and expectancies. All the six constructs demonstrated adequate model fit using confirmatory analysis fit by the developers and good internal reliability using Cronbach's alpha in this study. The data were descriptively analyzed, and subsequently, logistic regressions were performed, assessing demographic factors associated with healthy eating habits. The variables achieving a P value < 0.05 were considered statistically significant.

Results: A total of 461 respondents completed the questionnaire. Good social support (83.30%), outcome expectations (90.24%) and expectancies (92.41%), and the situation in relation to healthy eating (88.94%) were frequently observed among the respondents. The sentence has been revised to express the idea more clearly. However, the observations in these dimensions were not necessarily translated into good self-efficacy (33.41%), intentions (39.91%), and behavioral strategies relating to healthy eating (53.15%). Additionally, demographic variables such as ethnicity, age, and region were significantly associated with the positive attitude observed on the questionnaire constructs.

Conclusion: In summary, the findings of the study revealed that many Malaysians have poor self-efficacy, intentions, and behavioral strategies when it came to eating healthy. The demographic factors significantly associated with dietary behaviors should be targeted in future interventional studies and awareness programs.

Keywords: Feeding behavior, Adult, Psychological theory, Diet

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Introduction

According to the Global Burden of Disease Survey 2019, non-communicable diseases (NCDs) collectively resulted in a majority of disability and death worldwide; it should be noted that the percentage of these diseases increases with age (1). Improper nutrition and eating habits play a significant role in increasing the metabolic risk of many common NCDs. Common metabolic risks such as high fasting plasma glucose, high levels of low-density lipoprotein cholesterol levels, high systolic blood pressure, and high body mass index all lead to a number of prevalent NCDs. Research demonstrates that many of these metabolic risks can be effectively controlled with proper dietary interventions (2-5).

An individual's dietary behavior can be systematically documented, and future interventions can be effectively applied using theory-based approaches. A recent

systematic review found that theory-based interventions delivered in primary health care settings were more effective in improving the health outcomes of patients compared to those without theory underpinnings (6). A commonly used theory to guide health behavior interventions is Bandura's Social Cognitive Theory (SCT), which postulates that the interaction between individual aspects, environmental ones, and those of the person's behavior affects changes in one's behavior (7).

Theory-based approaches are seldom employed for documenting the dietary behavior of the general adult population. Published research in this field usually focuses on interventions for a specific age group, gender, or ethnicity (8-12). Nonetheless, global risk exposures to metabolic risks continue to rise annually (13) and stand to burden the healthcare systems with millions of dollars.

Subsequently, mapping the dietary behavior of the



general public on a variety of social cognitive constructs establishes an overview of the current dietary habits of the population. This potentially can be used for conducting future interventions or determining the influence of personal characteristics on the results observed on the constructs of the survey. Thus, guided by the SCT, this study aimed to determine the eating behavior of Malaysian adults and the demographic factors associated with positive eating habits.

Materials and Methods

This cross-sectional survey was conducted in (November-December) 2019 targeting Malaysian adults aged 18 or older. A convenience sampling design was adopted for the study, which included those who were able to understand Malay or English.

Potential respondents were approached at public areas such as shopping malls, eateries, market areas, and nearby education institutions. Respondents were given the option to answer the questionnaire in some modes of administration, including a web-based (Google Form) or paper-based survey. Ethical approval was obtained from the institutional human ethics committee. In addition, written consent was obtained from the participants prior to answering the survey.

The sample size was calculated according to a 95% confidence level, 80% power of the study, and a 5% margin of error, resulting in a required sample size of 377. The study targeted 452 respondents to account for possible study attritions.

The questionnaire, which was developed by Dewar et al, was based on constructs from Bandura's SCT (7, 14). Although the questionnaire was designed with adolescents in mind, the included dimensions of dietary behaviors are comprehensive and suitable for assessing the eating habits of the general public with minimal necessary modification. Moreover, this instrument had six constructs, including self-efficacy, intentions (i.e., proximal goals), situation (i.e., perceptions of the physical environment), social support, behavioral strategies, and outcome expectations and expectancies (i.e., perceived benefits and the value of these benefits, respectively). All the six constructs demonstrated adequate model fit using confirmatory analysis fit by the developers (14).

The self-efficacy construct, which consisted of six items, assessed the respondents' confidence in choosing/eating healthy foods when an option is available. Examples of the included items were "I find it difficult to choose low-fat foods" and "I find it difficult to choose healthy meals/snacks when I am eating out with my friends." The construct is scored on a 6-point Likert-type scale from "strongly disagree" to "strongly agree".

Next, the intention construct, measured on five items, evaluated the intentions to practice healthy eating in the short-term future of three months. Some of the questions asked included "In the next THREE MONTHS, do you INTEND to eat at least 3 servings of fruit each day? and

"In the next THREE MONTHS, do you INTEND to choose drinks and foods that are low in added sugar whenever you have a choice?" The construct is scored on a 4-point Likert-type scale from "not true at all of me" to "not true at all of me".

The situation construct determined the availability of healthy foods in the home environment of the respondents. This third construct of the questionnaire comprised four items. Sample items were "At home, there are healthy snacks available to eat." and "At home, vegetables are always available to eat (including fresh, frozen, or canned vegetables)." The construct is scored on a 6-point Likert-type scale from "strongly disagree" to "strongly agree".

The social support (six items) gauged the frequency of social support to eat healthy in the past three months from parents/peers/partners. Examples of items included "In the past THREE MONTHS, how often were fruit and vegetables available at home?" and "In the past THREE MONTHS, how often did you prepare healthy snacks or meals with your parents/caretaker/partner/friend?". The construct is scored on a 5-point Likert-type scale from "never" to "always".

The behavioral strategies (five items) estimated the frequency of behavioral strategies practiced to enforce healthy eating habits in the past three months. Samples of items embedded in the construct were "In the past THREE MONTHS, rather than choosing sugary drinks such as fruit juice or soft drink, did you choose water or sugar-free drinks such as diet soft drink?" and "In the past THREE MONTHS, did you leave food on your plate once you felt full during a meal?". The construct is scored on a 5-point Likert-type scale from "never" to "always".

Eventually, outcome expectations and expectancies (10 items) measured the beliefs of healthy eating benefits on five items (outcome expectations) and the importance of the five benefits of healthy eating described above to oneself on another five items (outcome expectancies). Examples of the items included "Healthy eating can help me to feel better physically." and "How important is feeling better physically to you?" for expectation and expectancy sub-sections, respectively. The expectation is scored on a 6-point Likert-type scale from "strongly disagree" to "strongly agree", while expectancy is scored on a 4-point Likert-type scale from "not important at all" to "extremely important".

The wording of the questions was maintained, except for the social support construct where 'partner/friend' was added into the options to maintain the relevance for the adult target group. The number of items for each construct ranged from four to seven. In addition to the constructs, a number of demographic questions were included in the questionnaire.

The constructs were then translated into Malay using the forward-backward translation approach and face-validated by an expert in the field who was also a native speaker. The constructs of the questionnaire were shown to exhibit good psychometric properties, supporting

expert-reviewed content and face-validity, as well as internal consistency when tested in the study. The internal reliability of the constructs was demonstrated to be good using Cronbach's alpha. The Cronbach's alpha values of the constructs were self-efficacy (0.71), intentions (0.77), situation (0.85), social support (0.78), behavioral strategies (0.86), and outcome expectations and expectancies (0.91).

The statistical software STATA (version 14, StataCorp, College Station, TX, USA) was used to run the analyses for the study. The scoring for each construct increased with the exhibited positive dietary behaviors. Negatively worded questions were recoded before further analysis. The available data were descriptively analyzed, and frequencies and percentages were calculated for the available categorical variables.

The mean, median, and range of sum scores were then presented for each construct. The mean score of each construct was calculated by summing the item scores and dividing them by the number of questions. A cut-off point reflecting positive healthy eating attitude was made for each section. More information is detailed in the results section. A higher score reflected a more positive attitude towards the eating habit dimension measured by the respective constructs. The distribution of respondents achieving a positive eating habit for each construct was presented as well. Subsequently, univariate binary logistic regressions were performed, assessing demographic factors associated with healthy eating habits, and scores 1 and 0 reflected positive and negative attitudes, respectively. Variables achieving a P -value < 0.10 were included in multivariate regression for each of the available sections, and a P -value < 0.05 was considered statistically significant.

Results

Overall, 461 members of the general public responded to the survey. The majority of participants ($n = 364$, 78.96%) selected a web-based (Google Form) survey for participating in the study. Most respondents were young (53.15%), female (68.55%), single (73.97%) and possessed an undergraduate degree (52.28%). The demographic details are provided in Table 1.

Regarding self-efficacy, the respondents generally agreed (respondents who chose the "agree slightly", "agree", or "strongly agree" option) that it was difficult to choose low-fat foods (59.00%) and healthy food when eating out with friends (71.37%). Furthermore, 10.41% of the respondents also strongly disagreed that it was easy to eat at least 3 servings of fruits or 4 servings of vegetables a day (Table 2).

Poor dietary behaviors were similarly reflected in the intention construct in which 57.05% of the respondents did not intend to eat the above servings of vegetables in a day (respondents who chose either 'not true at all of me' or 'not very true of me'). This contrasts with the intention concerning fruits and low-fat foods, in which most respondents intended to choose the healthier options.

The respondents generally agreed on the situation

Table 1. Demographics of Respondents

Demographic Variable	No.	%
Age		
18-20	245	53.15
21-30	93	20.17
31-40	39	8.46
41-50	48	10.41
≥ 50	36	7.18
Gender		
Male	145	31.45
Female	316	68.55
Marital status		
Single	341	73.97
Married	114	24.73
Divorced/separated/ widowed	6	1.30
Ethnicity		
Malay	315	68.33
Chinese	65	14.10
Indian	27	5.86
Others	54	11.71
Region		
North Peninsular	286	62.04
East Peninsular	50	10.85
Central Peninsular	57	12.36
South Peninsular	39	8.46
East Malaysia	29	6.29
Education level		
Primary school or lower	11	2.39
Secondary school	66	14.32
College/pre-university/diploma	127	27.55
Undergraduate	241	52.28
Postgraduate	16	3.47
Income		
Less than RM 1000	277	60.09
RM 1000- RM 3999	121	26.25
RM 4000- RM 6999	39	8.46
RM 7000- RM 9999	14	3.04
More than RM 10000	10	2.17

Total number of participants: 461

construct in which there were healthy foods and drinks available at home. However, most respondents only prepared or chose these healthy options over unhealthy ones only sometimes, as reflected on the behavioral strategies construct. Worryingly, one-tenth of the respondents (13.45%) had never prepared healthy food options that were low in fat and added sugar, and almost one-fifth of the respondents had never left food on their plates even if they felt full during a meal (17.35%).

It was positive to note that on the social support construct, many of the respondents had their peers/caretakers/partners encourage them to practice a healthy

Table 2. Distribution of Scores on Each Section

Construct		No. (%)					
Self-efficacy							
	Whenever I have a choice of the food I eat...	Strongly Disagree	Disagree	Disagree Slightly	Agree Slightly	Agree	Strongly Agree
1	I find it difficult to choose low-fat foods (e.g., fruit or “lite” milk rather than “full cream” milk).	33 (7.16)	95 (20.61)	61 (13.23)	80 (17.35)	144 (31.24)	48 (10.41)
2	I find it easy to choose a healthy snack when I eat between meals (e.g., fruit or reduced-fat yoghurt).	21 (4.56)	45 (9.76)	72 (15.62)	116 (25.16)	154 (33.41)	53 (11.50)
3	I believe I have the knowledge and ability to choose/prepare healthy snacks.	10 (2.17)	25 (5.42)	62 (13.45)	135 (29.28)	185 (40.13)	44 (9.54)
4	I find it difficult to choose healthy meals/snacks when I am eating out with my friends.	25 (5.42)	58 (12.58)	49 (10.63)	76 (16.49)	140 (30.37)	113 (24.51)
5	I find it easy to eat at least 3 servings of fruit each day.	60 (13.02)	63 (13.67)	73 (15.84)	115 (24.95)	106 (22.99)	44 (9.54)
6	I find it easy to eat at least 4 servings of vegetables/salad each day.	65 (14.10)	76 (16.49)	91 (19.74)	108 (23.43)	94 (20.39)	27 (5.86)
7	I find it easy to have healthy portion sizes during meals (e.g., not eating till I feel full).	36 (7.81)	44 (9.54)	104 (22.56)	112 (24.30)	129 (27.98)	36 (7.81)
Intentions							
	In the next THREE MONTHS do you...	Not true at all of me	Not very true of me	Somewhat true of me	Very true of me		
1	...INTEND to eat at least 3 servings of fruit each day?	34 (7.38)	122 (26.46)	243 (52.71)	62 (13.45)		
2	...INTEND to eat at least 4 servings of vegetables/salad each day?	65 (14.10)	198 (42.95)	149 (32.32)	49 (10.63)		
3	...INTEND to choose low-fat foods and drinks whenever you have a choice?	16 (3.47)	125 (27.11)	249 (54.01)	71 (15.40)		
4	...INTEND to choose drinks and foods that are low in added sugar whenever you have a choice?	11 (2.39)	88 (19.09)	234 (50.76)	128 (27.77)		
5	...INTEND to eat healthier portion sizes during meals (e.g., not eating till you feel full)?	19 (4.12)	123 (26.68)	238 (51.63)	81 (17.57)		
Situation							
	Situation	Strongly Disagree	Disagree	Disagree Slightly	Agree Slightly	Agree	Strongly Agree
1	At home, there are healthy snacks available to eat.	10 (2.17)	26 (5.64)	32 (6.94)	113 (24.51)	206 (44.69)	74 (16.05)
2	At home, there are healthy drinks available (e.g., cold water in the fridge, sugar-free drinks, and reduced-fat milk).	5 (1.08)	21 (4.56)	25 (5.42)	72 (15.62)	183 (39.70)	155 (33.62)
3	At home, fruit is always available to eat (including fresh, canned, or dried fruit).	8 (1.74)	17 (3.69)	16 (3.47)	68 (14.75)	229 (49.67)	123 (26.68)
4	At home, vegetables are always available to eat (including fresh, frozen, or canned vegetables).	8 (1.74)	18 (3.90)	7 (1.52)	58 (12.58)	212 (45.99)	158 (34.27)
Behavioral Strategies							
	In the past THREE MONTHS...	Never	Rarely	Sometimes	Often	Always	
1	...did you choose reduced-fat options when they were available (e.g., “lite” milk, reduced-fat cheese and yoghurt)?	18 (3.90)	28 (6.07)	255 (55.31)	130 (28.20)	30 (6.51)	
2	...rather than choosing sugary drinks such as fruit juice or soft drink, did you choose water or sugar-free drinks such as diet soft drink?	15 (3.25)	35 (7.59)	166 (36.01)	148 (32.1)	97 (21.04)	
3	...did you leave food on your plate once you felt full during a meal?	80 (17.35)	76 (16.49)	189 (41.00)	90 (19.52)	26 (5.64)	
4	...did you prepare healthy snacks and meals for yourself that were low in fat and added sugar?	62 (13.45)	93 (20.17)	183 (39.70)	89 (19.31)	34 (7.38)	
5	...did you try preparing new recipes for meals and snacks that were low in fat and added sugar?	117 (25.38)	109 (23.64)	147 (31.89)	58 (12.58)	30 (6.51)	
6	...did you do things to make eating fruits and vegetables more enjoyable (e.g., try a new recipe or blend fruit to make a fruit smoothie)?	103 (22.34)	92 (19.96)	154 (33.41)	71 (15.40)	41 (8.89)	
Social Support							

Table 2. Continued

In the past THREE MONTHS how often...		Never	Rarely	Sometimes	Often	Always
1	...were fruits and vegetables available at home?	11 (2.39)	38 (8.24)	84 (18.22)	176 (38.18)	152 (32.97)
2	...did your parents/caretaker/partner/friend make healthy snacks available (e.g., fruit or reduced-fat yoghurt)?	9 (1.95)	69 (14.97)	159 (34.49)	124 (26.9)	100 (21.69)
3	...did your parents/caretaker/partner/friend prepare a healthy home-cooked dinner for you?	6 (1.3)	61 (13.23)	158 (34.27)	137 (29.72)	99 (21.48)
4	...did your parents/caretaker/partner/friend encourage you to eat fruits and vegetables?	11 (2.39)	40 (8.68)	79 (17.14)	162 (35.14)	169 (36.66)
5	...did you prepare healthy snacks or meals with your parents/caretaker/partner/friend?	29 (6.29)	82 (17.79)	135 (29.28)	124 (26.9)	91 (19.74)

Outcome Expectations and Expectancies							
Section F: Healthy eating ...		Strongly Disagree	Disagree	Disagree Slightly	Agree Slightly	Agree	Strongly Agree
1a	... can reduce my risk for some illnesses and diseases (e.g., heart disease, diabetes, some cancers, and the like).	11 (2.39)	13 (2.82)	17 (3.69)	7 (1.52)	124 (26.9)	289 (62.69)
2a	... can help me to feel better physically.	6 (1.3)	16 (3.47)	20 (4.34)	14 (3.04)	158 (34.27)	247 (53.58)
3a	... can help me to control my weight.	10 (2.17)	20 (4.34)	18 (3.9)	13 (2.82)	143 (31.02)	257 (55.75)
4a	... can help to improve my concentration at school/work (e.g., not skipping meals).	8 (1.74)	12 (2.6)	26 (5.64)	44 (9.54)	171 (37.09)	200 (43.38)
5a	... can help me to feel more energetic throughout the day	8 (1.74)	10 (2.17)	20 (4.34)	31 (6.72)	167 (36.23)	225 (48.81)

Section G: How important ...		Not Important at All	Only Slightly Important	Important	Extremely Important
1b	... is reducing your risk for illness and disease to you?	1 (0.22)	12 (2.6)	135 (29.28)	313 (67.9)
2b	... is feeling better physically to you?	1 (0.22)	17 (3.69)	152 (32.97)	291 (63.12)
3b	... is controlling your weight to you?	4 (0.87)	31 (6.72)	156 (33.84)	270 (58.57)
4b	... is improving your concentration at school/work to you?	4 (0.87)	30 (6.51)	150 (32.54)	277 (60.09)
5b	... is feeling more energetic to you?	2 (0.43)	22 (4.77)	147 (31.89)	290 (62.91)

diet at least sometimes. As regards expectations and expectancies, most respondents felt that healthy eating could help with their physical and mental well-being and that such well-being was either important or extremely important to the respondents. Table 2 provides further details of the score distribution on each construct.

Based on the summary scores on each construct in Table 3, the constructs on self-efficacy, intentions, and behavioral strategies had the lowest scores; only 33.41-53.15% of respondents demonstrated positive dieting beliefs, intentions, and behaviors. Further positive eating distributions by demographics can be found in Supplementary File 1.

Multiple logistic regression results assessing demographic factors associated with the section positive sum scores are summarized in Table 4. Concentrating on the above sections with lower scores, there were ethnicity differences in which the Chinese had about two times higher odds of scoring positive sums on the self-efficacy (odds ratio [OR]=2.029) and intention (OR=1.860) constructs compared to the Malays. Those aged 51 or older were three times more likely (OR= 3.053) to possess positive dieting beliefs on the self-efficacy construct in comparison to those aged between 18 and 20. Regional differences in the scores existed for the intentions and

behavioral strategies even after controlling for other demographic factors. The latter construct was additionally influenced by income. The results of the univariate logistic regressions are available in Supplementary File 2.

Discussion

Our study findings demonstrated that while good social support, outcome expectations and expectancies, and situation, in relation to healthy eating were frequently observed among the respondents, the observations in these dimensions had not necessarily translated to good self-efficacy, intentions, and behavioral strategies. Additionally, some demographic variables were significantly associated with the positive attitude observed on the constructs of the questionnaire.

Most respondents recognized the importance of physical and psychological well-being and admitted that healthy eating could aid in achieving such a state. Social support from family and friends to eat healthily was available at least sometimes, complemented by the availability of such food options at home. However, almost 60% of the respondents displayed low intentions of eating healthily in the next three months. Sensitivity analysis revealed that possessing a positive score on the intention construct was significantly associated with scores reflecting the ease of

Table 3. Summary of Score Patterns

	Mean Score (SD)	Median Score	Range of Scores	Minimum Score Reflecting Positive Attitude	Percentage With Scores Reflecting Positive Attitude, No. (%)
Self-efficacy construct	25.08 (5.4)	25	10-42	28	154 (33.41)
Intentions construct	13.8 (2.8)	14	5-20	15	184 (39.91)
Situation construct	19.28 (3.7)	20	4-24	16	410 (88.94)
Behavioral strategies construct	17.74 (4.5)	18	6-30	18	245 (53.15)
Social support construct	18.3 (4.3)	19	5-25	15	384 (83.30)
Outcome construct					
i) Expectations	26.13 (5.2)	28	5-30	20	416 (90.24)
ii) Expectancies	17.83 (2.6)	19	7-20	15	426 (92.41)

Note. SD: Standard deviation.

Table 4. Multiple Logistic Regressions Assessing Positive Dietary Behavior

Demographic Variables	Positive Sum Scores on the Questionnaire Sections											
	Self-efficacy		Intentions		Situations		Behavioral		Social Support		Outcome Expectations	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Education level												
College/pre-university/ diploma (ref)												
Primary or lower	0.222	0.027 - 1.828			1.276	0.156 - 10.413	2.929	0.727 - 11.791	1.524	0.304 - 7.640	1.315	0.162 - 10.660
Secondary	0.730	0.365 - 1.460			0.938	0.403 - 2.185	1.205	0.648 - 2.244	4.110	1.446 - 11.682	1.315	0.520 - 3.322
Pre-U	0.640	0.392 - 1.047			2.645	1.117 - 6.266	1.033	0.657 - 1.625	1.880	0.999 - 3.537	2.651	1.068 - 6.583
Postgrad	0.734	0.192 - 2.810			0.331	0.097 - 1.131	0.346	0.092 - 1.298	0.594	0.158 - 2.229	0.394	0.119 - 1.307
Ethnicity												
Malay (ref)												
Chinese	2.029	1.142 - 3.606	1.860	1.057 - 3.273	0.643	0.275 - 1.505						
Indian	1.662	0.732 - 3.775	1.154	0.500 - 2.664	0.284	0.108 - 0.746						
Others	0.730	0.368 - 1.447	0.618	0.321 - 1.189	1.591	0.525 - 4.824						
Income												
<RM 1000 (ref)												
RM 1000- RM 3999	0.678	0.391 - 1.176					0.601	0.367 - 0.983	0.537	0.283 - 1.017		
RM 4000- RM 6999	1.041	0.484 - 2.238					0.999	0.489 - 2.041	1.095	0.385 - 3.115		
RM 7000- RM 9999	1.063	0.317 - 3.567					1.496	0.453 - 4.936	1.392	0.272 - 7.112		
>RM 10,000	0.561	0.098 - 3.219					6.660	1.071 - 41.434	0.239	0.054 - 1.05		
Age												
18-20 (ref)												
21-30	1.439	0.853 - 2.428	1.103	0.655 - 1.857								
31-40	1.533	0.734 - 3.199	1.297	0.525 - 3.204								
41-50	1.227	0.616 - 2.442	1.919	0.713 - 5.167								
≥51	3.053	1.452 - 6.42	1.209	0.450 - 3.245								
Region												
North Peninsular (ref)												
East Peninsular			2.042	1.084 - 3.847			1.133	0.614 - 2.091				
Central Peninsular			0.472	0.239 - 0.932			1.535	0.851 - 2.768				
South Peninsular			1.052	0.517 - 2.139			1.305	0.658 - 2.590				
East Malaysia			1.829	0.816 - 4.099			2.779	1.180 - 6.549				
Marital status												
Single (ref)												
Currently married or have been married before			1.262	0.574 - 2.775								

Abbreviations: CI, Confidence interval; OR, odds ratio.

Note. None of the tested variables were significant for Section G of the outcomes expectations and expectancies. Blank cells represent variables with $P < 0.10$ at the univariate level. Column 1 denotes the independent variables used to test whether sociodemographic characteristics affected the odds of exhibiting a positive dietary behavior. The rest of the columns indicate dependent variables (i.e., whether or not the particular section had a sum score reflecting positive dietary behavior). Values in bold are statistically significant at $P < 0.05$.

choosing healthy foods (self-efficacy construct) and the actual choice of healthy eating in the past three months (behavioral strategy construct). The latter two constructs also had numerous respondents scoring poorly.

A notable pattern was the difficulty and lack of intentions in consuming the stated number of vegetable servings per day. Similarly, in a study conducted among university students in Germany, less than 10% of those interviewed achieved the recommended vegetable intake (15). According to the Malaysian Adult Nutrition Survey 2014, the mean daily vegetable intake was 1.61 and 1.59 for men and women, respectively, which is significantly lower than the World Health Organization's (WHO's) recommended servings of five portions per day (16,17). This unhealthy pattern potentially extends into old age as well, which was revealed by a study analyzing vegetable consumption data of Malaysians aged 60 and over (18).

The taste of vegetables might not appeal to many and as observed for the behavioral strategy construct, nearly half of the respondents did not or rarely have the initiative to try new recipes which were healthy or even make vegetables more enjoyable for consumption. An interesting study, which collected 2696 comments from news websites in the United Kingdom relating to the public perspective on fruit and vegetable intake, similarly found that the taste of vegetables could deter people from consuming them. Many of these commenters were also unaware of the recommended dietary guidelines and lacked knowledge about healthy eating (19). Awareness of making vegetables tastier with simple new recipes and the recommended daily intake of vegetables could be initiated by the dietetics division of the state-level health departments nationwide.

A worrying 40% did not find it easy to have healthy portion sizes during meals, and 34% of the respondents had never or rarely left food on the plate even if they were full. A Cochrane systematic review evaluating the effects of portion sizes on consumption represented that people generally consume more food when offered larger-sized portions (20). Thus, awareness should focus on educating people to pick healthy portion sizes based on their nutritional requirements. A recently published scoping review of 22 articles indicated that the use of portion control plates was effective in aiding both children and adults alike pick proper portion sizes, along with promoting weight loss in those with obesity and type 2 diabetes (21). Portion plates could be popularized among the general public as an intervention tool for picking healthier portion sizes and in the correct nutritional proportions.

Logistic regression analysis revealed that a number of demographic characteristics had associations with the positive attitude reflected on the constructs, except for outcome expectancies. None of the tested variables were significant for this particular construct, and the homogenous nature of the answers (most respondents had high scores) could have contributed to the results. Nonetheless, the findings in demographic differences in

the other dietary behavior constructs could be used for targeted interventions of healthy eating for the general public.

Additionally, while the survey was developed based on the dietary guidelines for adolescents, the general dietary aspects are also relevant to the adult population and are in accordance with the WHO's nutritional guidelines (16). The dietary aspects touched upon are also relevant to the Malaysian population in which consuming deficient amounts of fruits and vegetables and excessive amounts of high-fat foods and sweetened food and beverages are currently a major concern for the country (22).

The limitations of the study included the non-probability sampling adopted for the study, reducing the generalizability of the study. In addition, most respondents were young. Nonetheless, when controlled for other factors, there were only significant differences in dietary behaviors on the self-efficacy construct whereby only those in the oldest age group had higher odds of displaying confidence in choosing healthy food when the option was available. Moreover, only face validity and internal reliability were directly assessed in this study. The original developers of the questionnaire found the model fit for each construct to be adequate using confirmatory analysis fit, supporting factorial validity. Nonetheless, the content validity of the questionnaire should be further evaluated in both the adult and Malaysian population for the results to be truly generalizable.

Future research could focus on the need of widening the applications of dietary behavior monitoring using theory-based approaches. Such applications could be used to monitor the general population and interventions applied to those who are currently having high metabolic risks of developing NCDs.

Conclusion

In general, the findings of the study revealed that many Malaysians had poor self-efficacy, intentions, and behavioral strategies when it revolved around healthy eating. The demographic factors significantly associated with dietary behaviors should be targeted in future interventional studies and awareness programs.

Authors' Contribution

SCO: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing-review & editing (60%); AVT: Formal analysis, Methodology, Writing-original draft, Writing-review & editing (40%).

Conflict of Interests

The author has reported no conflict of interests.

Ethical Permissions

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Supplementary Files

Supplementary File 1. Distribution of Respondents With Positive Dietary Behavior by Demographic Characteristics.

Supplementary File 2. Univariate Logistic Regressions Assessing Positive Dietary Behavior With a 95% CI.

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