

Logistic Regression for Assessing Prevalence and Socio-demographic Correlates of Depression During the COVID-19 Pandemic

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Abstract: The outbreak of COVID-19 that emerged in Wuhan, China has spread as a global outbreak in a few months, resulting in billions into lockdown. This pandemic has caused a major health burden and has significantly impacted the mental health of the students due to the closure of educational institutions. Therefore, this study aimed to determine the depression level among university undergraduate students in Kelantan and its predicting factors. A cross-sectional study was conducted among 366 undergraduate students. The validated Patient Health Questionnaire- 9 (PHQ-9) was used to evaluate depression. The results indicated that 45.21% of the students experienced mild depression, 19.73% had moderate severe anxiety, and 15.18% reported moderately severe depression. Multiple logistic regression has been applied for predicting the factors affecting the depression level of the students during the Covid-19 pandemic. The dependent variable is the depression status where it is categorized into 0 and 1; 0 denoting depressed="no" and 1 denoting depressed =" yes". The results of binary logistic regression suggested that younger students had depression (OR=1.802, 95% CI = 1.029 - 3.154) and female students were more likely to have depression (OR=2.072, 95% CI = 1.066 - 4.024). The results also found that students with higher CGPA had a lower chance of having depression (OR = 0.331, 95% CI= 0.13 - 0.846). The findings of this study highlight the needs of psychological intervention programs in order to identify students who may need support regarding depression.

Keywords: COVID-19, pandemic, depression, student, multiple logistic regression

1 Introduction

Originating and starting in Wuhan, China in December 2019, novel coronavirus or officially known COVID-19 has spread to all provinces in China and affecting other countries across the world [1-4]. To date (November 7, 2021), 250 million cases and 5.04 million reported worldwide. World Health Organization (WHO) has declared the outbreak of COVID-19 as pandemic on March 11, 2020 due to its rapid expansion. Similar to the other parts around the world, Malaysia is also struggling with the rising number of COVID-19 cases and deaths where the first case was reported on January 25, 2020. As of November 7, 2021, a total of 2.5 million cases and 29,256 deaths had been documented in Malaysia.

The large scale of a pandemic disease does not only affect physical health but it may also harm mental health, and the effect of mental health is said to be more lasting than the consequences resulted from physical harm [5]. A number of studies investigating the effects of the emergence of infectious disease such as Severe Acute Respiratory Syndrome (SARS) [6] and Ebola Virus Disease (EVD) [7] support the view that the aftermath of the disease may exacerbate the negative impact on mental health and emotions. Moreover, empirical studies revealed that the outbreak of SARS and Middle East Respiratory Syndrome (MERS) can cause sleep disorders, anxiety and depression [8]. In the context of the outbreak of COVID-19, several studies have shown an increase in prevalence of depression and anxiety symptoms [9-12]. The COVID-19 crisis has forced the closure of educational institutions worldwide. Thus, the closure caused a sudden transition from face-to-face to online mode in education system. Studies examining mental health among college students revealed that COVID-

19 pandemic has negatively impacted the mental health and well-being [13-14]. There have been many concerns regarding the impact of COVID-19 on mental health of students. Recent studies have highlighted several challenges experienced by students due to the widespread of COVID-19 that forced closure of institutions: for instance, uncertainty towards completion of their study and career path [15] and perceived fear of getting COVID-19 infection [16].

Currently, the education institutions in Malaysia remains closed in 2021 due to the rising number of cases. Since March 2020, all universities started to conduct open and distance learning (ODL) to replace the traditional face-to-face method. Lecturers and students are required to use online application such as Google Meet, Google Classroom, and other platforms to run the classes. It is the fact that COVID-19 pandemic affects all aspects of life, including student's life. The rapid transition from face-to-face to online delivery mode may affect the physical, emotional, and mental health students. It is anticipated that this disease could last for years ahead. Literature suggests that the mental health of the students can affect their academic performance [17-20]. The different method of study, environment, and daily life of students during the lockdown may elevate their stress level. Therefore, the stressful experience they went through during online learning might aggravate their depression symptoms. Previous studies [21-25] have reported that there were prevalence of depression and anxiety among university students during the COVID-19 pandemic. Hence, there is a need to study the prevalence of mental health among students during the emergence of this infectious disease.

Although extensive research has been carried out across the globe to investigate the prevalence of depression and anxiety among young adults or college students, few studies have been carried out to investigate the prevalence of depression among university students during the outbreak of COVID-19 in Malaysia. To date, there is a scarce of study concerning mental health among students that involved Kelantan's population. As such, this study aims to fill the gap by focusing on university undergraduates in Kelantan to explore the prevalence of depression among them during the COVID-19 pandemic. This study also offers an attempt to look into the socio-demographic factors that associated with the depression status among the students. It is anticipated that this study will contribute to the existing knowledge of prevalence of depression among students during the outbreak of COVID-19.

2 Method

A Study Design and Sample

A cross-sectional study was conducted between Mar 2021-May 2021. The inclusion criterion was undergraduate students attending Universiti Teknologi MARA Cawangan Kelantan. Thus, all postgraduate or part-time students were excluded. Sample size for the study was determined using Sample Size Calculator by Raosoft that can be accessed online. Considering 95% of confidence level, 5% margin of error, and 50% response distribution, the sample size recommended is 366.

B Sampling Technique

A complete sampling frame of all the undergraduate students was obtained from Academic Affairs Department, UiTM Cawangan Kelantan. Using stratified sampling technique, a sample of 366 students was chosen. The population was stratified according to gender: male and female. After a proportionate stratification was calculated, simple random sampling technique was used to select students from each stratum. Table 1 shows the sample size for each stratum with 90 males (i.e., $1884/7659 \times 366$) and 276 females ($5775/7659 \times 366$).

Table 1: Sample size

Gender	Population size for each stratum	Sample size for each stratum
Male	1884	90
Female	5755	276
Total	7659	366

C Ethical Consideration

This study was approved by Universiti Teknologi MARA (UiTM) Research Ethics Committee. An informed consent was obtained from all the respondents.

D Questionnaire

The survey instrument used was an online self-reported questionnaire. The link of online questionnaire was designed in “google form” and sent out to the respondents via WhatsApp application. The questionnaire was provided in two languages (Bahasa Melayu and English). The questionnaire consists of 2 sections with 16 items. The first section includes question on demographic profile such as age, gender, family income, parents’ educational level, residence area, family history of depression and Cumulative Grade Point Average (CGPA). The second section consists of Patient Health Questionnaire-9 (PHQ-9) to measure depression level.

i. PHQ-9

PHQ is a 3-page self-administered questionnaire that was developed by Spitzer, Kroenke and Williams [26]. PHQ-9 is the subsection of full PHQ that consists of 9-item depression module. The reliability and efficiency of this instrument has been tested in two different studies (PHQ Primary Care Study and PHQ Obstetrics-Gynaecology (Ob-Gyn) Study) [27]. The internal reliability of PHQ-9 resulted from both studies were considered excellent, with Cronbach’s Alpha = 0.89 in PHQ Primary Care Study and 0.86 in the PHQ Ob-Gyn Study. For each their answers, the respondents will be given point. The point in PHQ-9 ranged from “0 = not at all” to “3=nearly every day”. The depression score was then calculated by summing all the points obtained. The depression score is then graded as 'none-minimal = 0-4, mild = 5-9,' moderate = 10-14," moderately severe = 15-19," severe = 20.' The depression score obtained from PHQ-9 is summarized in Table 2.

Table 2: Distribution of PHQ-9 scores

Score	Description
0-4	None-Minimal
5-9	Mild
10-14	Moderate
15-19	Moderately Severe
20-27	Severe

E Statistical Analysis

The data were analyzed using IBM Statistical Package for the Social Sciences (SPSS) V23.0. Data are presented as mean±standard deviation for continuous variable. Frequency and percentage for categorical variables are also reported. Multiple logistic regression was performed to identify socio-demographic correlates of depression among the students. For the purpose of building logistic regression, the depression level was categorized into two categories. Since the scores were less than 5 indicates the absence of depressive disorder, hence the dependent variables were classified into two categories. None-minimal is categorized as no depression and 4 remaining categories of mild, moderate, moderately severe, and severe are collapsed into 1 category indicates having depression. A *p*-value less than 0.05 was employed to establish statistical significance.

3 Results

i. Socio-demographic characteristics

The questionnaires were sent out to 366 respondents. A total of 365 questionnaires were returned with a response rate of 99.7%. Table 3 presents the frequency and percentage for socio-demographic characteristics of the respondents who completed the questionnaire.

Table 3: Frequency distribution of socio-demographic characteristics

Variable	Description	Frequency(n)	Percentage (%)
Age	18-21	198	54.2
	22 and above	167	45.8
Gender	Female	289	79.2
	Male	76	20.8
Parents' income	<RM2001	157	43.0
	RM2001-RM4000	91	24.9
	RM4001-RM6000	60	16.4
	>RM6000	57	15.6
Father's educational level	SPM or below	211	57.8
	Certificate	34	9.3
	Diploma	32	8.8
	Degree	53	14.5
	Master	15	4.1
	PhD	3	0.8
	Others	17	4.7
Mother's educational level	SPM or below	219	60.0
	Certificate	41	11.2
	Diploma	39	10.7
	Degree	47	12.9
	Master	5	1.4
	PHD	1	.3
	Others	13	3.6
Residence area	Urban	162	44.4
	Rural Area	203	55.6
Depression History in family members	No	338	92.6
	Yes	27	7.4

Of the 365 respondents, most of them (79.2%) were female and 20.8% were males. More than half (54.2%) of the respondents aged between 18 and 21 years while others were in the age group 22

and above (45.8%). Parents’ income was reported as follows: more than half (43.0%) indicated their parents’ income was less than RM2001, 24.9% reported between RM2001-RM4000, 16.4% stated their parents’ income is between RM4001-RM6000, and 15.6% reported more than RM6000. Father’s educational level was reported as follows: SPM or below (57.8%), followed by degree (14.5%), certificate (9.3%), diploma (8.8%), master (4.1%), and PhD (0.8%). In terms of mother’s education level, 60% indicated SPM or below, 12.9% indicated degree, 11.2% reported certificate, 10.7% reported diploma, followed by Master (1.4%) and PhD (0.3%). Two hundred and three respondents (55.6%) resided in rural area while almost half of the sample (44.4%) resided in urban area. With regards to respondent’s family history with depression, only 27 respondents (7.4%) reported that their family members had been diagnosed with depression. As depicted in Table 4, students scored CGPA of 3.42 with standard deviation of 0.34 (range 1.95-4).

Table 4: Summary descriptive statistics of CGPA

Mean \pm Std. Deviation	Median	Minimum	Maximum
3.4217 \pm 0.34081	3.5000	1.95	4.00

The median is 3.5, indicating that 50% of students scored a CGPA less than 3.5 while another 50% scored more than 3.5.

ii. Depression Level

Based on participants’ responses, frequency and percentage of depression level is shown in Table 5. Out of 365 respondents, 70 of them (19.18%) had no or minimal symptoms of depression and 165(45.21%) reported had mild depressive symptoms. Moreover, 72 students had moderate depression (19.73%). Fifty-eight of the students (15.89%) indicated that they experienced moderately severe depression. No students were reported suffering from severe depression.

Table 5: Depression level

Depression Level	Frequency(n)	Percentage (%)
None-minimal	70	19.18
Mild	165	45.21
Moderate	72	19.73
Moderately Severe	58	15.89
Severe	0	0

Table 6 presents the prevalence of depression among university students according to each socio-demographic characteristic. Referring to the table below, a majority of female and male respondents are mildly depressed, with 135 respondents (46.7%) and 30 respondents (39.47 percent) respectively. Half of the respondents aged between 18-22 year (50.5%) reported mild depression. Additionally, 35(17.67%) and 31(15.66%) had moderate and moderately severe depression respectively. More than one third of respondents aged 22 and above (38.92%) experienced mild depression. Of 167 students aged of 22 and above, a total of 37(22.16%) and 27(16.17%) had moderate and moderately severe depression respectively. The majority of students from rural area indicated having mild depression symptoms (45.32%) followed by none-minimal depression (19.71%). Similarly, majority of those who were from urban area showed mild depression symptoms (45.32%). Eight respondents (29.63%) whose family members that had been diagnosed with depression were moderately severe depressed. Fifty respondents (14.79%) with no family history of depression had moderately severe depression symptoms.

Table 6: Depression level according to socio-demographic characteristic

	None-minimal	Mild	Moderate	Moderately Severe
Gender				
Female	51(17.64)	135(46.71)	54(18.69)	49(16.96)
Male	19(25)	30(39.47)	18(23.68)	9(11.84)
Age				
18-21	32(16.16)	100(50.5)	35(17.67)	31(15.66)
22 and above	38(22.75)	65(38.92)	37(22.16)	27(16.17)

Table 6: Depression level according to socio-demographic characteristic (*Cont...*)

	None-minimal	Mild	Moderate	Moderately Severe
Residence Area				
Urban	29(17.9)	73(45.06)	29(17.9)	31(19.14)
Rural	41(20.2)	92(45.32)	43(21.18)	27(13.3)
Depression History in family members				
Yes	0(0)	11(40.74)	8(29.63)	8(29.63)
No	70(20.71)	154(45.56)	64(18.93)	50(14.79)
Parents' income				
<RM 2001	29(18.47)	79(50.32)	22(14.01)	22(14.01)
RM 2001-RM 4000	18(19.78)	44(48.35)	18(19.78)	11(12.09)
RM 4001-RM 6000	9(15)	25(41.67)	11(18.33)	15(25)
>RM 6000	14(24.56)	17(29.82)	16(28.07)	10(17.54)
Father's education level				
SPM or below	33(15.64)	108(51.18)	39(18.48)	31(14.69)
Certificate	6(17.65)	15(44.12)	8(23.53)	5(14.71)
Diploma	5(15.63)	14(43.75)	6(18.75)	7(21.88)
Degree	19(35.85)	16(30.19)	8(15.09)	10(18.87)
Master	3(20)	2(13.33)	7(46.67)	3(20)
PHD	0(0)	1(33.33)	2(66.67)	0(0)
Others	4(23.53)	9(52.94)	2(11.76)	2(11.76)
Mother's education level				
SPM or below	34(15.53)	107(48.86)	45(20.55)	33(15.07)
Certificate	10(24.39)	19(46.34)	5(12.20)	7(17.07)
Diploma	5(12.82)	20(51.28)	8(20.51)	6(15.38)
Degree	17(36.17)	11(23.40)	8(17.02)	11(23.40)
Master	0(0)	1(20)	3(60)	1(20)
PHD	0(0)	0(0)	1(100)	0(0)
Others	4(30.77)	7(53.85)	2(15.38)	0(0)

iii. Multiple Logistic Regression Analysis

Multiple logistic regression analysis was performed to identify the association between socio-demographic characteristics and depression status. The dependent variable (depression status) was categorized into two categories (depressed; yes and no). The alpha level for this analysis was set at 0.05. There are few variables with small sample size for its categories. In logistic regression analysis, small sample size can cause inflated odds ratio phenomenon. Hence, those variables with small sample size were either excluded in building the predictive models or recoded into new categories. Table 7 summarized the variables that had been excluded and collapsed into new categories for the purpose of building the predictive model.

The results of multiple logistic regression analysis are presented in Table 8. Out of 7 socio-demographic variables, the results suggested that only 3 variables (gender, age and CGPA) are found to be significantly associated to the dependent variable (depression; yes or no).

Table 7: Summary of recoded and excluded variables

Variable	Decision	New Category(n)
Father’s education level	Recoded	<ul style="list-style-type: none"> ● School level (228) ● University level (137)
Mother’s education level	Recoded	<ul style="list-style-type: none"> ● School level (232) ● University level (133)
Parents’ income	Recoded	<ul style="list-style-type: none"> ● <RM2001 (157) ● ≥RM2001 (208)
Depression History in family members	Excluded	

Table 8: Multiple logistic regression analysis

Variable	Beta Coefficient, β	p-value
Age		
22 and above	0.589	0.039
18-21*		
Gender		
Female	0.728	0.032
Male*		
CGPA	-1.104	0.021
Parents’ Income		
< RM2001	-0.343	0.298
≥ RM2001*		
Father’s education level		
School Level	0.432	0.196
University Level*		
Mother’s education level		
School Level	0.284	0.380
University Level*		
Residence Area		
Urban	0.048	0.867
Rural		

Note: * reference group

iv. Final Model

Multiple logistic regression was carried out again using significant variables (age, gender, CGPA) found in earlier section to obtain the final model predictive model. The final predictive model to predict the depression status among university students in Kelantan is expressed as shown in Eq. (1) and Eq. (2).

$$P(Y_i = 1) = \frac{1}{1+e^{-z}} \quad (1)$$

where

$$z = 3.981 + 0.589(\text{Age}) + 0.728(\text{Gender}) - 1.104(\text{CGPA}) \quad (2)$$

$P(Y_i=1)$ is defined as probability as having depression.

Age: 1 if 18-21 years old
2 if 22 and above

Gender: 1 if Female
2 if Male

CGPA ranged from 0 to 4.0

v. Odds Ratio

The odds ratios for each variable are given in Table 9. The results suggested that student who are in 18-21 years old are (1.802 \approx 2 times) more likely to have depression compared to 22 years old and above. Moreover, the result revealed that female students are 2 times more likely to have depression compared to male. It was also found that students with higher CGPA tend to have lower chance to be depressed.

Table 9 : Odds ratio

Variable	Odds Ratio , Exp(β)
Age 1: 18-21 years old 2: 22 years old and above *reference group: 22 and above	1.802
Gender 1: Female 2: Male *reference group: Male	2.072
CGPA	0.331

4 Discussion

The current study found that a majority of students (45.21%) had mild depressive symptoms, and the proportions of students with no or minimal symptoms, moderate, and moderately severe were 19.18%, 19.73%, and 15.89% respectively. This was achieved by summing the scores based on the students' responses in answering PHQ-9 questionnaire. The prevalence of mild depression was higher compared to a study using similar instrument among university students in Bangladesh [22]. The Bangladeshi study observed the prevalence of non-minimal, mild, moderate, severe to be 18.3%, 38.9%, 24.8%, and 18.1% respectively. These results were quite similar from the present study. Furthermore, a recent study assessing depression using Center for Epidemiological Studies Depression Revised Scale, and Mental Health Inventory-5(CESD-R-10) instrument reported that 72% of Bangladesh university students had depressive symptoms [24]. In this study, students in younger age group (18-21) were more likely to have depression. This is consistent with the findings from another study among Bangladeshi university students by Mehareen et al. [25]. This could be due to challenges faced by younger student towards e-learning during the COVID-19 pandemic.

Aside from COVID-19 concern such as being infected, this age group might be vulnerable to mental illness as they might experience new physical environment (transition from college to university) [28]. Additionally, sudden closure of university due to the outbreak of COVID-19 caused them to miss social interaction. Hence, they might be struggled to adapt to their emotional state. In contrast to earlier findings by Islam et al. [22], this study found that gender was significantly associated to depression status. Binary logistic regression suggested that female students were more likely to be depressed compared to male students. This finding is in agreement with that of Mehareen et al. [25] who found that female had higher chance to suffer moderate to severe depression compared to male students. Furthermore, a recent Malaysian study by Sundarasan et al. [15] among university students reported that female students were found to have higher level of anxiety. Aside from the findings discussed above, in terms of CGPA, it was found that students with higher CGPA have lower chance to be depressed. This result is likely explained by the fact that their academic performance might affect their mental health. This reasoning is further supported by the finding in previous study by Islam et al. [22] that students who lagging academically were more likely to be depressed. In addition, Hamaideh et al. [29] found there is significant association between GPA and depression among Jordanian university students.

Some limitations of the present study should be acknowledged. The present study was carried out in a single institution. Thus, the sample obtained are unlikely to be representative of those in in other institutions or other parts of the country, for instance of different ethnic. As a consequence, the extent to which the results can be generalised is compromised. Although careful measures were taken to ensure a strong study, there were still limitation due to self-reported questionnaire which might have led to response bias. Response bias can occur if the respondents have misunderstanding in answering the questions, or they might be reluctant to provide true answers.

5 Conclusion

This study achieved one of its primary goals in which to explore the prevalence of depression among university students. Based on the preceding discussion of the results, in brief, this study provides evidence on the prevalence of depression during the COVID-19 pandemic. More specifically, this study set out to identify the socio-demographic factors that associate to depression status. Analysis of the data revealed that male students, older age group students, and those who obtained higher CGPA are less likely to be depressed. As COVID-19 has disrupt many lives including students, there is a need to recognize the challenges faced by students as well as their mental health. It is the growing challenge across the nation faced by students due to the closure of universities to reduce the spread of COVID-19. Therefore, it is suggested that government and educational institutional could collaborate to develop appropriate intervention programs. As not much studies pertaining on the mental health or depression of university students during Covid-19 pandemic specifically in North-East Malaysia, this study could also provide beneficial preliminary information for future studies regarding this area. Since it has been almost two years fighting with the Coronavirus, people might have been getting used with the new norm which might lead to better mental health. Thus, a related sample study on the changes of mental health during the first year and second year of pandemic is suggested.

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