

Article

Dietary habits, shopping behavior and weight gain during COVID-19 pandemic lockdown among students in a private university in Selangor, Malaysia

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Abstract

Background: Due to the global surge in COVID-19 cases, numerous countries have enforced lockdowns of varying stringency. Social isolation and stay-at-home orders have detrimental effects on one's lifestyle and dietary habits. This study aimed to assess the dietary patterns, food preferences, shopping behavior and weight gain during the lockdown among students in a private university in Malaysia.

Design and Methods: We conducted a cross-sectional study among 426 students using convenience sampling method one-month after initiating the Conditional Movement Control Order (November 15-30, 2020), using a validated self-administered web-based survey. Chi-square test with post-hoc and planned comparison procedures were performed.

Results: Of the 426 participants, more than half were females (55.9%). Over half of the surveyed students reported increased eating (51.2%), snacking (55.2%) and online food ordering (71.1%) during the lockdown. Meat products and sweet drinks (both >90%) were the most consumed food among individuals with higher BMI. 45.5% of the participants reported weight gain (mean 3.36, SD 1.61kg) one month after the lockdown. Female, youth (aged 19-24), working remotely, increased eating, snacking, cooking, and online food ordering were positively associated with weight gain.

Conclusions: Findings suggested that unintended consequences of lockdown have negative impacts on dietary habits and food preferences among university students. Advocacy and public health measures for nutritional support amidst the pandemic are crucial, especially for at-risk groups such as overweight and obese individuals.

Introduction

The novel coronavirus disease (COVID-19) is a respiratory disease caused by SARS-CoV-2 that was initially discovered in Wuhan, China, in late December 2019.¹ Due to the virus's rapid spread worldwide, the World Health Organization (WHO) declared COVID-19 a Pandemic on March 11, 2020, acknowledg-

ing that the virus has spread beyond Asia to different continents worldwide.² Since the beginning of the pandemic, different public health initiatives have been undertaken, forcing numerous nations to go under lockdown. While lockdowns are a useful approach to bringing outbreaks under control, they do have negative consequences.³ As COVID-19 spread across South East Asia, Malaysia has been under various phases of lockdown – the Movement Control Order (MCO), since March 18, 2020.⁴ A third wave of COVID-19 occurred in Malaysia in early September 2020. Malaysia once again implemented a new MCO – where schools and universities had to shut down, and people were requested to work and study from home.⁵

Quarantine causes negative impacts on people's lives, including disruption in individuals' daily routines and food choices, which can influence the nutritional quality of the diet consumed during the lockdown.⁶ According to the WHO, maintaining a good eating habit is crucial during this pandemic since nutrients play a vital role in our immune system, and nutritional deficiencies are associated with increased host susceptibility to infections of any sort.⁷ In general, dietary habits, food preferences, and overall health are all linked in some way.⁷ Adequate nutrition is critical for university students, especially during the transition from youth to adulthood.⁸ Poor nutritional habit is one of the most common problems found among university students and posed as a risk factor for current health condition and predisposition to diseases in the future.^{8,9} The implemented MCO required a prolonged stay at home since universities were closed, and students will be attending classes remotely. Thus, the nutritional habit among university students during the MCO is an area of potential concern.

Changes to nutritional intake during a period of lockdown are likely to vary across different populations. A study conducted in Poland during the COVID-19 pandemic lockdown suggested that students staying at home during quarantine cooked and bought food more often than previously.¹⁰ Individuals' eating habits and food choices may alter during the quarantine due to limited access to nutritious meals and a preference for fast food and instant food products.¹⁰ People staying at home get to spend more time with their family members, and tend to eat more meals and snack more frequently due to increased home cooking.¹¹ Lockdowns also play a part in "stress eating", which may contribute to poor dietary

Significance for public health

Dietary habits and food preferences among university students during the pandemic, in particular, have attracted a great deal of attention worldwide. It is necessary to explore the dietary habits, food preferences, shopping behaviour and weight gain among university students in the Malaysian context. Addressing the information gaps will provide the government, public health stakeholders, and higher education sector baseline data needed to properly plan and implement nutrition policies for young adults during the quarantine and future outbreaks.

intake and unhealthy food choices.^{12,13} Studies also found that individuals who have changed their eating habits and food preferences during the COVID-19 pandemic lockdown are more likely to gain, rather than lose weight.^{10,14}

Aside from dietary habits and food choices, the COVID-19 pandemic is affecting consumers shopping behaviour and has an impact on the hospitality industry.^{10,15} With social distancing becoming the norm, shutdown of supermarkets, restaurants and cafes has transformed how people get their food with a surge in online grocery shopping.¹⁶ Since shopping in grocery stores has an increased risk in contracting the virus, this induces fear for people to shop physically, and prompting consumers' shopping patterns to shift rapidly to online shopping.^{10,17} As COVID-19 cases continue to surge worldwide, e-shopping for food will most likely continue to gain traction as many stores shutdown, forcing the merchants to sell their goods via online platforms.¹⁸ Food insight (2020)¹⁹ further suggested that college-educated people and those under 45 years were more likely to use online grocery delivery compared to non-college educated and older age groups. A study conducted in Singapore also noted that social networking sites addiction could co-occur with unhealthy food intake, online shopping addiction and unlimited access to food.²⁰ However, no study has been conducted to explore the relationship between shopping behaviour and weight gain. This is a knowledge gap that needs to be explored as online food shopping and unlimited access to food may predispose the youth to malnutrition and affective disorder.²⁰

Dietary habits and food preferences among university students during the pandemic, in particular, have attracted a great deal of attention in western countries^{10,14} and less so in Malaysia.²¹ It is necessary to explore the dietary habits, food preferences, shopping behaviour and weight gain among university students in the Malaysian context. Addressing the information gaps will provide the government, public health stakeholders, and higher education sector baseline data needed to properly plan and implement nutrition policies for young adults during quarantine and future outbreaks.

This study aimed to assess the dietary pattern, food preferences, shopping behaviour and weight gain among students during the COVID-19 pandemic lockdown in a private university in Malaysia.

Design and Methods

Study setting and population

This cross-sectional study was conducted according to the protocol approved by the Ethics Committee of Management and Science University (Ethics Code: MSU-RMC-02/FR01/09/L1/077). A quantitative cross-sectional study was conducted conveniently among 426 students from the privately-run Management & Science University, in Shah Alam, Malaysia. The duration for conducting the survey was from November 15 to 30, 2020 one month after the initiation of the Conditional Movement Control Order. This CMCO was in place from 14 October 2020 to 12 January 2021, before the reinstatement of MCO on 13 January 2021. The questionnaire was piloted on a sample of 30 to test its validity and reliability, and data obtained from the pilot study were not included in the final analysis. A total of 426/501 (85%) participants had completed the survey. Due to the lockdown, Remote Data Collection (RDC) method was used to gather data. Validated self-administered online questionnaires were completed by using Google Form. Students studying at the Management & Science

University in Shah Alam, and aged 18 years and above were included in the study. The online survey allowed only one response per contact number. Data encryption was done to protect data confidentiality.

Study instruments

This study utilized a questionnaire adapted from the Poland study conducted by Sidor *et al.* (2020).¹⁰ Psychometric properties of the questionnaire such as content validity, face validity, and reliability test were assessed prior to questionnaire distribution. The questionnaire consisted of 3 sections and 30 items: Section A – sociodemographic and anthropometric profile (13 items), Section B – dietary habits changes and food products consumption during the lockdown (13 items), and Section C – shopping behaviour during the lockdown (4 items). For Section A, the anthropometric profile were self-reported and measured by the respondents. The online survey has fulfilled the criteria in the Checklist for Reporting Results of Internet E Surveys (CHERRIES).

Validity and reliability

The questionnaire's content validity was evaluated by 3 experts in the field. The set of questions included for CVI calculation was 13 questions in Section B (dietary habits and food preferences during the pandemic) and 4 questions in Section C (shopping behaviour during the pandemic). All the questions received an acceptable CVI of more than 70%. The final CVI calculated was 100%. Other psychometric properties such as face validity and reliability were assessed by conducting a pilot study of 30 subjects. The final FVI was 99% and the internal consistency for all the sections were good, Cronbach's alpha values ranging from 0.67 to 0.82.

Data analysis

Descriptive statistics (frequency, proportion, mean, standard deviation and range) were used to describe socio-demographic and anthropometric data, food consumption rate, prevalence of weight gain, changes in dietary pattern and shopping behaviour. Chi-square test with post-hoc was used to identify the association between socio-demographic characteristics, changes in dietary habits and shopping behaviour with weight gain after one month lockdown. Post-hoc and planned comparison procedures for interpreting chi-square test results were performed according to Beasley and Schumacker (1995).⁸ Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) statistical software version 26.0, and a value of $p < 0.05$ was considered statistically significant.

Results

Sociodemographic and anthropometric profile

A total of 426/501 (85%) respondents had completed the survey. The main reasons for non-response include refusal or failure to answer all the questions present in the questionnaires. Majority of the respondents were aged 19 to 24 (63.4%), females (55.9%), Malays (50.5%), undergraduate students pursuing degree (71.8%), from a middle-income group (M40; 51.2%), lived with family (45.8%) in urban area (77.7%) during the lockdown, and within a normal self-reported BMI range (mean = 22.0, standard deviation 3.20kg/m²; Table 1).

Food consumption rates during the lockdown

Figure 1A showed the consumption rates of different food products during the lockdown. As observed, grain products (86.4%), meat products (77%), and sweet drinks (67.1%) were the most consumed food products daily. Almost half (43.2%) of the participants consumed sweet drinks more than once per day, and more than 70% did not consume vegetables and fruits daily. More than half of the respondents consumed fast food, instant food, confections, and salty snacks from a few times per week to a few times per day. There was a vast difference in food consumption rates among participants in different BMI groups (Figure 1B-1E). For normal BMI and underweight respondents, the most daily consumed foods were grains, meats, and vegetables, while fast foods, instant foods, and confections were the least daily consumed foods (Figure 1B). The most daily consumed foods for obese and over-

weight respondents were meats, sweet drinks, confections, and fast food, while vegetables and fruits were the least daily consumed foods.

Changes in dietary habits during the lockdown

As shown in Figure 2A-C, more than half of the respondents reported an increase in food consumption (51.2%), snacking (55.2%), and cooking (53.8%) during the lockdown. Compared to respondents with lower BMI (<23.0kg/m²), increase in food consumption and snacking were doubled among respondents with higher BMI (≥23.0kg/m²; Figure 3A-3C).

Changes in shopping behaviour during the lockdown

As observed in Figure 4a, majority of the participants reported feeling fear over contracting the Coronavirus disease during gro-

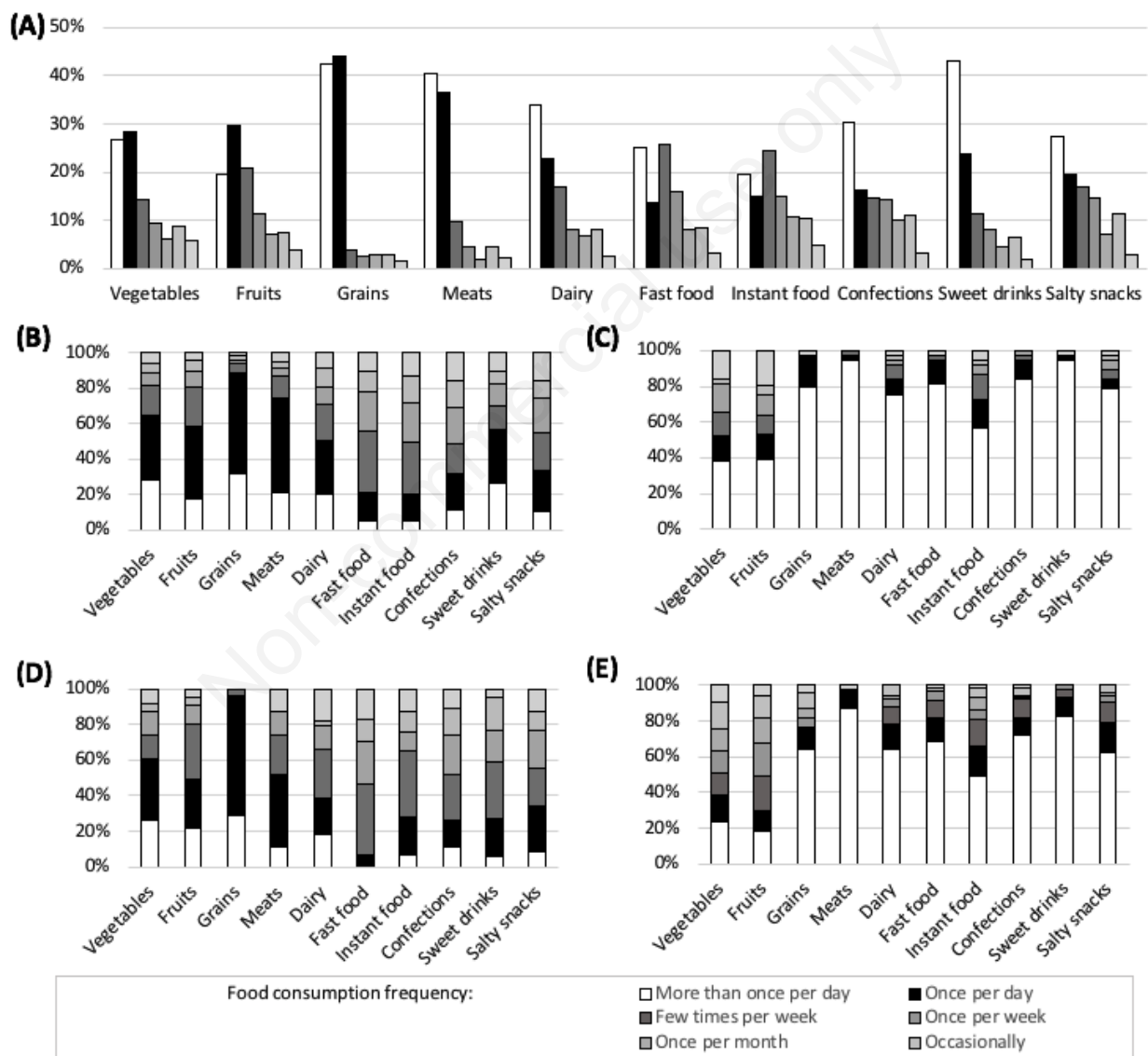


Figure 1. (A) Food consumption rate among respondents during the lockdown (n = 426). (B) Food consumption rate among respondents with BMI =18.5 – 22.9kg/m² (n = 248). (C) Food consumption rate for respondents with BMI ≥27.5 kg/m² (n = 37). (D) Food consumption rate among respondents with BMI <18.5 kg/m² (n = 48). (E) Food consumption rate for respondents with BMI ≥23.0 – 27.4 kg/m² (n = 93).

cery shopping (81%) and via food product contamination (61.3%). More than half of the participants (59.6%) reported ordering food or groceries online and only 17.6% did physical grocery shopping at mall during the lockdown (Figure 4B). Most of the students (71.1%) also reported an increase in online food ordering during the lockdown. As shown in Table 2, both having fears over contracting COVID-19 during grocery shopping and via food products contamination were highly significantly associated with the preferred way to shop for food during the lockdown ($p < 0.001$).

Weight gain after one-month of lockdown

As shown in Table 3, 45.5% of respondents have experienced weight gain (mean 3.36kg, SD 1.61kg), while 33.6% reported no weight changes, 11% were unsure of having any weight changes, and 9.9% reported weight loss (mean 2.43, SD 1.33kg) after one month of lockdown.

There was a broad difference in the prevalence of weight changes among respondents in different BMI groups (Figure 5). Respondents with higher BMI ($\geq 23.0 \text{ kg/m}^2$) were two-fold (>80%) more likely to report weight gain than respondents with

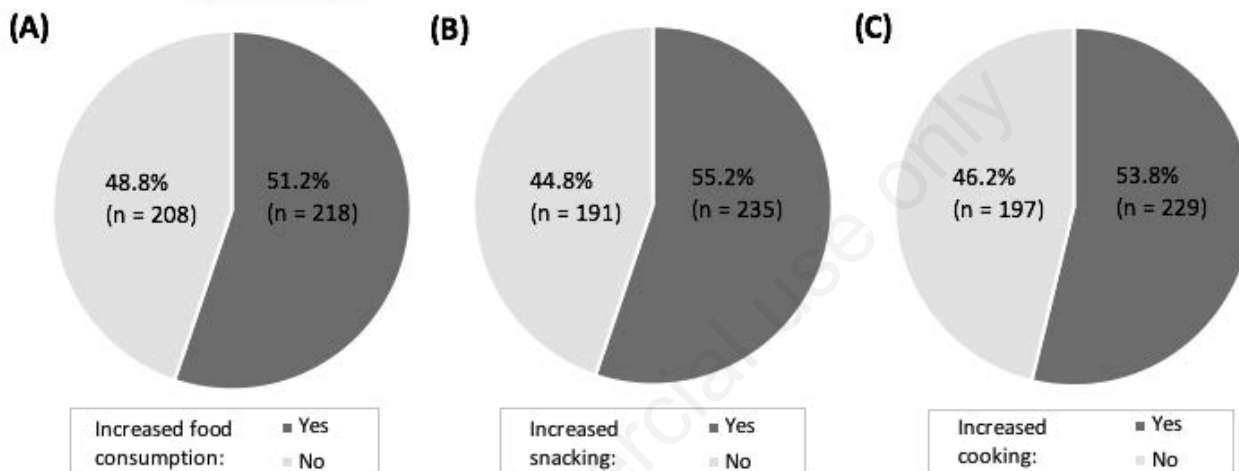


Figure 2. (A) Increased food consumption among respondents during the lockdown (n = 426). (B) Increased snacking among respondents during the lockdown (n = 426). (C) Increased cooking among respondents during the lockdown (n = 426).

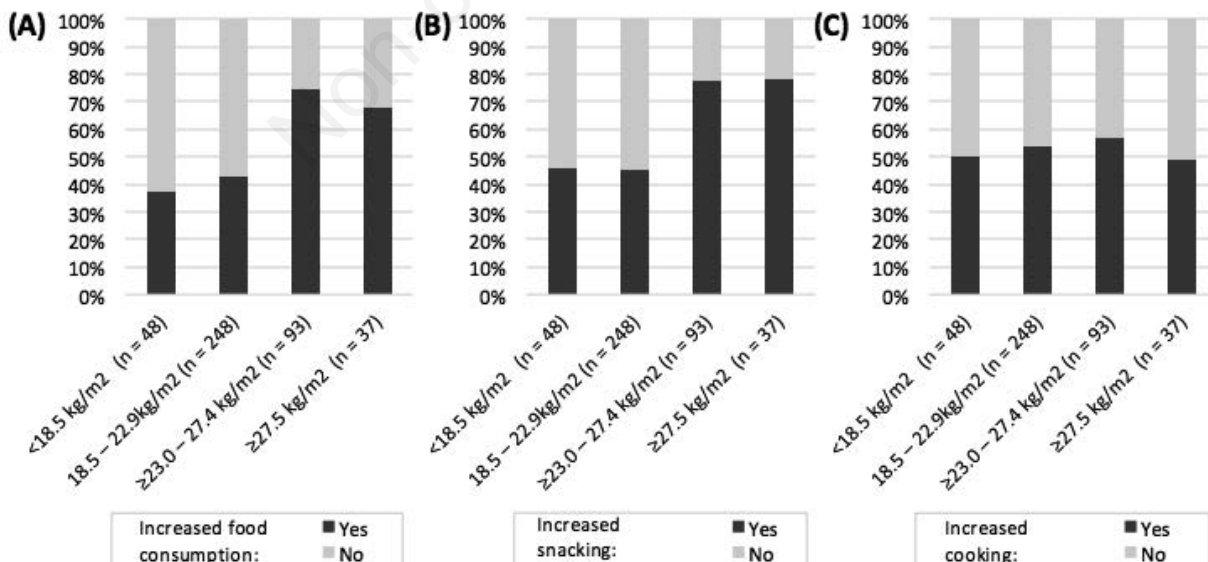


Figure 3. (A) Increased food consumption among different BMI groups during the lockdown (n = 426). (B) Increased snacking among different BMI groups during the lockdown (n = 426). (C) Increased cooking among different BMI groups during the lockdown (n = 426).

lower BMI ($<23.0\text{kg/m}^2$) ($<30\%$). Most of the respondents with lower BMI ($<23.0\text{kg/m}^2$) reported no weight changes after one month of lockdown.

Association between independent variables and weight gain

As shown in Table 4, there were significant associations between weight gain after one-month lockdown and the variables age group ($p<0.001$), gender ($p=0.008$), household income group ($p<0.001$), employment status ($p<0.001$), increased food consumption ($p<0.001$), increased snacking ($p<0.001$), increased cooking ($p<0.001$), and increased online food ordering ($p=0.005$). Post-hoc test with Bonferroni adjustment revealed that highly significant associations were found between weight gain with respondents aged 19-24 and 25-29, low-income group (B40s), and individuals working from home, $p<0.001$, respectively. Respondents aged 19-24 and working from home were positively associated with weight gain, whereas respondents aged 25-29 and individuals from low-income group were negatively associated with weight gain.

Discussion

This study found that students studying in a private university in Selangor, Malaysia showed a $\approx 3.4\text{kg}$ self-reported weight gain after the first month of Conditional Movement Control Order (CMCO). Female, youth (aged 19-24 years), working remotely, increased food consumption, increased snacking, increased cooking, and increased online food ordering were significantly associated with weight gain after one-month of lockdown.

The consequences of the COVID-19's rampant spread have impacted the food systems range from undernutrition to overweight or obesity and diet-related non-communicable diseases (NCDs).²⁴ The impact of unhealthy and poor diets has drawn much attention throughout the pandemic given people living with or affected by NCDs and obesity are carrying higher risk of becoming severely ill or die from COVID-19.²⁵ As the COVID-19 pandemic repercussions spread, the points of interaction between people and their food environments are shifting rapidly and taking on greater importance in daily life.²⁴ For decades, NCDs represent the leading cause of death worldwide, contributing to more than 15 million premature deaths each year.²⁶ The escalating global burden of diet-related NCDs compromises health equity and equality in developing nations.^{27,28} Alongside the emergence of the COVID-19 pandemic, the tremendous impact on Malaysia's economic, social, and environmental contexts²⁹⁻³² have further exacerbated the disparities in health and health care in Malaysia.³³ Since the implementation of CMCO on 14 October 2020, the people in Selangor have

been living in semi-confinement.⁵ COVID-19 itself along with public health measures, policy responses, and lockdowns enforced to combat its spread have led to an evolving impact on individual's day-to-day food consumption, as well as on both external and personal food environment.²⁴ Confinement and prolonged stay at

Table 1. Sociodemographic and anthropometric profile (n = 426).

Variables	n	%
Age group		
19-24	270	63.4
25-29	130	30.5
≥ 30	26	6.1
Gender		
Female	238	55.9
Male	188	44.1
Ethnicity		
Malay	215	50.5
Chinese	67	15.7
Indian	49	11.5
Others	95	22.3
Household income group ^a		
Low (B40)	52	12.2
Middle (M40)	218	51.2
High (T20)	156	36.6
Education level		
Diploma	88	20.7
Degree	306	71.8
Postgraduate	32	7.5
Employment status		
Working remotely	40	9.4
Working in rotating basis	71	16.7
Working at workplace	35	8.2
Not working	280	65.7
Residential area during lockdown		
Urban	331	77.7
Rural	95	22.3
Living arrangements (during lockdown)		
Alone	39	9.2
With family	195	45.8
With relatives	37	8.7
With friends	155	36.4
Body Mass Index ^b (during lockdown) (kg/m^2)		
Underweight ($<18.5\text{ kg/m}^2$)	48	11.3
Normal weight ($18.5 - 22.9\text{ kg/m}^2$)	248	58.2
Overweight ($\geq 23.0 - 27.4\text{ kg/m}^2$)	93	21.8
Obesity ($\geq 27.5\text{ kg/m}^2$)	37	8.7

^aB40 ($<RM4,850$); M40 ($RM4,850-RM10,959$); T20 ($>RM10,960$);²² ^bBody Mass Index classification.²³

Table 2. Association between preferred way to buy food and having fears over contracting SARS-CoV-2 via grocery shopping and food products contamination (n = 426).

Fears over contracting SARS-CoV-2	Preferred way to buy food			χ^2	p-value
	Order food online (n=254)	From nearby shops (n=97)	From supermarket (n=75)		
During grocery shopping					
Yes	231	66	48	46.036	
Not sure	12	10	6		<0.001
No	11	21	21		
Via food products contamination					
Yes	187	48	34	32.225	
Not sure	23	13	9		<0.001
No	44	36	32		

home especially among university students who are attending classes remotely have prompted them to practice irregular and unhealthy dietary habit.¹⁰

This study found that grain products (86.4%), meat products (77%) and sweet drinks (67.1%) were the most consumed food products among the students in daily basis. Almost half of the surveyed individuals had been consuming sweet drinks for more than once daily and more than half of the respondents reported frequent consumption of fast food, instant food, confections and salty

snacks in daily or weekly basis, but only a quarter reported consuming vegetables and fruits daily during the lockdown. These findings were similar to a previous study conducted by Pellegrini *et al.*³⁴ in Italy, which revealed that unhealthy food preferences such as sweets, snacks, frozen or canned meals were the most consumed food products during the lockdown, whereas fruits and vegetables were the least. This might be due to confinements and social isolation have eventually led to a rise in loneliness, boredom, anxiety, and despair, which may contribute to a significant

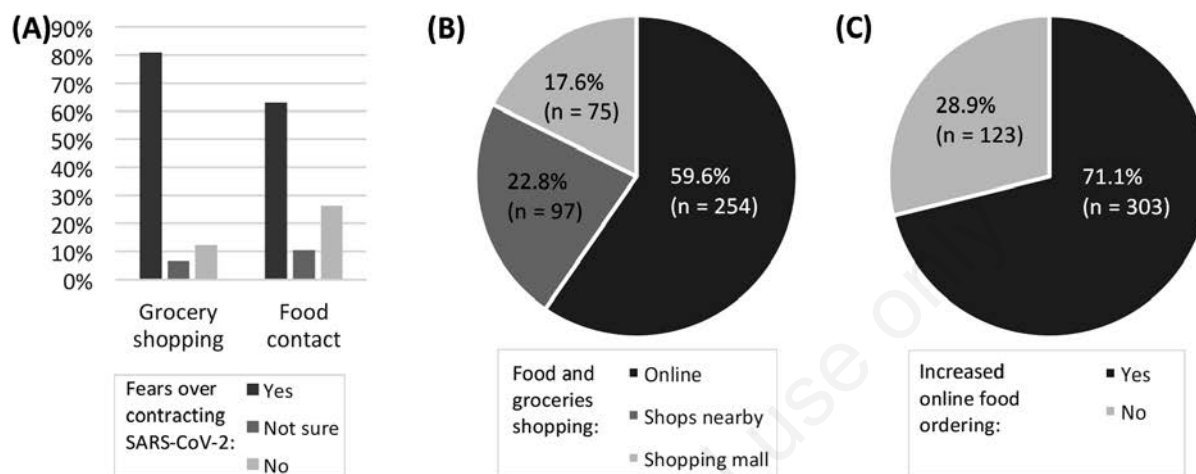


Figure 4. (A) Fears during grocery shopping and food contact (n = 426). (B) Shopping patterns during the lockdown (n = 426). (C) Increased online food ordering during the lockdown (n = 426).

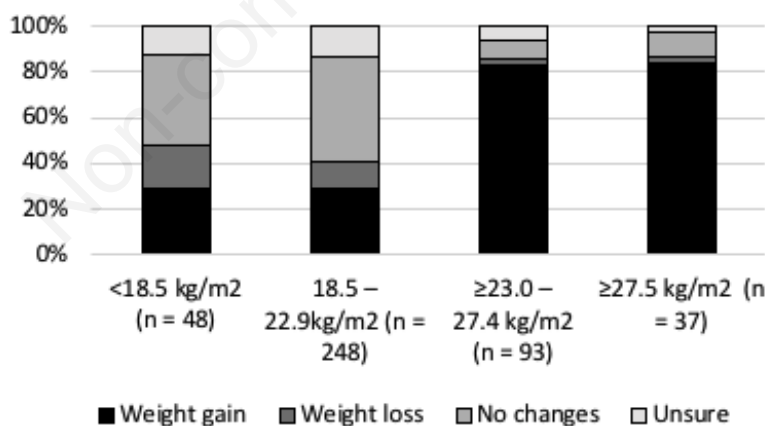


Figure 5. Weight changes among different BMI groups after one month of lockdown.

Table 3. Observed weight changes after one

Observed Weight Changes	n	%	Mean (kg)	SD (kg)	Range (kg)
Weight gain	194	45.5	3.36	1.61	1 - 10
Weight loss	42	9.9	2.43	1.33	1 - 6
No changes	143	33.6	-	-	-
Unsure	47	11.0	-	-	-

influence in the lifestyle and eating habit.^{36,37} The influence of stress, emotional disturbances and mood disorders on young adults' dietary habits are widely documented in recent years.^{38,39} This is related to stress eating or comfort eating that elicits the consumption of flavourful food such as fast food and sweet food and chocolates to induce the production of happy hormones that promote positive feelings.^{40,41} However, a study carried out by Celorio-Sarda *et al.*⁴² in Spain revealed a trend towards practising

healthy diet during the COVID-19 pandemic among students taking Food Science courses. There was reduced consumption of unhealthy foods - fast food, unhealthy snacks, candies, cookies, cakes, and pastries, with increased consumption of fresh fruits and vegetables, nutritious snacks, and water during the pandemic.⁴² Since these students were exposed to an in-depth understanding of food products, food texture, food processing, nutritional composition and scientific knowledge and skills of the food chain, this sup-

Table 4. Association between sociodemographic characteristics, changes in dietary and shopping patterns with weight gain after one month lockdown (n=426).

Variables	Weight gain		χ^2	p-value
	Yes (n/%) (n = 194)	No (n/%) (n = 232)		
Age group				
19-24	139	131	16.827	<0.001
25-29	40	90		
≥30	15	11		
Gender				
Female	122	116	7.116	0.008
Male	72	116		
Ethnicity				
Malay	93	122	5.754	0.124
Chinese	25	42		
Indian	24	25		
Others	52	43		
Household income group				
Low (B40)	11	41	14.443	0.001
Middle (M40)	109	109		
High (T20)	74	82		
Education level				
Diploma	32	56	3.827	0.148
Degree	146	160		
Postgraduate	16	16		
Employment status				
Working remotely	30	10	18.456	<0.001
Working in rotating basis	27	44		
Working at workplace	11	24		
Not working	126	154		
Residential area				
Urban	156	175	1.513	0.219
Rural	38	57		
Living arrangements				
Alone	23	16	3.665	0.300
With family	83	112		
With relatives	72	83		
With friends	16	21		
Increased in food consumption				
Yes	151	67	101.341	<0.001
No	43	165		
Increased in snacking				
Yes	161	74	111.512	<0.001
No	33	158		
Increased in cooking				
Yes	123	106	13.334	<0.001
No	71	126		
Shopping patterns				
Order food or groceries online	126	128	5.263	0.072
Order food or groceries at shops nearby	35	62		
Grocery shopping at mall	33	42		
Increased online food ordering				
Yes	151	152	7.806	0.005
No	43	80		

port the fact that health literacy played a crucial role in healthy lifestyle and behaviour.⁴³

For food consumption rate among different BMI groups, students with lower BMI ($<23.0\text{kg/m}^2$) consumed mostly grain products, meat products and vegetables in a daily basis, whereas fast food, instant food and confections were the least consumed food daily. Whereas, in contrary to the findings on students with higher BMI ($\geq 23.0\text{kg/m}^2$), the most consumed food daily were meat products, sweet drinks, confections and fast food, while vegetables and fruits were the least consumed food daily. This is alarming as consumption of sugary drinks is highly associated with increased risk of obesity which eventually increases the prevalence of NCD such as Type 2 Diabetes, hypertension and so on.⁴⁴ Fast food meals are high in calories, sodium, trans-fat, saturated fat, and sugar, which are linked to obesity and diet-related NCDs.^{45,46} Fast food is known for its poor nutritional value as most fast food has been stripped of any vitamins and minerals.⁴⁶ However, despite knowing the harmful effects of fast food intake, this study findings indicated that more than half of the students reported consuming fast food for at least few times daily or weekly. This might be related to the usage of mobile applications for food ordering with unlimited access to food.^{10,17} Fast food is convenient, time-saving and way cheaper than organic or healthy food, which might be the reasons for frequent consumption, particularly among students with a lack of cooking skills.⁴⁷

During the lockdown, more than half of the students have reported changes in dietary habits such as increased in food consumption, snacking and cooking. The present findings clearly suggested that lockdown may pose as a significant dietary risk, especially for students with higher BMI ($\geq 23.0\text{kg/m}^2$) – increased in food consumption and snacking were doubled compared to students with lower BMI ($<23.0\text{kg/m}^2$). The study also found that increased food consumption, increased snacking, and increased cooking were positively associated with weight gain. In general, individuals with higher BMI are known to exhibit more worrisome eating habits, such as overeating or Eating in the Absence of Hunger (EAH).⁴⁸ As people were obliged to work and study remotely, prolonged stay at home may further promote unhealthy dietary habits.⁹ Other than increased in food consumption, increase in snacking may also lead to an increase in fat mass and percentage.⁴⁹ A previous study conducted in the United States also suggested that individuals with higher BMI tend to snack significantly more frequently in the evening, which is more detrimental to health than nibbling during daytime.⁵⁰ Another study conducted by Husain *et al.*⁵¹ also detected two important unhealthy meal pattern practise by the community in Kuwait during the pandemic – breakfast skipping and late-night snacking. Waking up late is the main culprit behind breakfast skipping, which also lead to staying up late and late-night snacking. This is explained by Okada *et al.*⁵² that found a significant association between a late dinner or bedtime snacking with breakfast skipping among Japanese women, as well as an association between late-night snacking with overweight and obesity.

Consistent with the literatures, this study also found home-cooking increases during the lockdown.^{51,53-55} As people are ordered to stay at home as a result of the COVID-19 pandemic, changes in daily routine made consumers to find new ways to occupy their time and accomplish their daily responsibilities including cooking.⁵³ According to an American survey, over half of the participants reported cooking and baking more frequently during the pandemic.⁵³ This result is also line with the findings of Di Renzo *et al.*⁵⁴ and Scarmozzino and Visioli,⁵⁵ who discovered that during the lockdown, Italian people consumed more home-made food and bakeries such as bread, pizza and desserts. Some

other possibilities for often home-cooking might be students sought to eat healthier to strengthen their immunity amidst the pandemic or homemade food is cheaper than restaurant food. However, concluding that individuals ate more healthily during the pandemic is challenging despite increased home-cooking due to the unlimited access to fast food, junk food and snacks in the food system and environment.²⁵

The rapid spread of COVID-19 and the public health measures implemented have inevitably heightened public anxiety and panic, which has been magnified by broad mass media and social media coverage, myths, and misinformation.⁵⁶ When the third wave of COVID-19 occurred in Malaysia in early September 2020, a Conditional Movement Control Order in Malaysia was imposed on October 14th 2020, the media broadly commented on the sudden surge of COVID-19 cases in Malaysia, with 30,889 confirmed cases and 249 deaths,⁵⁷ and this has further worsen the level of anxiety among the public. As of March 15th, 2022, almost 3,842,969 confirmed cases of COVID-19 had been reported by the Ministry of Health Malaysia.⁵⁸ The results of the study have clearly reflected the situation in which majority of the participants ($>80\%$) reported feeling fear over contracting the Coronavirus disease during grocery shopping. These results match those observed in a Polish study that found more than half of the surveyed participants as well had fear over contracting COVID-19 from in-store grocery shopping.¹⁰ The study's findings also revealed that having fears over contracting COVID-19 during grocery shopping were highly significantly associated with the preferred way to shop for food during the lockdown. Since shopping in grocery stores has an increased risk in contracting the virus, this induces fear for people to shop physically, and prompting consumers' shopping patterns to shift rapidly to online shopping.^{10,17}

The nationwide action to counter the spread of COVID-19 alongside social distancing becoming the norm, shutdown of physical stores and supermarkets has transformed how people purchase food through online grocery shopping.¹⁶ In line with this, the study found that during the lockdown more than half of the students reported ordering food or groceries online, whereas only 18% did physical grocery shopping at mall. Most of the students (71%) also reported an increase in online food ordering during the lockdown. As new Coronavirus variants continue to emerge, COVID-19 cases will continue to surge worldwide. E-shopping for food will most likely become the new trend as merchants will sell their goods via online platforms and consumers will prefer to shop in convenient way.¹⁸ A study conducted in America suggested that college-educated people and those under 45 years were more likely to do online grocery shopping compared to non-college educated and older age groups.¹⁹ However, young adults should be educated with proper social media use as social networking sites addiction could co-occur with unhealthy food intake, online shopping addiction and unlimited access to food.²⁰ According to a survey conducted by Rakuten Insight in Malaysia, about 58% of the respondents utilize food delivery apps during the COVID-19 pandemic.⁵⁹ However, the public might not realise that the frequency of eating convenient food from food ordering is positively associated with weight gain⁶⁷ and its negative impacts have yet to be discovered.⁶⁰ Though the present study revealed that increased online food ordering were positively associated with weight gain, there is currently no research to support how food ordering impacts health and wellness on an individual level or from a public health perspective in Malaysia. The authors strongly advocate for additional research to fill these critical gaps.

Weight gain during the lockdown was attributed to a combination of decreased physical activity, increased food consumption, overeating, late-night snacking, stress, and anxiety associated with

new norm adaptation.^{10,49,52,61} In the present study, almost half of the students have gained weight after one month lockdown. There was also a vast difference in the prevalence of weight changes across different BMI groups. The present study revealed that the reported weight gain was two-fold more prevalent among students with higher BMI ($\geq 23.0\text{kg/m}^2$) than students with lower BMI ($< 23.0\text{kg/m}^2$). A previous study conducted in Italy found that adverse mental burden resulted from the COVID-19 pandemic was greatly associated with weight gain, in which self-reported anxiety or depression was the most significant predictor for weight gain among adults with higher BMI.³⁴ Beyond doubt, a study also highlighted a significant proportion of Malaysian – 25% had severe depressive symptoms.³⁵ Individuals who are under stress tend to munch snacks and sweet food as an act to relief stress and promote positive feelings.^{40,41} Individuals with higher BMI not only consume more food but also snack more frequently in the evening,⁵⁰ which make them gain weight faster.⁵²

Furthermore, the study revealed that sociodemographic characteristics such as female, youth (aged 19-24 years) and working remotely were positively associated with weight gain. For age factor, younger students may be more vulnerable than older students. Study remotely requires new adaptation – new virtual learning mode and assessment methods.⁶² Younger students are also more worried about their future education and ability to pay for tuition fees than older students. In addition, previous study found that younger students used social media more often than older students during the pandemic, which may exposed them to more risk-inducing messages, which can lead to stress and poor mental health, and subsequently stress eating.^{12,13} Fulkerson *et al.*¹¹ found that individuals who are working remotely do have more time to spend with their family members and consumed more homemade meals. Working remotely also changes one's dietary habits to snack more frequently and comfortably even during their working hours due to easy access to food.⁶³

A previous study conducted in Malaysia also found that a higher percentage of female students have reported weight gain during the lockdown compared to males.⁶⁴ In fact, obesity rates among adults in Malaysia have been reported to be as high as 14.1%, with a higher prevalence in women (16.7%) than men (11.4%).⁶⁵ Industrialization, gender equality and sociocultural changes in recent years have empowered many women to have more control over their lives including building their own career.⁶⁶ Work-life balance, however, is not an easy task, alongside with studying or working remotely and needing to take care of their family at the same time, have led to an increase in eat-out practice particularly among the females.⁶⁷ Women also tend to gain weight easier than men as women body size is smaller and required fewer calories than man, excess calories will be stored as fat.⁶⁸ Another reason being women are less physically active than men and sedentary behavior decreases basal metabolic correction factor by 10-50%, which makes it hard to lose weight.⁶⁹ A growing body of literature also demonstrated that females are more emotional compared to males physiologically with menstrual cycle hormone disturbances, which can further promote emotional or binge eating.^{70,71}

Malaysia is the Southeast Asian country with the highest obesity rate⁶⁵ with two out of every three Malaysians are either overweight or obese.⁷² According to Romieu *et al.*,⁷³ obesity is primarily caused by an imbalance in energy consumption and expenditure. Overweight and obesity are related to our food and physical activity choices, which are impacted by a variety of circumstances including an obesogenic environment – an environment that enhances our risk of gaining weight and becoming obese.⁷⁴ In recent years, a considerable amount of literature have discovered income as one of the most important socioeconomic factor to be

inversely associated with obesity.^{75,76} A meta-analytic study conducted by Kim *et al.*⁷⁷ also revealed that obesity is more prone to occur in people with lower incomes. However, this study contradicts the inverse association between income and weight gain, and found that lower income were negatively associated with weight gain. In line with this, a Malaysian study conducted by Ibrahim *et al.*⁷⁸ also reported that 38% of the low-income group have experienced income shocks and up to 25% have experienced starvation due to the COVID-19 crisis. The Healthy People 2020⁷⁹ framework of social determinants of health clearly explains that factors such as material conditions which limit one's access to nutritious food and healthcare, food insecurity, alongside lifestyle factors like unhealthy dietary habits and physical inactivity, and psychosocial factors like social isolation and stress are the reasons behind lower income and malnutrition. According to the World Bank,⁸⁰ COVID-19's impacts contributed to significant and extensive rise of global food insecurity, impacting vulnerable households in almost every country, and the effects are predicted to last until 2022.

Given the current situation, the trend of practising unhealthy dietary patterns and online shopping will continue to grow, prompting permanent unhealthy eating habits which could be difficult to change. This deterioration, if sustained in the long-term, could have a negative impact on NCDs including premature deaths. Finally, as health is an outcome, precondition and indicator of the economic, social and environmental facets of sustainable development, the Malaysian government should design an integrated national public health policy to achieve healthier food system, lifestyle and dietary habits, and to scale up the national effort to build a healthier society for all, amidst the COVID-19 war. Effective nutritional health promotion programmes should be catered to vulnerable groups to adopt and maintain healthy lifestyle and dietary habits. Considering the ease of online food ordering, strong advocacy should be planned for online food ordering platforms to adopt ethical practice in healthy diets' promotion. Online health education on healthy diets and regular exercises should also be implemented to promote health related quality of life and well-being during the COVID-19 pandemic.⁸¹

Limitations and Recommendation for Future Research

While we have a basic understanding of the dietary pattern, food preferences, shopping behaviour and weight gain during the lockdown from the cross-sectional study, it is recommended to conduct cohort studies to examine the long-term impact of lockdown on dietary and weight changes. This study was only able to access self-measured anthropometric data, which might contribute to response bias. We strongly advocate for additional research in this arena to objectively report on consumer demographics, anthropometry, dietary and shopping patterns in Malaysia. A more extensive study on dietary habits including breakfast skipping, late-night snacking, stress eating and their associations with weight gain should be explored in future research. The quantitative approach used to generalize results is often not sufficient. In-depth interviews of possible causes of dietary and weight changes should be explored using qualitative studies, in the future. Lastly, further surveys in other student populations should also be explored.

Conclusions

Following the emergence of new COVID-19 variants and surges of cases, unhealthy diet and weight gain are more prevalent than ever. During the lockdown, almost half of the participants have gained weight, and more than half of them increased eating and

online food ordering. Sociodemographic characteristics such as female, youth, working status and income, increased eating, snacking, cooking and online food ordering are associated with weight gain among the university students. Effective public health measures including nutritional health promotion programmes can be implemented to promote healthy lifestyle and dietary habits, especially to females. The current nutritional policy and action plans should be evaluated and revised to curb the growing obesity epidemic. Advocacy for appropriate use of online platforms for food ordering should be developed to cater healthy food to the public.

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Key words: COVID-19; lockdown; eating habits; dietary habits; weight gain; online shopping.

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