

ORIGINAL ARTICLE

Factors Associated with Diet Quality during COVID-19 Pandemic among Undergraduate Students in Universiti Putra Malaysia

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ABSTRACT

Introduction: The COVID-19 preventive and restriction measures may disrupt an individual's daily diet quality, potentially leading to obesity and other non-communicable diseases. This study aims to assess and determine factors associated with diet quality during the COVID-19 pandemic among undergraduate students at Universiti Putra Malaysia. **Methods:** 130 eligible undergraduate students, who participated in this cross-sectional study were assessed using Global Physical Activity Questionnaire (GPAQ), Depression, Anxiety, Stress Scale (DASS-21), and Rapid Eating Assessment for Participants short version (REAP-S). Self-reported sociodemographic characteristics, body weight status, and nutrition knowledge were evaluated. Statistical analysis was conducted using IBM SPSS 26.0 and $p < 0.05$ was denoted as statistically significant. **Results:** Most of the respondents were female (76.2%), aged between 20-22 years old (64.6%), Bumiputera (80.0%), funded by loan or scholarship (73.1%), low socioeconomic status (60.0%), residing in the family household (57.7%), consumed home-cooked meals (58.5%), and used the e-hailing food services for 0-3 days/week (63.1%). There was an equal distribution in the year and program of study in every selected faculty. Most were having normal BMI status (54.6%), good nutrition knowledge (66.9%), sedentary (48.5%), less severe mental health status (85.4%), and good diet quality (62.3%). Nonetheless, throughout the study, only the anxiety subscale was associated with diet quality ($r = -0.20$, $p < 0.05$). **Conclusion:** Perceived anxiety may lead to poor diet quality. Future studies could determine the food environment and food security faced by the students as these factors vary among individuals. It is also recommended to measure diet quality differences before, during, or after the pandemic.

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INTRODUCTION

Diet quality could be defined as the extent of an individual's diet that abides by dietary recommendations and guidelines on the consumption of a variety, balanced, and nutritious diet, which helps to provide adequate energy and essential nutrients for growth, and healthy lifestyles (1, 2). In short, the healthier the dietary habit, the higher the diet quality.

By the end of December 2019, a new deadly, contagious pneumonic disease caused by a novel coronavirus was discovered in the city of Wuhan, China, and the disease was later named COVID-19 (3). On 24th January 2020, the first 22 cases of COVID-19 were detected in Malaysia (4). However, the number of cases continued to increase, and on 18th March, the government of Malaysia imposed

Movement Control Order (MCO) or 'partial lockdown' on all Malaysian citizens (5). The similarity of these control measures was to avoid mass gatherings to curb virus transmission (4). The government also prepared updated guidelines for Malaysians to adapt to this new norm such as wearing a face mask, applying one meter of physical distancing, and advice on good practices for handwashing (6).

Some studies reported during quarantine or lockdown, individuals' carbohydrate source intakes increased especially unhealthy diets such as confectioneries, junk food, and sugary drinks (7-9). These could be due to emotional eating or the search for comfort food because of social isolation, loneliness, boredom, anxiety, and depression (9). Some studies reported that mental health status significantly improved with healthy foods such as fruits, vegetables, and seafood, (10-11).

A study also reported that most of the respondents reported an increase in food consumption due to stressful eating behaviour and an increased intake of

confectioneries would eventually increase the possibility of gaining weight as physical inactivity increased to 39.5 % during the pandemic (12). This could be due to the response of sight and smell, and most likely to increase in snacking after dinner (13).

The changes in dietary behaviour during the pandemic could be due to insufficient knowledge of nutrition or inaccessibility to healthy food. Based on the study conducted among university students, the populations tend to deviate from healthy eating due to a lack of knowledge on healthy eating, pricey, and inaccessibility of healthy food (14). However, there was insufficient information on the correlation between knowledge and diet quality.

In summary, based on the studies mentioned, pandemics and lockdowns increased the food intake among the population due to stress, sleep disturbance, and sedentarism. This behaviour might lead to weight gain among the population. Due to insufficient studies conducted and evidence on factors associated with one's dietary quality during the pandemic and insufficiently conducted on university students. Hence, this study aimed to assess and determine factors associated with diet quality during the pandemic among undergraduate students.

MATERIALS AND METHODS

Study population and design

This was an online cross-sectional study conducted among local undergraduate students at Universiti Putra Malaysia (UPM), Serdang, from April to May 2021. The sample size was calculated using the correlation coefficient formula (Cole, 1997) with power set at 80% and type 1 error at 5%.

$$n = \frac{(z_{1-\frac{\alpha}{2}} + z_{1-\beta})^2}{r^{*2}/(1 - r^{*2})} + 5$$

Where:

n = Calculated sample size

Z_{1-α/2} = z score for significance level at 5% = 1.96

Z_{1-β} = z score for power set at 80% = 0.842

r* = correlation

Using multistage sampling, a program of study in each of the Art and Social Science, Science, and Technical fields were randomly selected. The students from the respective programs were randomly selected and invited to participate in the study through the Whatsapp group. The inclusion criteria were undergraduate students between the ages of 19-25 years old, whereas international students and students from nutrition and dietetic programs were excluded from the study. Nonetheless, the presence of COVID-19 illness among respondents was not taken into consideration in this study. Out of 164 recruited students, only 130 eligible

participants consented and completed the questionnaire. Therefore, the response rate was 73.2%.

Before pre-testing and data collection, ethics approval was obtained from the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia (JKEUPM), with the reference number JKEUPM-2021-019. Permission to conduct the study among the targeted population was obtained from the Department of Nutrition, Faculty of Medicine and Health Sciences, UPM, and from the respective Dean of the faculties. The duration for data collection was April to May 2021.

Instruments

Sociodemographic characteristics and BMI status

For sociodemographic information, the respondents self-reported their date of birth, age, sex, ethnicity, faculty, the program of study, year of study, study funding, monthly personal income, parent's monthly household income, current living arrangement, type of meal preparation, and presence and frequency of e-hailing food services usage.

The respondents self-recorded their latest weight (kg) and height (cm) as this study was conducted online. The BMI status was classified as <18.5 kg/m² (underweight), 18.5-24.9 kg/m² (normal), 25.0-29.9 kg/m² (pre-obese), and ≥30.0 (obese) (15).

Nutrition knowledge

To assess nutrition knowledge among respondents, the validated questionnaire developed by the Malaysian Technical Working Group on Research (TGW-R) (16) was used. A study showed that this instrument had high reliability (17). This multiple-choice questionnaire consisted of 20 questions which comprised nutrient functions, food energy, nutrient inadequacy, food preferences, and nutrient supply (17). The scoring method was one mark given for the correct answers and a zero mark for incorrect or unsure responses. The possible range of total score was 0-20 which will be converted into percentages. The cut-off score was 0-50% (poor), 51-74% (moderate), and 75-100% (good) (16).

Physical activity level

Global Physical Activity Questionnaire 2nd version (GPAQv2) developed by World Health Organisation (WHO) (18) was used to determine frequency and time spent on physical activity (PA) levels in a typical week among respondents. GPAQv2 also showed was suitable and accessible to various countries and cultures (19). The test-retest reliability for the overall questionnaire was 0.44-0.89 (20-21). This self-administered questionnaire contained 16 items including open-ended questions which comprised three domains: work, transportation (cycling and walking from one place to another), and

sedentary behaviour. The moderate- and vigorous-intensity activities were defined based on METs value which differs by domain (18). The total PA per week was accumulated from the sum of minutes spent for PA and METs values from the three domains.

If the respondents performed ≥ 3 days of vigorous PA and accumulated ≥ 1500 MET-minute per week, or perform ≥ 7 days of moderate- and vigorous PA and scored ≥ 3000 MET minutes per week, the respondents were denoted as very active. If the respondents performed ≥ 3 days of vigorous PA for ≥ 60 minutes per week, or ≥ 5 days of moderate PA and walking for ≥ 150 minutes per week, or ≥ 5 days of combined moderate- and vigorous PA and achieved ≥ 600 MET-minute per week, the respondents were moderately active. If none of the above is achieved or no activity is reported, the respondents were reported as inactive (18).

Mental health status

The instrument used to assess the variable was the short version of the Depressive, Anxiety, Stress Scale (DASS-21) which was developed by Lovibond and Lovibond (1995) (22) and previous local studies showed adequate validity and reliability of DASS-21(23-24). This 4-point Likert scale questionnaire had a total of 21 items which comprised seven items each for depression, anxiety, and stress subscales. The score ranges from zero (never), one (sometimes), two (often), and three (almost always). The scores in each subscale were further multiplied by two to assess the severity of depression, anxiety, and stress experienced by the respondents (22). The minimum achievable score for each subscale was zero, while the maximum was 42.

The cut-off point for depression was 0-9 (normal), 10-13 (mild), 14-20 (moderate), 21-27 (severe), and ≥ 28 (extremely severe). For anxiety, 0-7 (normal), 8-9 (mild), 10-14 (moderate), 15-19 (severe), and ≥ 20 (extremely severe). As for the stress subscale, 0-14 (normal), 15-18 (mild), 19-25 (moderate), 26-33 (severe), and ≥ 34 (extremely severe). Therefore, the possible total score for DASS-21 was 0-120 with the cut-off point ≥ 60 labelled as 'severe'.

Diet quality

The validated Rapid Eating Assessment for Participants shortened version (25) was adapted to measure the respondents' diet quality. This 16-items self-administered questionnaire consisted of breakfast skipping habits, consumption of high-fibre food, fruits, vegetables, and dairy products, sources of protein, and salty, fatty, and sugary food consumption, food preparation, food security, and respondents' self-efficacy to change their diet. This self-administered questionnaire was modified according to the guidelines and serving size highlighted by the Malaysian Dietary Guidelines (26), Malaysian Food Pyramid 2020 and Malaysian Food Composition Database (MyFCD). The purpose of the modification was

to conform to Malaysian foods and cultures. To ease the respondents in identifying the serving size, pictures of standard household measurements were included. The Cronbach's alpha for REAP-S in this study was $\alpha=0.51$. For the scoring method, only the first 13 items were reported (27), with which one point for 'usually/often', two points for 'sometimes', and 'three' points for 'rarely/never or does not apply to me'. Hence, the possible scoring range was 13-39, and the higher diet quality was denoted with higher scores. The Median was used as the cut-off score for diet quality (28).

Statistical analysis

The data obtained were analysed using IBM SPSS Statistic 26.0. Categorical variables were presented in frequency and percentages, while continuous variables were presented in mean and standard deviation. By considering the data normality, Pearson correlation and Spearman correlation was used to analysing for continuous variables. For categorical variables, the Chi-square independence test was used for data that fulfil the assumption, and if not, Fischer's Exact test will be performed. The $p<0.05$ was denoted as a significant value.

The data obtained were analysed using IBM SPSS Statistic 26.0. Descriptive statistics were used to analyse the sociodemographic statistics, diet quality and other covariates. The Pearson correlation was used to analyse the continuous variables, whereas, the Chi-square independence test was used to analyse the categorical variables, in determining the association between diet quality with sociodemographic characteristics, BMI status, nutrition knowledge, physical activity level, and mental health status. Spearman correlation and Fischer's Exact test were performed when the data was skewed or did not fulfil the assumption. The $p<0.05$ was denoted as statistically significant.

RESULTS

Sociodemographic characteristics

Table I showed the sociodemographic characteristics of the overall 130 respondents. The majority of the respondents were female (76.2%, $n=99$) and male respondents only comprised around 23.8% ($n= 31$). The mean age of the respondents was 21.98 ± 1.16 years old, which ranges from 20-25 years old. The majority of the respondent were Bumiputera (80.0%, $n=104$) which consisted of Malay (78.5%, $n=102$) and Sabahan (1.5%, $n=2$). The remaining were Chinese (13.8%, $n=18$) and Indian (6.2%, $n=8$). Next, there was an equal distribution of every year of study in each program of the faculties. Only a small number of the respondents were self-funded during the year of study (26.9%, $n=35$), while the majority received scholarships (3.1%, $n=4$) and loans (91.0%, $n=91$). The number of respondents who received $<RM 200.00$ and $RM 200.00-RM 599.99$ as monthly allowance were equal, with the mean value

Table I Sociodemographic characteristics of the respondents (n= 130)

Variables (n=130)	Mean ± SD	N (%)
Age (years old)	21.98 ± 1.16	
20-22		84 (64.6)
23-25		46 (35.4)
Sex		
Male		31 (23.8)
Female		99 (76.2)
Ethnicity		
Bumiputera		104 (80.0)
Non-Bumiputera		26 (20.0)
Faculty of study		
Faculty of Human Ecology (FEM)		49 (37.7)
Faculty of Biotechnology and Molecular Science (FBMB)		46 (35.4)
Faculty of Design and Architecture (FRSB)		35 (26.9)
Program of study		
B. Sc. (Human Development and Management)		49 (37.7)
B. Sc. (Molecular Biology)		46 (35.4)
Bachelor of Design (Industrial Design)		35 (26.9)
Year of study		
First-year		34 (26.2)
Second-year		37 (28.5)
Third-year		35 (26.9)
Fourth-year		24 (18.5)
Study funding		
Scholarship, Loan		95 (73.1)
Self-funded		35 (26.9)
Monthly allowance (RM)	326.37 ± 266.27	
<200.00		57 (43.8)
200.00 - 599.99		57 (43.8)
≥ 600.00		16 (12.3)
Parent's monthly household income (RM)	5,102.29 ± 4530.91	
B40: ≤ 4,849.99		78 (60.0)
M40: 4,850.00 -10,959.99		39 (30.0)
T20: ≥ 10,960.00		13 (10.0)
Current living arrangement		
Family household		75 (57.7)
Rental houses		10 (7.7)
UPM residential colleges		45 (34.6)
Type of meal preparation (weekly)		
Home-cooked		76 (58.5)
Dine-in, Take-away		46 (35.4)
E-hailing services		8 (6.2)
Presence of e-haling services at the current living arrangement		
No		20 (15.4)
Yes		110 (84.6)
Frequency of using e-haling services (n=110)		
Regular (4-7 days)		6 (4.6)
Average (0-3 days)		82 (63.1)
Never used the services		22 (16.9)

SD= standard deviation

RM 326.37 ± 266.27. As for parents' monthly income level, ≤RM 4,849.99 was the most amount reported by the respondents (60.0%, n=78) and the mean was RM 5,102.29 ± 4530.91. Most of the respondents reported residing in the family household (57.7%, n=75) during the pandemic. Some of the respondents reported residing in the residential college (34.6%, n=45) and a few reported staying in rental houses (7.7%, n=10). During the pandemic, most of the respondents were

prone to have home-cooked meals (76%, n=58.5). Some of the respondents were also having meals from restaurants, either dine-in (5.4%, n= 7) or takeaway (30.0%, n=39); however, the respondents were less likely to have meals from e-hailing services (GrabFood, Foodpanda etc.) (n=8, 6.2%). In most of the places, where the respondents were currently residing, there was an availability of e-hailing food services (84.6%, n=110) and the mode of frequency of using the services per week was 0-3 days (63.1%, n=82).

Other covariates

Table II showed the mean and frequency of body weight status, nutrition knowledge, physical activity level, and mental health status of the respondents. The mean weight and height of the respondents were 57.10 ± 14.13 kg and 1.60 ± 0.01 m, respectively. The respondents' average BMI status was 22.22 ± 5.23 kg/m², with the

Table II Body weight status, nutrition knowledge, physical activity level, and mental health status of the respondents (n=130)

Variables (n=130)	Mean ± SD	N (%)
Body weight status (BMI level) (kg/m²)	22.22 ± 5.23	
Weight (kg)	57.10 ± 14.13	
Height (m)	1.60 ± 0.01	
BMI Classification		
Underweight (<18.5)		31 (23.8)
Normal (18.5-24.9)		71 (54.6)
Overweight (25.0-29.9)		18 (13.8)
Obese (≥30.0)		10 (7.7)
Nutrition knowledge	12.35 ± 2.88	
Poor (0-10 scores)		9 (6.9)
Moderate (11-14 scores)		34 (26.2)
Good (15-20 scores)		87 (66.9)
Physical activity levels^a	1080.00 (195.00-2640.00)	
Number of days spent	6.48 ± 5.38	
Number of durations spent (minutes)	115.60 ± 152.87	
Low		63 (48.5)
Moderate		37 (28.5)
High		30 (23.8)
Sitting (minutes) (n=129) ^a	240.00 (90.00-420.00)	
Mental health status	31.25 ± 24.38	
Less severe (<60 scores)		111 (85.4)
Severe (≥60 scores)		19 (14.6)
Depression subscales	9.92 ± 9.08	
No symptom (0-9 scores)		72 (55.4)
Have symptoms (≥10 scores)		58 (44.6)
Anxiety subscales	10.23 ± 8.59	
No symptom (0-7 scores)		56 (43.1)
Have symptoms (≥8 scores)		74 (56.9)
Stress subscales^a	10.00 (2.00-16.00)	
No symptom (0-14 scores)		92 (70.8)
Have symptoms (≥15 scores)		38 (29.2)

SD= standard deviation

^aMedian (Interquartile range, Q₁-Q₃)

majority being normal (54.6%, n=71). Quite a few respondents were underweight (23.8%, n=31), followed by pre-obese (13.8%, n=18), and obese (7.7%, n=10). Next, most of the respondents were reported to acquire moderate to good nutrition knowledge (26.2%, n=34 and 66.9%, n=87, respectively) with a mean score was 12.35 ± 2.88 scores. About 6.9% of the respondents (n=9) reported having poor nutrition knowledge.

As for physical activity level, the average number of days spent was 6.48 ± 5.38 days and the average time spent was 115.60 ± 152.87 minutes per week. Most of the respondents were likely to practice an inactive lifestyle (48.5%, n=63), followed by moderately active (28.5%, n=37), and very active (23.8%, n=30). The amount of energy spent on physical activity (METs value) was 1080.00 METs per week, and the number of minutes spent sitting was 240.00 minutes per day.

Furthermore, there was an almost equal distribution of respondents who were less severe (37.7%, n=49) and had poor mental health status (35.4%, n=46), with a mean value of 31.25 ± 24.38 scores. Most of the respondents reported experiencing less severe depression (86.2%, n=112) with mean scores of 9.92 ± 9.08 . As for anxiety subscales, the majority reported having symptoms of anxiety (56.9%, n=74) with a mean score of 10.23 ± 8.59 . Most of the respondents reported having no symptoms of scores (70.8%, n=92) with a median score of 10.00.

Diet quality

As there is no documented diet quality classification for the REAP-S diet quality instrument, the median was used as a cut-off point based on the previous study (Mayra et al., 2019). Overall, with a mean score of 26.79 ± 3.32 , most of the respondents were having high diet quality (62.3%, n=81). The details were shown in Table III.

Factors associated with diet quality

Based on Table IV, although respondents aged 20-22 years old, females, Bumiputera, funded by scholarship or loan, monthly allowance <RM200.00, parents monthly household income \leq RM4,849.99, living in a family household, consumed home-cooked meals, and no e-hailing services at the current location reported to have high diet quality, nevertheless there were no significant associations with diet quality ($p > 0.05$). There was also no significant association between body weight status, nutrition knowledge, physical activity level, and overall mental health status with diet quality ($p > 0.05$). The depression and stress subscales also reported no

Table III: Diet quality of the respondents (n=130)

Variables (n=130)	Mean \pm SD	N (%)
Diet quality	26.79 ± 3.32	
Low (< 26 scores)		49 (37.7)
High (\geq 26 scores)		81 (62.3)

SD= standard deviation

association with diet quality ($p > 0.05$), except for the anxiety subscales. Anxiety was negatively associated with diet quality ($r = -0.20$, $p = 0.024$). The details of the findings were as in Table V.

DISCUSSION

The overall good diet quality among the respondents in the present study was inconsistent compared to the previous study among university students (29). Due to the pandemic of COVID-19, several studies showed there was a reduction in healthy foods consumption such as fruits, vegetables, nuts, legumes, and fish/seafood among general populations (7, 12, 30) and an increase in carbohydrate sources and snacking (7-8, 30-31). The engagement to poor diet and insufficient intakes of certain food groups during the pandemic could be due to confinements, business closure, short grocery store operation hours, and limited access to food environments (30, 32). The increased consumption of confectioneries and sugary foods could be due to boredom, stress, and anxiety during the pandemic (12). Based on the findings in this study, the majority of female and Malay respondents were consistent with the previous study (33-34). This could be due to the higher percentages of female students in Malaysian tertiary education (34). Yet, the insignificant findings between sex and diet quality in the present study contradicted prior studies, whereby, females had higher diet quality than male students (29, 35-36). Higher favourability for a good diet among females might be because of practice dieting and good nutrition knowledge. Similar to a local study (37), the present results showed there was no significant association between ethnicity and diet quality might be due to the overrepresentation of the Malay population.

The age and distribution of the year of study among the respondents were also consistent with the previous study (33-34). The reduced participation among older students could be due to an increase in assignments, projects, and exams. There were mixed findings in the association between the variables with diet quality. As some studies agreed with the present findings (35-36), several studies were showed older age students tend to consume soft drinks and packaged drinks (29) and less likely to consume fruits, vegetables, fish, pasta or rice, cereal products, dairy products, and sweets (35).

In the same agreement as the previous study (33), most of the respondents were from low socioeconomic status and were funded by scholarships. The association between financial status and diet quality were contradicted by the prior study (38) because less nutritive and low-diet-quality foods were more accessible, affordable, palatable and culturally acceptable to individuals from lower-income levels compared to nutrient-dense foods (39). However, there might be underreporting in the current findings as these subjects could be sensitive and

Table IV: Association between sociodemographic characteristics and diet quality (n= 130)

Variables (n=130)	Diet quality					
	Low diet quality n (%)	High diet quality n (%)	χ^2	p-value	r	p-value
Age (years old)			0.004	0.951	-0.04	0.693
20-22	31 (63.3)	53 (65.4)				
23-25	18 (36.7)	28 (34.6)				
Sex			0.86	0.354		
Male	9 (18.4)	22 (27.2)				
Female	40 (81.6)	59 (72.8)				
Ethnicity			2.23	0.135		
Bumiputera	43 (87.8)	61 (75.3)				
Non-Bumiputera	6 (12.2)	20 (24.7)				
Faculty of study			3.93	0.140		
Faculty of Human Ecology (FEM)	23 (46.9)	26 (32.1)				
Faculty of Biotechnology and Molecular Science (FBMB)	17 (34.7)	29 (35.8)				
Faculty of Design and Architecture (FRSB)	9 (18.4)	26 (32.1)				
Program of study			3.93	0.140		
B. Sc. (Human Development and Management)	23 (46.9)	26 (32.1)				
B. Sc. (Molecular Biology)	17 (34.7)	29 (35.8)				
Bachelor of Design (Industrial Design)	9 (18.4)	26 (32.1)				
Year of study			3.51	0.319		
First-year	12 (24.5)	22 (27.2)				
Second-year	10 (20.4)	27 (33.3)				
Third-year	16 (32.7)	19 (23.5)				
Fourth-year	11 (22.4)	13 (16.0)				
Study funding			0.16	0.900		
Scholarship, Loan	35 (71.4)	60 (59.2)				
Self-funded	14 (28.6)	21 (25.9)				
Monthly allowance (RM)			5.77	0.056	-0.01	0.881
<200.00	17 (34.7)	40 (49.4)				
200.00 - 599.99	28 (57.1)	29 (35.8)				
≥ 600.00	4 (8.2)	12 (14.8)				
Parent's monthly household income (RM)			0.46	0.795	-0.06	0.511
≤ 4,849.99	29 (59.2)	49 (60.5)				
4,850.00 -10,959.99	16 (32.7)	23 (28.4)				
≥ 10,960.00	4 (8.2)	9 (11.1)				
Current living arrangement			4.14	0.126		
Family household	32 (65.3)	43 (53.1)				
Rental houses	1 (2.0)	9 (11.1)				
UPM residential colleges	16 (32.7)	29 (35.8)				
Type of meal preparation (weekly)^c			3.36	0.165		
Home-cooked	27 (55.1)	49 (60.5)				
Dine-in, take-away	21 (42.9)	25 (30.9)				
E-hailing services	1 (2.0)	7 (8.6)				
Presence e-hailing services			0.001	0.985		
No	42 (85.7)	68 (84.0)				
Yes	7 (14.3)	13 (16.0)				
Frequency of using e-hailing services			2.97	0.246		
Regular (4-7 days)	2 (4.8)	4 (5.9)				
Average (0-3 days)	35 (83.3)	47 (69.1)				
Never used the services	5 (11.9)	17 (25.0)				

χ^2 = Chi-square independence test
r= Pearson correlation coefficient
^c Categorical data analysis, χ^2 =Fischer's Exact test

Table V Association between body weight status, nutrition knowledge, physical activity level, mental health status and diet quality (n=130)

Variables (n=130)	Diet quality					
	Low diet quality n (%)	High diet quality n (%)	χ^2	p-value	r	p-value
Weight (kg)					-0.06	0.506
Height (m)					0.04	0.696
Body weight status (BMI level) (kg/m²)			5.68	0.128	-0.09	0.304
Underweight (<18.5)	13 (26.5)	18 (22.2)				
Normal (18.5-24.9)	23 (46.9)	48 (59.3)				
Pre-obese (25.0-29.9)	6 (12.2)	12 (14.8)				
Obese (≥ 30.0)	7 (14.3)	3 (3.7)				
Nutrition knowledge			2.29	0.319	0.12	0.164
Poor (0-10 scores)	5 (10.2)	4 (4.9)				
Moderate (11-14 scores)	10 (20.4)	24 (29.6)				
Good (15-20 scores)	34 (69.4)	53 (65.4)				
Physical activity levels^b			3.77	0.152	0.25	0.780
Number of days spent					0.11	0.234
Number of durations spent (minutes)					0.07	0.465
Low	23 (46.9)	39 (48.1)				
Moderate	18 (36.7)	19 (23.5)				
High	8 (16.3)	23 (28.4)				
Sedentary behaviour (minutes) (n=129) ^b					-0.13	0.145
Mental health status			0.47	0.493	-0.16	0.077
Less severe (<60 scores)	40 (81.6)	71 (87.7)				
Severe (≥ 60 scores)	9 (18.4)	10 (12.3)				
Depression subscales			0.36	0.551	-0.11	0.213
No symptom (0-9 scores)	25 (51.0)	47 (58.0)				
Have symptoms (≥ 10 scores)	24 (49.0)	34 (42.0)				
Anxiety subscales			0.35	0.557	-0.20	0.024*
No symptom (0-7 scores)	19 (38.8)	37 (45.7)				
Have symptoms (≥ 8 scores)	30 (61.2)	44 (54.3)				
Stress subscales^b			0.22	0.640	-0.13	0.157
No symptom (0-14 scores)	33 (67.3)	59 (72.8)				
Have symptoms (≥ 15 scores)	16 (32.7)	22 (27.2)				

χ^2 = Chi-square independence test

r= Pearson correlation coefficient

^b non-parametric data analysis, r= Spearman correlation

*p<0.05

confidential.

Furthermore, most of the studies showed the majority of university students and the general population tend to consume home-cooked meals and were less likely to eat outside during the pandemic (8, 30), which was consistent with the current findings. The reduction in eating outside could be because of awareness and the restrictions taken by the government to curb virus transmission (8). The present study also showed that the type of meal preparations was not associated with diet quality which was against the previous study (40). Nonetheless, the results of high good diet quality and increased intake of home-cooked meals should not be the sole indicator of healthy eating. This was because

the increasing intakes of energy-dense homemade foods and snacking behaviour could also be interpreted as home-cooked meals (8). Therefore, the external factors that need to be considered might be nutrition knowledge and meal preparation skills and methods (40).

Although the current findings showed the majority of BMI status was normal during the pandemic of COVID-19 which was consistent with several studies (9, 13, 31), there were quite concerning numbers of respondents who were underweight and overweight/ obese. Besides genetics, insufficient nutrient intake and diseases, the increasing prevalence of underweight among female university students (14, 34) could be due to media and culture which advertise thinness as part of beauty

standards (41). The overabundance of less healthy foods, cheap, and less encouragement for healthy eating could also influence the purchasing of low-diet quality foods and induced weight gain (42-43). The insignificant relationship between body weight status and diet quality was differed by several prior studies (9, 13, 29, 31). Nonetheless, the insignificant association in the current study could be due to over- or underreporting as this section depends on the respondent's memory recall and was not directly measured by the researchers (31).

The nutrition knowledge level among respondents based on the findings was slightly inconsistent with the previous studies (38, 44). The inconsistency showed the level of exposure to health and nutrition awareness received by university students. Although the current findings showed the majority of the respondents had good nutrition knowledge and good diet quality, there was an insignificant correlation between the variables. Despite the inconsistencies with the previous study (44, 45), nutrition knowledge was not the sole indicator of good diet quality. This was because a study conducted among Polish, German, and Slovak students showed that Polish students had good diet quality, but less healthy diet compared to German and Slovak students (38). The external factors that needed to be considered were accessibility to healthy food options, convenience, taste, price, and cooking skills which could affect students' preferences and eating patterns (38, 44).

Moreover, several studies reported there was a drastic reduction in physical activity and an increase in sedentary behaviour among the general population (9, 12, 32) and university students (46) during the COVID-19 pandemic. The motivation (7-9, 47), accessibility, and safety issue might influence the rate of physical activity conducted by the respondents (47). A study reported that there was a significant association between sedentary behaviour and diet quality (35), which was aligned with the present study. Nonetheless, some studies mentioned students who engaged in active lifestyles had good diet quality (38, 47). Based on the current findings, although most of the respondents claimed to have good diet quality and engaged in inactive lifestyles, the presence of remote or online learning due to confinement during the pandemic lead to less movement during the pandemic (32).

Unlike the present study, the pandemic did bring negative impacts on university students' mental health status (48-49). The students had concerns about the health of their loved ones, pursuing studying, low productivity, financial status, future employment, and contracting the virus (49). Based on the current study, the overall mental health status was not significantly associated with diet quality, yet several studies showed that a positive mental health attitude was associated with good diet quality (10-11). Individuals with high happiness scores tend to consume full-three meals, have adequate intakes of fruits and vegetables and were

less likely to skip breakfast (11). High optimism also led to good diet quality because adequate intakes of glucose promote happiness and enhance healthy eating behaviours (11).

Furthermore, based on the present findings, the anxiety subscale was negatively correlated with diet quality ($r = -0.20$, $p < 0.05$) and aligned with previous studies, whereby, students with negative emotions were more likely to have poor diet (14, 50). Despite the insufficient studies on the association between mental health status with diet quality during the pandemic especially among university students, most studies did show social isolation, loneliness, boredom, anxiety, and depression could lead to emotional eating and search for comfort food (9, 12, 48). The students also reported having changes in dietary patterns from the hungry, poor eating pattern, lack of appetite, and an increase in cooking (48).

Although the current study could at least help to provide an overview of the diet quality among undergraduate students studying at Universiti Putra Malaysia during the pandemic COVID-19, however, some limitations need to be discussed for improvements in future studies. This study solely relied on the respondent's memory recall and self-recorded data on the financial status, weight, and height measurement which might lead to under- or overreporting as some might consider the subjects confidential or private. Aside from the small sample size, this study only involved certain programs of study in UPM, Serdang; therefore, could not be the whole representation of Malaysian's undergraduate students. In addition, some of the instruments used were not well-known among the target population although the instrument had been validated and might not be suitable for the present environment. For instance, although REAP-S was easy to administer and provided quick screening for diet quality (27), the instrument was least known globally and in Malaysia. While some of the food is included to suit Malaysian's food culture, this act might be insufficient because the items were created to suit the culture and environment of the Western countries. Next, because of the design approach, this study could not determine the causal and effective relationship between the variables.

CONCLUSION

The majority of the students reported having good diet quality during the pandemic of COVID-19. Nonetheless, anxiety could give a negative impact on one's diet quality. This indicated that proper mental health management was crucial among university students and should be highlighted by the university's administration and respective authorities. Moreover, the relationship between the food environment and food insecurity should be observed for an in-depth understanding of this issue. Future research also could determine the changes in diet quality before, during, or after the pandemic of

COVID-19 for comprehensive insights.

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