

COVID-19 LOCKDOWN: THE MAGNITUDE OF DEPRESSIVE SYMPTOMS IN RELATION TO DIET AND PHYSICAL ACTIVITY AMONG MALAYSIAN UNIVERSITY STUDENTS

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Abstract: This cross-sectional study aims to investigate the relationship between habitual food consumption, physical activity, and depression among 608 public university students during the Movement Control Order via convenience sampling. Students' food consumption was assessed using a semi-quantitative food frequency questionnaire, while the International Physical Activity Questionnaire and the Depression Anxiety Stress Scale 21 were used to evaluate physical activity levels and depressive symptoms, respectively. The pre-tested questionnaire was self-administered via Google Forms, and the data was analysed using SPSS v25. The most frequently consumed food items were "plain water" (score: 95.9) and "white rice" (score: 93.7). Approximately 74.3% of the students reported moderate-to-high physical activity levels. However, mental health was a concern, with 49.2% of the students exhibiting depressive symptoms, 55.1% showing signs of anxiety, and 33.1% reporting stress symptoms. There were significant correlations between depressive symptoms and consumption of certain food groups such as cereal and cereal products, fast food, eggs, milk and milk products, and confectionery, at $p < 0.05$. Similarly, significant correlations were observed between depressive symptoms and total walking, total moderate physical activity, and total physical activity, at $p < 0.05$. These findings highlight the impact of COVID-19 on university students' health, emphasising the need for appropriate interventions and preventative measures for their well-being.

Keywords: COVID-19 impact, university students' mental health, dietary habits, physical activity, depressive symptoms.

Introduction

The COVID-19 pandemic, caused by an infectious disease that causes symptoms ranging from mild respiratory illness to severe breathing difficulties (The World Health Organisation, 2021), prompted governments worldwide, including Malaysia, to enforce preventive measures. One such measure was the Movement Control Order (MCO), initiated by the Malaysian government on March 18, 2020, and lasting until November 1, 2021 (Ministry of Health, 2020; Tang, 2020). While the MCO aimed to curb the virus's spread, it inadvertently impacted university students' habitual food consumption, physical activity, and mental

health. Studies published in the Journal of Sustainability Science and Management (JSSM) have explored various aspects of the COVID-19 pandemic (Azman & Abdullah, 2021; Lian *et al.*, 2022; E-Vahdati *et al.*, 2023). However, none have examined the relationship between habitual food consumption, physical activity, and depression among university students, highlighting a significant gap in knowledge. During the pandemic, university students reported decreased consumption of vegetables, legumes, and fruits, and increased snacking due to lockdown restrictions (Liu *et al.*, 2016; Cheng & Kamil, 2020; Unyang *et al.*, 2020; Cecchetto

et al., 2021). This shift towards a more sedentary lifestyle disrupted their usual eating habits and increased their consumption of meat and other proteins (Patel et al., 2019). Limited access to fresh food further exacerbated these changes (Patricia et al., 2021).

The pandemic also led to a decrease in physical activity among university students, increasing the risk of non-communicable diseases, obesity, and lower academic performance (Omar et al., 2015; Rajappan et al., 2015; Lipošek et al., 2019; NHMS, 2019; Harmouche-Karaki et al., 2020). Additionally, the pandemic heightened mental health issues among university students, with a significant increase in depressive symptoms (Cheng et al., 2020; Ismail et al., 2020; Cecchetto et al., 2021; Porru et al., 2021). The overarching aim of this study is to investigate the relationship between habitual food consumption, physical activity, and depressive symptoms among university students in Malaysia during the COVID-19 pandemic. While previous studies have explored various aspects of dietary intake and food group consumption, there remains a gap in understanding habitual food consumption patterns specifically during the pandemic among Malaysian university students. The severity of the pandemic situation in Malaysia may have led to changes in the habitual food consumption behaviours of university students, which this study aims to explore. To achieve this, the following objectives will be addressed:

- (1) To examine the habitual food consumption patterns of university students during the COVID-19 pandemic in Malaysia using a semi-quantitative food frequency questionnaire.
- (2) To evaluate the physical activity level of university students during the COVID-19 pandemic in Malaysia using the International Physical Activity Questionnaire.
- (3) To determine the prevalence and severity of depressive symptoms among university students during the COVID-19 pandemic in Malaysia using the Depression Anxiety Stress Scale 21.
- (4) To investigate the relationship between habitual food consumption, physical activity, and depressive symptoms among university students during the COVID-19 pandemic in Malaysia.

Despite numerous studies on dietary intake and food group consumption, data on habitual food consumption patterns during the pandemic, particularly among Malaysian university students, remain scarce. Understanding these changes is crucial due to the severe impact of the COVID-19 pandemic in Malaysia.

Materials and Methods

Research Design

A cross-sectional study was conducted during the MCO in September 2020. The study utilised convenience sampling to survey university students in Malaysia via an online survey. The study involved all 20 public universities in Malaysia, as reported by the Department of Statistics Malaysia and the Ministry of Higher Education in 2021. These universities were geographically categorised into five zones: South, North, Middle, East, and Sabah and Sarawak (The Department of Statistics Malaysia, 2021). A heterogeneous sample selection method was used for each public university. The Yamane formula for sample size calculation was applied, and based on the most recent data (2019) provided by the Department of Statistics Malaysia, the total population of the 20 public universities was 567,624 (Department of Statistics Malaysia, 2021). Therefore, the estimated sample size required was at least 400 respondents among the whole population of public university students in Malaysia, with an acceptance sampling error of 0.05. A total of 608 respondents participated in this study, all of whom were current public university students aged 18 to 24 years or older at one of Malaysia's 20 public universities. This study was approved by the Universiti Malaysia Terengganu Research Ethics Committee with the reference number: UMT/JKEPM/2020/54.

Research Instrument

Self-administered Food Frequency Questionnaire

The food frequency questionnaire (FFQ) used in this study was adapted from the Malaysian Adult Nutrition Survey (2014), supplemented with elements from Kroke *et al.* (1999), and the EPIC-Norfolk FFQ (1988). This comprehensive FFQ includes 105 food items that are categorised into 11 distinct food groups. These groups encompass grains and grain products (15 items), instant foods (8 items), meat and processed meat (7 items), fish and seafood (11 items), eggs (4 items), beans and bean products (6 items), milk and dairy products (6 items), vegetables (10 items), fruits (11 items), drinks (16 items), and confectioneries (11 items). Food consumption frequency was measured on a 9-point scale, ranging from “none” to “six or more times per day”. Data from the 608 subjects were organised based on frequency, percentage, scale rating, and category for the score of all food items. To estimate the consumption amount for each food group, a conversion factor was applied based on the frequency of intake from the collected data. The frequency of food consumption was categorised into the conversion factor, which was then multiplied by the food weight of the items. Each category had its respective ranges, where highly consumed foods were 80.0 to 100.0 points, moderately consumed foods 60.0 to 79.9 points, and less consumed foods 59.9 points or less.

International Physical Activity Questionnaire (IPAQ)

The physical activity of the respondent was monitored using the International Physical Activity Questionnaire (IPAQ), a specially designed instrument (Surujlal *et al.*, 2017). In this study, the short form of the IPAQ was used, which consists of four sections. These sections include a selection part (nine questions) and short answer questions (11 questions). The sections of the short-form IPAQ cover transportation physical activity (six questions), housework, house maintenance and caring for

family (six questions), recreation, sport, and leisure-time physical activity (six questions), and time spent sitting (two questions). The physical activity data collected were analysed by calculating continuous scores and referencing the categorical score table. Median values and interquartile ranges were computed for walking, moderate-intensity activities, vigorous-intensity activities, and combined total physical activity. The metabolic equivalent task (MET) values and formula for MET-minutes/week were computed for different domains such as transportation physical activity, housework, house maintenance and caring for family, and leisure-time physical activity. After obtaining the total physical activity MET-minutes/week, the physical activity level was identified according to the short-form IPAQ scoring protocol (PAQ, 2005).

Depression Anxiety Stress Scale 21 (DASS-21)

The Depression Anxiety Stress Scale 21 (DASS-21) is a self-report instrument designed to measure the negative emotional states of depression, anxiety, and stress (Lovibond & Lovibond, 1995). The validity and reliability of DASS-21 have been established, with high Cronbach’s alpha values ranging from 0.7 to 0.95 in various studies, attesting to its robustness (Lovibond & Lovibond, 1995; Musa & Fadzil, 2007; Ramli *et al.*, 2009). In this study, DASS-21, comprising 21 questions, made up the final section. The rating scales ranged from “0” (did not apply to me at all) to “3” (applied to me very much, or most of the time). Stress was represented by questions 1, 6, 8, 11, 12, 14, and 18; anxiety by questions 2, 4, 7, 9, 15, 19, and 20; and, depression by questions 3, 5, 10, 13, 16, 17, and 21. The total score for each category was calculated by summing the scores and multiplying by 2. The final total score for each category was used to determine the level of depression, anxiety, and stress according to the DASS-21 scoring table by Lovibond and Lovibond (1995).

Data Collection

The survey was administered online via Google Forms, the link to which was disseminated through various platforms such as WeChat, WhatsApp, Telegram, and Facebook. The recipients of the link were selected based on the criterion of being a student at a public university in Malaysia. Participation was voluntary, and upon clicking the link, respondents were directed to the form. Before proceeding to answer the questions, respondents were required to read the provided information and give their informed consent. The questionnaire, which required approximately 20 minutes to complete, was self-administered, with respondents reading, recalling, and answering at their own pace. Upon completion, the data was automatically saved and stored in Google Drive.

Data Analysis

Data analysis was conducted using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp, 2017). Prior to the analysis, a normality test was performed. Descriptive analyses were employed to ascertain socio-demographic data, habitual food consumption, physical activity during the COVID-19 pandemic, and depressive symptoms among university students. The relationship between habitual food consumption and depressive symptoms, as well as physical activity and depressive symptoms among Malaysian university students during the COVID-19 pandemic, was determined using a Spearman correlation. A two-sided p-value of 0.05 was considered statistically significant.

Results

Respondent profile

Table 1 presents the socio-demographic characteristics of the respondents, who are university students from public universities in Malaysia ($n = 608$). The majority of the respondents were female (81.4%), with a smaller proportion of male respondents (18.6%). The median age of the respondents was 22.1 years. The ethnic distribution was predominantly Malay (79.3%), followed by Chinese (13.3%), other ethnicities (4.4%), and Indian (3.0%). Most respondents (60.2%) resided in households comprising four to six individuals. The majority of the respondents' parents had a household income of less than RM 2,500 (34.0%). The fathers of most respondents were self-employed (29.9%), followed by those employed in the private sector (23.0%) and the government sector (19.1%). About half of the respondents' mothers were not employed. The median number of dependents was 3.64. The majority of the respondents (48.5%) relied on the National Higher Education Fund Corporation for financial support for their higher education, followed by parental support (24.2%) and scholarships (18.4%). During the MCO period, most respondents (91.6%) stayed with their families, followed by those staying in hostels (4.9%) and rental homes (3.5%). Most respondents reported having a moderate internet connection at home (61.3%), with a smaller proportion reporting a good internet connection (31.9%). The majority of the respondents reported having moderate internet speeds (48.7%), followed by fast internet speeds (34.5%), slow internet speeds (10.4%), and no internet access (0.5%).

Table 1: Socio-demographic characteristics of university students from public universities in Malaysia ($n = 608$)

Characteristics	Frequency (n)	Percentage (%)	Median (IQR)
Gender			
Female	495	81.4	
Male	113	18.6	

Age			22 (1)
18 years old	47	7.7	
19 years old	15	2.5	
20 years old	65	10.7	
21 years old	138	22.7	
22 years old	191	31.4	
23 years old	116	19.1	
24 years old	25	4.1	
Others	11	1.8	
Race			
Malay	482	79.3	
Chinese	81	13.3	
Indian	18	3.0	
Others	27	4.4	
Number of household members			5.47 (2.77)
≤ 3	64	10.5	
4-6	366	60.2	
7-9	160	26.3	
≥ 10	18	3.0	
Household income (MYR)^a			
Less than 2,500	207	34.0	
2,500-4,000	161	26.5	
4,001-7,100	104	17.1	
More than 7,100	136	22.4	
Father's occupation			
Unemployed	58	9.5	
Self-employed	182	29.9	
Government sector	116	19.1	
Private sector	140	23.0	
Retired	112	18.4	
Mother's occupation			
Unemployed	307	50.5	
Self-employed	50	8.2	
Government sector	150	24.7	
Private sector	71	11.7	
Retired	30	4.9	

Number of dependents		3.64 (3.27)
No dependents	0	0.0
1-3 people	291	47.9
4-6 people	270	44.4
More than 7 people	47	7.7
Financial aid		
No financial aid	53	53.0
PTPTN	295	48.5
Parents	147	24.2
Scholarship	112	18.4
Other family members	1	0.2
Residence during MCO		
Staying with family	557	91.6
Rental house	21	3.5
Hostel	30	4.9
Other	0	0.0
Internet connection during MCO^b	n	%
Good	194	31.9
Moderate	373	61.3
Poor	41	6.7
Internet speed at the residence^c		
No internet service	3	0.5
Slow	63	10.4
Moderate	296	48.7
Fast	210	34.5
Very fast	36	5.9
No internet subscription	0	0.0

^aHousehold income is based on the Department of Statistics Malaysia (2021)

PTPTN = National Higher Education Fund Corporation

MCO = Movement Control Order

^bInternet connection: "Good" connection was defined as having stable internet access with minimal disruptions during online activities. "Moderate" connection referred to occasional interruptions that mildly affected online activities. "Poor" connection was characterised by frequent disruptions that severely impacted the ability to engage in online activities.

^cInternet Speed: "No internet service" indicates the absence of any internet connection at the residence. "Slow" speed was associated with difficulty in performing basic tasks such as browsing and email checking. "Moderate" speed allowed for comfortable browsing and some streaming services. "Fast" speed was capable of handling most online activities, including high-definition video streaming and video conferencing. "Very fast" speed was suitable for all online activities, including heavy downloads and ultra-high-definition streaming, without any noticeable lag.

Habitual Food Consumption

Table 2 presents the food consumption scores for a total of 105 food items, categorised into three groups: Highly consumed foods, moderately consumed foods, and less consumed foods. In the highly consumed food category, only two items were included: Plain water and white rice, with food consumption frequency scores of 95.9 and 93.7, respectively. This indicates that white rice is a staple food for university students. Other significant sources of carbohydrates in the students' daily meals included white bread (score: 68.7), flavoured rice (score: 64.0), wheat noodles (score: 62.2), and rice noodles (score: 61.3).

In the moderately consumed foods category, the top three items were leafy vegetables, chicken, and chicken eggs, with scores of 76.5, 76.4, and 73.8, respectively. The least consumed item in this category was ladies' fingers, with a score of 60.0. The top three items in the "less consumed food" category were apples, prawns, and watermelon, with scores of 59.2, 58.6, and 57.5, respectively.

The main sources of protein in the students' meals were chicken (score: 76.4), followed by

chicken eggs (score: 73.8), fish (score: 71.2), and fried chicken (score: 66.4), all categorised as moderately consumed foods. Beef (score: 53.2) and mutton (score: 39.1) were less consumed, possibly due to the religious beliefs of some respondents and the higher cost of these items compared with chicken and eggs. Non-halal foods and beverages such as pork (score: 32.3), ham (score: 30.3), beer (score: 29.8), luncheon meat (score: 29.5), and bacon (score: 8.7), were categorised as less consumed foods, likely due to religious restrictions among Muslim respondents.

Table 3 displays the average daily consumption of different food groups by Malaysian university students from public universities. The food group with the highest consumption was beverages, with a median of 1705.3 g/day. Grains and grain products were the second highest consumed food group, with a median of 416.3 g/day, followed by vegetables (253.0 g/day). The three least consumed food groups were fish and seafood (57.5 g/day), eggs (23.3 g/day), and legumes and legume products (18.8 g/day).

Table 2: Food consumption frequency score of university students from public universities in Malaysia ($n = 608$)

Food Items	Score
Highly consumed foods (Score: 80.0-100.0)	
Plain water	95.9
White rice	93.7
Moderately consumed foods (Score: 60.0-79.9)	
Leafy vegetables	76.5
Chicken	76.4
Hen eggs	73.8
Cabbages	72.5
Fish	71.2
Tea	70.5
White bread	69.7
Fried Chicken	66.4

Non-leafy vegetables	66.1
Tomatoes	65.7
Other type of legumes	64.2
Flavored rice	64.0
Malted drinks	62.5
Local kuih	62.4
Wheat noodles	62.2
Banana	61.8
Rice noodles (Mihun/kueh teow/laksa)	61.3
Bean sprout	60.1
Ladies finger	60.0
Less consumed foods (Score: 20.0-59.9)	
Apple	59.2
Prawn	58.6
Watermelon	57.5
Coffee	57.4
Anchovy	57.2
Mango	57.2
Mushrooms	56.0
Snacks/crackers	55.9
Orange/lime	55.5
Bun	55.4
Brinjal	55.4
Cream crackers	55.0
Wholemeal bread	54.6
Squid	54.2
Grape	54.0
Ready-to-drink beverages	53.7
Roti canai/roti telur/roti sardin	53.4
Beef	53.2
Chocolate bar	53.0
Commercial milk	52.5
Sweets	52.1
Fruit juice	52.0
Cake	51.9
Nugget	51.9
Sausage/hotdog/frankfurter	51.8
Evaporated milk	51.4
Chocolate drinks	51.2
Fish/prawn/squid/crab (ball/cake)	51.1

Flavored/cream/filled cookies	51.0
Salted or dried vegetables	50.8
Cordial syrup	50.6
Pre-mixed drinks	50.5
Keropok lekor	50.5
Lolly ice	49.4
Burger	49.1
Guava	49.0
French fries	48.9
Fish/prawn/squid/crab crackers	48.6
Papaya	48.1
Pasta	47.3
Legumes	47.2
Yogurt drinks	47.0
Cereal grains prepared with water	46.9
Yogurt/lassi/tairu	46.6
Dried fruits	46.6
Breakfast cereals	46.3
Cheese	46.1
Honeydew	45.8
Soy milk	45.8
Tauhu	45.4
Carbonated drinks (including isotonic)	45.3
Canned fish	44.2
Fresh milk	43.7
Pastry	43.5
Groundnuts	43.4
Jelly/custard	43.1
Fermented soybeans	42.4
Corn	42.4
Mashed potatoes	41.6
Pizza	41.3
Ice blended	41.2
Coleslaw	40.7
Shellfish	40.6
Powdered milk	40.4
Glutinous rice	39.5
Taufufa	39.4
Crab	39.3
Mutton	39.1

Salted eggs	38.9
Pickled fruits	38.7
Duck eggs	35.5
Capati	34.9
Pickled fish	34.7
Tosai	34.3
Herbal/botanical drinks (pre-mixed)	34.3
Quail eggs	34.0
Herbal/botanical brewed drinks	34.0
Energy drinks	32.3
* Pork	32.3
* Ham	30.3
* Beer	29.8
* Luncheon meat	29.5
* Bacon	28.7

Food items with (*) are non-halal foods that are forbidden for Muslims to consume

Table 3: Amount of food groups consumed by university students from public universities in Malaysia ($n = 608$)

Food groups	Median (IQR) (g/day)
Beverages	1705.3 (804.7)
Grain and grain products	416.3 (319.0)
Vegetables	253.0 (488.6)
Fruits	125.4 (218.1)
Milk and milk products	71.5 (143.8)
Meat and meat products	68.4 (97.1)
Fast food	60.9 (80.8)
Confectionaries	60.9 (77.7)
Fish and seafood	57.5 (71.0)
Eggs	23.3 (31.5)
Legume and legume products	18.8 (40.3)

Physical Activity

Table 4 presents the intensity of physical activity and sitting duration among university students, as measured by IPAQ. The median for total physical activity was 235.4 MET/min per week. Vigorous intensity activity had a median of 0.0 MET/min per week, followed by walking intensity at 3.3 MET/min per week, and moderate intensity physical activity at 6.0 MET/min per week. However, more than half of the

subjects in this study spent less than 10 minutes on each physical activity intensity, which, according to the scoring protocol of IPAQ, should be recorded as “0 minutes”. The total sitting duration, including transportation, was 2,460 minutes per week, with an average daily sitting duration of 351.4 minutes, indicating that university students sit for about 5 hours per day.

Depressive Symptoms

Table 5 presents the results of the DASS questionnaire for university students from public universities. In the depression domain, the majority of students fell into the normal category (50.8%), followed by those in the moderate depression category (18.6%), mild depression (14.8%), extremely severe depression (8.1%), and severe depression (7.7%). In the anxiety domain, 44.9% of students were in the

normal category, followed by moderate anxiety (23.2%), extremely severe anxiety (15.1%), severe anxiety (9.9%), and mild anxiety (6.9%). In the stress domain, the majority of students were in the normal category (66.9%), followed by mild stress (12.3%), moderate stress (10.7%), severe stress (0.1%), and extremely severe stress (3.0%).

Table 4: Physical activity intensity and sitting duration among university students from public universities in Malaysia ($n = 608$)

Physical activity (MET/min per week)	Median (IQR)
Walking intensity	3.3 (247.5)
Moderate intensity	6.0 (27.0)
Vigorous intensity	0.0 (231.0)
Total of physical activity	235.4 (1263.4)
Sitting	
Sitting total (includes transportation) (mins/week)	2460.0 (1691.3)
Average sitting total (includes transportation) (mins/day)	351.4 (241.6)

Table 5: Depressive, anxiety and stress levels of university students from public universities in Malaysia ($n = 608$)

Characteristics	Frequency (n)	Percentage (%)
Depression		
Normal	309	50.8
Mild	90	14.8
Moderate	113	18.6
Severe	47	7.7
Extremely severe	49	8.1
Anxiety		
Normal	273	44.9
Mild	42	6.9
Moderate	141	23.2
Severe	60	9.9
Extremely severe	92	15.1
Stress		
Normal	407	66.9
Mild	75	12.3
Moderate	65	10.7
Severe	43	7.1
Extremely severe	18	3.0

Correlation between Habitual Food Consumption, Depressive, Anxiety and Stress Symptoms and Physical Activity

Table 6 reveals a significant, yet weak, correlation between depression, anxiety, and stress symptoms and the consumption of cereals and cereal products, fast food, eggs, milk and milk products, and confectioneries. The strength of these relationships is relatively poor, with correlation coefficients (R-values) ranging from 0.1 to 0.18. This suggests that while these food groups are associated with depression, anxiety, and stress symptoms, they only account for a small portion of the variation in these symptoms. No significant correlation was found between these symptoms and the consumption of meat, meat products, vegetables, or fruits. Certain food groups such as fish and seafood, and beverages, showed a weak but significant correlation with anxiety and stress symptoms, but not with depression symptoms. Legumes and legume products were only significantly correlated with anxiety symptoms. Given the weak relationships observed, further research is needed to better understand these associations and to explore other potential contributing factors.

Table 7, on the other hand, demonstrates a significant correlation between depression, anxiety, and stress symptoms and total walking, total moderate physical activity, and total physical activity. Interestingly, total moderate physical activity showed a moderate relationship with depression, anxiety, and stress symptoms. This suggests that as moderate physical activity increases, there is a corresponding increase in depression, anxiety, and stress scores. However, total vigorous physical activity did not show a significant correlation with these symptoms. These findings highlight the complex relationship between physical activity and mental health, and further research is needed to explore these dynamics in more detail.

Discussion

The findings of this study, conducted during the MCO in Malaysia, revealed a positive correlation between depression, anxiety, and stress symptoms and all food groups. This

Table 6: Correlation between depressive, anxiety and stress symptoms and food group consumption (g/day) ($n = 608$)

Food Group Consumption (g/day)	Depression		Anxiety		Stress	
	r_s	P-value	r_s	P-value	r_s	P-value
Cereals and cereal products	0.121	< 0.001*	0.168	< 0.001*	0.148	< 0.001*
Fast food	0.126	0.002*	0.174	< 0.001*	0.142	< 0.001*
Meat and meat products	0.025	0.533	0.010	0.811	0.026	0.514
Fish and seafood	0.059	0.145	0.103	0.011*	0.089	0.029*
Eggs	0.154	< 0.001*	0.180	< 0.001*	0.134	0.001*
Legume and legume products	0.042	0.297	0.094	0.020*	0.078	0.055
Milk and milk products	0.108	0.008*	0.141	< 0.001*	0.140	0.001*
Vegetables	0.015	0.705	0.024	0.562	0.027	0.511
Fruits	0.042	0.304	0.051	0.210	0.046	0.262
Beverages	0.061	0.131	0.092	0.023*	0.098	0.015*
Confectionaries	0.170	< 0.001*	0.165	< 0.001*	0.171	< 0.001*

*Correlation significant at $p < 0.05$.

Table 7: Correlation between depressive, anxiety and stress symptoms and physical activity ($n = 608$)

	Depression		Anxiety		Stress	
	r_s	P-value	r_s	P-value	r_s	P-value
Total physical activity	0.122	0.003*	0.106	0.009*	0.168	< 0.001*
Total walking	0.160	< 0.001*	0.155	< 0.001*	0.227	< 0.001*
Total moderate	0.564	< 0.001*	0.474	< 0.001*	0.513	< 0.001*
Total vigorous	0.020	0.629	0.014	0.738	0.079	0.051

*Significant correlation at $p < 0.05$.

aligns with a study by El Ansari *et al.* (2014), which found a significant positive correlation between “unhealthy” foods such as fast food and confectioneries, and depressive symptoms among undergraduate university students. However, our study also found a significant correlation between milk and milk products and all depression, anxiety, and stress symptoms, which differs from previous studies (Kim & Shin, 2019).

The MCO, which restricted movement and changed daily routines, may have influenced these results. For instance, the increased consumption of “unhealthy” foods and milk products could be a result of stress eating due to the MCO. Similarly, the positive correlation between fruit and vegetable intake and depressive and anxiety symptoms found in our study contradicts previous research (Liu *et al.*, 2016). This discrepancy could be due to the limited access to fresh produce during the MCO, leading to changes in dietary habits.

Our study also found a positive correlation between depressive symptoms and physical activity, which is consistent with Chen *et al.* (2020). However, this contradicts other studies that found a negative correlation (Sedek *et al.*, 2020; Chi *et al.*, 2021; Kundu *et al.*, 2021). The MCO, which limited outdoor activities and gym access, may have led to decreased physical activity and increased sedentary behaviour, contributing to increased depressive symptoms.

These findings underscore the impact of the MCO on university students’ mental health, dietary habits, and physical activity. Future interventions should consider these factors

and aim to promote balanced eating habits, physical activity, and mental health awareness during pandemic-related restrictions. Online campaigns and discussions could be particularly effective given the circumstances (Cheng & Kamil, 2020).

One limitation of this study is that it was conducted online, which could have influenced the results. Respondents may have under- or overestimated their answers, particularly regarding the duration of physical activity and the frequency of specific food consumption. However, despite these limitations, our study still boasts a high number of respondents, which enhances the reliability of our findings and provides a comprehensive overview of the situation among university students during the MCO. Furthermore, this study is among the first to explore the relationship between habitual food consumption, physical activity, and depressive symptoms during a pandemic in the Malaysian context, filling a significant gap in the existing literature. Even though the MCO has ended, the insights gained from this study remain valuable. They can inform the development of strategies to support students’ mental and physical health during future periods of disruption, whether due to a pandemic or other crisis. Our findings can also guide universities and policymakers in creating supportive environments that promote healthy eating and physical activity habits, and mental wellbeing, irrespective of the circumstances. Future research should consider these limitations and potentially include more objective measures of food consumption and physical activity.

Conclusions

The study found that among university students in Malaysia, plain water and white rice were the most frequently consumed items, with beverages being the most consumed food category. The students sat for an average of 351 minutes each day, and a significant proportion engaged in moderate or vigorous physical activity. However, a concerning number of students reported depression, anxiety, and stress symptoms. Significant relationships were found between these symptoms and the consumption of certain food groups such as cereals and cereal products, fast food, eggs, milk and milk products, and confectioneries. Moreover, there was a strong connection between physical activity, depression, anxiety, and stress symptoms. These findings have significant implications for current health guidelines and policies. They highlight the need for tailored interventions to support the mental health and well-being of university students during the COVID-19 pandemic. Future research should focus on determining the strength of the relationship between habitual food consumption, physical activity, and depressive symptoms. This will contribute to a better understanding of the issue and guide intervention strategies for the student community and the nation.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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